ACRONYMS

AIGA	alternative income-generating activity
BCAS	Bangladesh Center for Advanced Studies
CA	cooperative agreement
CIDA	Canadian International Development Agency
CNRS	Center for Natural Resource Studies
DANIDA	Danish Agency for Development Assistance
DFID	Department for International Development
DOE	Department of Environment
DOF	Department of Fisheries
ERD	External Relations Division
FAD	Fish-aggregating device
FTF	Farmer-to-Farmer program
GIS	geographic information system
GOB	Government of Bangladesh
HH	Hail-Haor
IMED	Implementation Monitoring and Evaluation Division
ISMP	Investment Support to MACH Project
KM	Kangsha-Malijhi
LCG	Local Consultative Group
LGC	local government committee
MACH	Management of Aquatic Ecosystems through Community Husbandry
MOEF	Ministry of Environment and Forestry
MOFL	Ministry of Fisheries and Livestock
MOL	Ministry of Land
NGO	nongovernmental organization
NRM	natural resource management
RMO	resource management organization
RPT	Results Package Team
RRA	rapid rural appraisal
RUG	resource user group
TB	Turag-Bangshi
UFO	upazila fisheries officers
UNO	upazila nirbahi officers
UP	union parishad
USAID	U.S. Agency for International Development

Preface

The completion report that follows summarizes the activities and achievements of the Management of Aquatic Ecosystems through Community Husbandry (MACH) project, initiated in September 1998. The report covers activities and achievements through August 31, 2003. MACH fieldwork began at two sites (Hail-Haor in Sreemangal and Turag-Bangshi site in Kaliakor) in June 1999 after an initial inception period. Fieldwork at a third site (Kangsha-Malijhi in Sherpur) began the following year in July 2000. This report, therefore, presents achievements in the field for four years in the case of the Sreemangal and Kaliakor sites and three years in the case of the Sherpur site.

In this time, MACH has promoted ecologically sound management of floodplain resources (fisheries and other wetland products) for the sustainable supply of food to the poor of Bangladesh. 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 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, multisectoral, participatory process of planning and implementation for reviving wetland function including fisheries.

This completion report, which presents the accomplishments of MACH through its partners and collaborators since inception to the end of August 2003, consists of five volumes, of which this volume is the main report. This volume contains the following five sections:

- Program Implementation and Achievements
- Project Performance and Impact
- Cooperation with and Support to Other Organizations
- Financial Resources Utilized
- Lessons Learned and the Way Forward.

Volumes 2 through 5 contain a great deal of supplementary information, not found in the main report. Volume 2 contains project maps and other appendices, volume 3 presents details of the Fish Catch and Consumption Survey Report, volume 4 presents the Performance Monitoring Report, and volume 5 presents the Geospatial Data Portfolio.

Executive Summary

This completion report summarizes the activities and achievements of the Management of Aquatic Ecosystems through Community Husbandry (MACH) project from September 1998 through August 2003. MACH fieldwork began at two sites (Hail-Haor in Sreemangal and Turag-Bangshi in Kaliakor) in June 1999. Fieldwork at a third site (Kangsha-Malijhi in Sherpur) began in July 2000.

To accomplish project goals, MACH has undertaken a range of activities:

- Assisted project site communities and government in securing dry season surface water, establishing wetland sanctuaries, maintaining riparian areas, and protecting surrounding watersheds
- Assessed the economic value of wetlands, particularly for the poor and worked to reduce fishing pressure through community development, including alternative income-generating activities
- Influenced policy by working cooperatively, primarily through the Bangladesh Wetlands Network and also with the Government of Bangladesh, other projects, nongovernmental organizations, and donors.

MACH has involved all community resource users (fishers, farmers, the middle class and elites, women, local government, and others) and considered all the products (fish, plants, water and wetlands products) and factors affecting a wetland. The project has helped establish a total of 42 community-based management organizations, including 16 wetland resource management organizations (RMOs), nine upland stream resource management committees (RMCs), and 17 *dohas* or river RMCs. These groups are utilizing best resource management practices on more than 18,000 ha of rainy season wetlands and more than 50 km of streams.

After four years, MACH is seeing results in the wetlands and communities where it works. Positive trends are being seen in fish production as well as overall biodiversity at all MACH sites. MACH has also appreciably influenced institutions and national and local wetland policy and widely disseminated lessons learned both within Bangladesh and in other countries. For example, the government recently made several decisions of environmental importance for the country, establishing important precedents for the future management of public wetlands.

This executive summary reviews a range of MACH achievements in:

- Wetland resource management and environmental improvements
- Community development and poverty reduction
- Institutions and policies
- Outreach and dissemination.

It concludes with a discussion of the lessons learned and way forward.

Wetland Resource Management and Environmental Improvements

Bangladesh is faced with ever decreasing dry season surface water; in many areas, ground water tables have dropped beyond the range of shallow hand pumps. This trend is likely to continue into the future as the need for water upstream increases, as local need for water by

competing uses continues to increase, and as widespread watershed degradation continues to send high sediment loads onto the floodplains of Bangladesh. Wetlands and in particular their fisheries depend highly on surface water patches that remain during the dry season, but these are becoming increasingly scarce. *Beels* no longer retain sufficient amounts of water, and flow of some rivers in MACH areas has diminished by up to 40%. In one case, a previously navigable river became innavigable due to reduced dry season flows. As a result, fish have come under increasing pressure during the dry season and have fewer opportunities to escape capture in reduced water areas. Tidal wedges previously experienced only in major river systems are now seen in many of the feeder channels and smaller rivers. Such is the case with the Turag River (a distributary of the Jamuna) due to reduced dry season flow volumes in major rivers such as the Ganges.

Securing dry season surface water. MACH has worked with community groups and local governments in three large floodplain wetlands to secure and sustain as much dry season surface water as possible, in the process creating areas for retention of fish. This work has been supported by project funds and, at the end of the project, with additional support from local currency 416b funds made available by a project implementation letter signed by the Government of Bangladesh (GOB) and U.S. Agency for International Development (USAID) for habitat restoration through physical intervention. With these new funds, MACH helped communities through their RMOs to reexcavate and restore *beels* and canals with habitat critical to fish and other aquatic life, resulting in year-round standing water that had once disappeared seasonally and securing dry season wetland function. The process required large-scale restoration works demanding tremendous effort. In the process, the project had the opportunity to educate many senior-level officials on the issues surrounding wetlands and the need for their restoration and protection.

Communities have also succeeded at all three sites in securing:

- Year-round wetland sanctuaries
- Fishing time closures during critical spawning and both pre- and post-spawning periods
- Halt to destructive fishing practices in the managed areas
- Conservation of reintroduced endangered or threatened fish species.

Through these measures and other MACH interventions, fish catch and consumption have not only been maintained, but increased in all three MACH sites for the past three years (see volumes 3 and 4 for complete data on the increases). Maintaining the fishery in these floodplains is an accomplishment in itself, considering the degradation and loss of habitat and overfishing that had been taking place. Fish and plant diversity has also been enhanced at all sites, both through creation of sanctuary areas and perennial water and reintroduction of selected, previously present mature adults of species at newly created deep sanctuary habitats, both in *beels* and rivers. Some species have already successfully reproduced. Later sections of this volume as well as volume 2 and 4 present supporting data.

Establishing wetland sanctuaries. The first milestone crossed by the project was to gain access to leased water bodies for more than three years. Communities in the three sites through their RMOs and with the support of MACH succeeded in obtaining leases of water bodies for up to ten years. In other cases, previously leased water bodies have been permanently handed over to the communities and local government officials. A total of 24 water bodies have been handed over to MACH-supported RMOs for improved management

and conservation. In a part of the leased water bodies, the RMOs have formed sanctuaries, which are kept off limits to fishing. MACH has also been able to support communities and local government institutions in gaining from the Ministry of Land (MOL) permanent control of water bodies *(jhalmohols)* previously leased for fishing. In this case the entire area previously leased for fishing becomes a permanent sanctuary for conservation and protection by the community. The GOB relinquished claims to revenue in lieu of sanctuary establishment that will in the future provide benefits to the whole area. A total of eight permanent central sanctuaries (previously leased) in the three sites will be protected for the long term, providing fish shelter throughout the year, increasing both fish diversity and yield.

Maintaining riparian areas. Community groups have formed to implement and maintain riparian areas. These groups are limiting grazing and planting native species to bring back degraded stream banks. In addition, MACH is working with the communities to replant many wetland areas that had once consisted of swamp forests of *hidjal* and *karoch*. The project successfully established these wetland swamp species in the middle of Hail-Haor through RMOs, providing future habitat and feeding areas for all aquatic animals as well as birds. In addition, the more than 333,000 trees planted during MACH could potentially boost the value of community yield from the trees alone to more than the original cost of the entire MACH project.

On one MACH site, industrial pollution has had a significant impact on one aquatic system on which communities rely for their livelihoods. The project has been able to effect some changes in the views of the industries toward wetlands and alter some of the harmful processes they use. MACH has already intensified efforts by supporting and cooperating on a U.K. Department for International Development (DFID) grant to reduce pollutants on the site.

Protecting watersheds. MACH was originally only to work in wetlands or lowlands. Wetland communities in at least two MACH sites, however, indicated that upper watershed land use was one of the major factors in the decline of wetland habitat. It also became evident during the baseline survey and participatory community planning sessions that problems that existed in the wetlands originated in the hills, particularly at the Hail-Haor site in Srimangal. Communities there cited increased erosion in upper watersheds as one of the major reasons for the siltation in of the wetlands.

MACH decided to apply resources to some of the most degraded hilly areas and address pineapple land use that had become detrimental to the hilly areas of Hail-Haor. In collaboration with Winrock's Farmer-to-Farmer Program, MACH initiated improved watershed management practices with selected pineapple growers in Hail-Haor. Contour planting, a more productive method of growing pineapple, replaced vertical rows, reducing soil erosion. Demonstrations of this method were very successful and are now spreading to other farmers in the watershed of Hail-Haor wetlands. In addition, the deputy commissioner of Moulvi Bazaar agreed to change the conditions of future leases for pineapple cultivation to reflect the contour planting regimen. MACH phase II will continue to support contour planting and seek further related land-use policy changes at the district level.

Another extremely successful watershed improvement is a riparian tree restoration program. MACH planted approximately 47 indigenous riparian species and a total of 168,454 trees in the riparian areas where none had earlier existed. The anticipated benefits include increased income to the communities managing these riparian areas (from the sale of wood selectively

harvested in the future) as well as benefits to both upstream and downstream communities due to decreased loss of land through erosion and reduced sediment to the *haor*.

Community Development and Poverty Reduction

MACH recognized early on the value of wetland areas, particularly to the poor, although the actual value of the wetlands of Bangladesh had clearly not been established. MACH's early surveys of project wetland areas revealed many of the benefits not accounted for in past studies. MACH's economic valuation for Hail-Haor wetlands found, for example, that, even in a semidegraded condition, they were far more valuable than realized. The very poor are the largest group of beneficiaries and receive more than 50% of the benefits. Removal or degradation of these wetlands could clearly be extremely harmful to the poor's livelihood strategies. Volume 2, appendix 16, presents the complete results of this valuation.

The MACH approach ensures that all community resource users have a voice in management decisions and equitable access to wetland resources. MACH has been especially concerned with the rights and access of poor and disadvantaged resource users, especially fishers, living around the wetlands. Seasonal fishing bans and creation of fish sanctuaries have been necessary and implemented to manage wetlands sustainably. MACH recognized, however, that this can be disadvantageous to the poorest groups dependent on the resource, so from its inception, MACH has stressed supplementary or alternative income in its work with fishers and other disadvantaged groups.

MACH through its partner CARITAS has organized groups of economically or socially disadvantaged men and women that use and live around the wetland areas where the project worked. MACH has formed 225 such organizations or resource user groups (RUGs) for poor fishers (consisting of 4,598 families) and worked with them by not only providing credit and helping them save, but also building awareness, improving literacy, strengthening group development, addressing nutrition and health, and supporting and training on a large variety of alternative income–generating activities.

Winrock and its partners have had many years of experience with microcredit in Bangladesh and worked with many of Bangladesh's premier credit organizations, including Grameen and the Bangladesh Rural Advancement Committee. As experience with microcredit has shown, small loans cannot by themselves lift people out of poverty. The primary purpose of small loans for alternative income generation has been to ensure that RUG members have sufficient resources to weather the closed fishing seasons that communities impose on themselves through the RMOs.

Through CARITAS, MACH instigated a survey of the credit system and benefits to its members. The overall finding was that each annual loan on average supplied a profit of 30% above and beyond the loan and interest. This amounted on average to Tk 2,150/loanee/year.[1] The survey also showed that loan income increases for RUG members as they gain experience and as loan amounts increase. Results from the survey show on average a first loan income of Tk 1,152; a second loan income of Tk 2,482; and a third loan income (on a limited numbers of loans) of Tk 5,019. In total, RUG members have accessed more than Tk 36 million in loans for generating alternative supplemental income and accumulated personal savings in excess of Tk 3.96 million. As management of the wetlands requires restricted fishing periods—from as little as two weeks to as much as 2–3 months, depending on the

[1] In this document, all dollar amounts are U.S. dollars unless otherwise indicated.

nature of the fishery—the supplemental income programs have buffered potential negative impacts of these restrictions on the poorest.

Institutions and Policies

Local partnerships. MACH has been a leader in the sector in use and development of strong local partnerships at local government levels. Other programs involved in community-based management have looked up to and agreed with the MACH approach; discussions are ongoing with the Fourth Fisheries Project and other projects on future strategy for open water/wetland management. The community-based MACH approach with strong ties to local government institutions at the upazila and union level is gaining wide acceptance as a preferred institutional approach.

MACH has worked closely with DOF upazila fishery officers (UFOs), and open water fisheries management has become a priority. MACH has supported conflict management efforts through UFOs and local administrations, successfully strengthening skills of local government professionals in resolving complex problems and conflicts. The UFOs, as member/secretaries of the local government committees (LGCs), have become very effective in resolving conflicts and supporting the plans of the RMOs.

MACH has also been successful in involving local government at the union, upazila, district, and national levels. MACH works directly with elected union officials as well as with upazila-, district- and department- or ministry-level GOB staff. Fifty-one elected UP representatives are involved with RMOs at the union level. Elected upazila parishad chairpersons are included as advisors to community organizations managing wetlands and riparian areas at MACH sites and serve as members of MACH-initiated LGCs, which work in partnership with the project at the upazila level. The project also taps the services of other central government upazila officers as technical resources: agriculture, fisheries, and livestock officers assist in skill training for resource users, and forestry, engineering, and fisheries officers provide technical guidance to the project. Practical natural resource planning skills have been developed among LGC members.

MACH has established and involved organizations at various levels to implement the program:

- A project steering committee meets once a year to provide guidance to the project with the involvement of Ministry of Fisheries and Livestock (MOFL), Department of Fisheries (DOF), MOL, and other GOB partners.
- At an intermediate level, the Results Package Team (RPT), chaired by USAID, meets regularly (at least monthly) and includes members from the DOF and project partners.
- At the field level, MACH and local government institutions have established LGCs chaired by the upazila nirbahi officer (UNO), with the UFO as member/secretary and union chairpersons and other upazila officers as members. Project partners are also members as are representatives from the RMOs. Aquatic resource areas were identified, communities consulted through a multistep process, and community-based organizations (that is, RMOs) established through consensus among the resource users surrounding the wetland or aquatic resource area.

RMOs are formed either around an entire continuous wetland or around portions of larger ones and consist of fishers, grass harvesters, cattle and duck forage users, rice growers, and other wetlands resource users. The RMO's general body typically includes from 50 to 160

members, depending on resources and population. The RMO elects an 11- to 21-member executive committee every two years for planning and development of the resource management plan.

National wetlands policy. General agreement exists that, in the past 30 years, policies have largely addressed national and sectoral agendas, but with considerable overlap and lack of coherence. Policymaking has tended to be top-down, originating from central government with little effort being made to consider or involve a wider range of stakeholders in policy formulation.

MACH has had a voice in government, but that voice was greatly enhanced when joined with other like-minded agencies and organizations. MACH's approach to dealing with policy issues has been to coordinate efforts with allies in the GOB, nongovernmental organizations (NGOs), and wider donor community to effect change jointly. This is reflected in MACH's work in collaboration with MOFL/DOF to support the coordinated Local Consultative Group (LCG) effort, which produced the "Fisheries Sector Review and Future Development" study. USAID has been a major supporter of that effort through MACH.

MACH has worked with the GOB, the LGCs, and others to ensure that the country's capture fisheries and wetlands are recognized as critical to rural poverty alleviation strategies. A MACH finding now being disseminated to a wider audience of government, NGOs, and donors is that aquatic resources are of major economic importance to surrounding communities; they are, in most cases, more valuable as common wetlands than as agricultural land in some areas. More important, those aquatic resources provide major benefits to the rural poor. As poverty alleviation and support for the poor is the main goal of the GOB's Integrated Poverty Reduction Strategy, it made sense to include preservation of these national assets in the government's overall poverty reduction plan.

MACH has developed close and continuing relationships with government at all levels. MACH staff meet informally and almost daily, both in Dhaka and in the field, with various GOB officers in fisheries, land, local government rural development and cooperatives (LGRD), agriculture, livestock, cooperatives, and other agencies as needed. MACH has facilitated site visits for the secretary of MOF, the joint secretary of MOL, the director general of the DOF, as well as concerned Planning Commission and most of the senior MOFL personnel. The project will continue to encourage field visits by senior government staff. In MACH phase II, relationships with government will take on more importance as the project institutionalizes the MACH approach.

By its very existence, MACH impacts GOB policy. MACH activities have changed the views of the GOB on the efficacy of working with communities in partnership with the local government. MACH has established precedents for DOF and others, including, as described above, extending leases for community-managed wetlands to ten years, establishing permanent and seasonal sanctuaries, and—one of the most important and significant changes—the first agreement by the GOB to transfer formerly leased beels as permanent sanctuaries to be operated by communities. In addition, MACH has received the GOB's agreement in principle to enable MACH to assist the government in acquiring critical wetlands now in private hands, using "Investment Support to MACH Project" (ISMP) funds.

MACH has been instrumental in encouraging policy-level coordination among the GOB, the wider NGO community and donors in the sector. The best way to effect policy change is to

ensure wide consultation and cooperation from all those concerned. With the International Union for the Conservation of Nature, Bangladesh Center for Advanced Studies (BCAS), and the World Bank, MACH encouraged and was instrumental in achieving a cooperative approach to policy change through the Bangladesh Wetlands Network. This network is a loose confederation of 29 concerned government agencies, NGOs, projects, and donors working or otherwise active in Bangladesh wetlands and floodplain and wetland management projects, who share experiences and pursue mutually beneficial policy changes.

Outreach and Dissemination

To demonstrate the MACH approach and disseminate methods, cross visits and outreach sessions have taken place with fishers, government (MOL; MOF; MOFL; Economic Relations Division; Planning Commission; Implementation, Monitoring, and Evaluation Division; and others), and administrators from Bangladesh and other countries, other projects, donors, and members of civil society. Other projects whose representatives visited MACH sites included:

- Fourth Fisheries Project (DOF)
- Aquaculture and fisheries programs of Mymensingh, Noakhali, and Patuakhali (funded by the Danish Agency for Development Assistance [DANIDA])
- Coastal and Wetland Biodiversity Management Project (funded by the U.N. Development Programme and Global Environment Facility)
- Community-Based Forest Management Project of the DOF (funded by DFID)
- Integrated Coastal Zone Management Project of the Water Resource Planning Organization (WARPO) (funded by the Royal Netherlands Embassy [RNE])
- Dampara Project of Women's Development Banking (WDB) (funded by the Canadian International Development Agency [CIDA]).

MACH has also received foreign visitors from Brazil, Vietnam, Nepal, and the United States.

To promote communication of results, MACH developed a video, used widely to disseminate the approach. MACH activities have also been broadcast nationwide on popular Bangladesh television programs, such as "Mato-o-Manush" ("Soil and Humans"). MACH-funded posters have been used widely for dissemination of project concepts.

The MACH RPT has also facilitated dissemination of the MACH approach. The RPT consists of representatives of project partners: the GOB (MOFL and DOF), USAID, Winrock, Bangladesh Center for Advanced Studies, Center for Natural Resource Studies, and CARITAS. All MACH partners have long and extensive histories working in the natural resource (wetland) arena in Bangladesh. Due in part to the success of MACH, they have become leaders in the fisheries and environmental community. The partners have strong expertise in natural resource planning and management, alternative income generation, and local government institutional development. Members of the team provide guidance at high levels on land, water, fisheries, and other natural resource issues. Through experience gained in this project, the partners disseminate MACH knowledge and best practices through workshops, seminars, donor discussions, and GOB meetings. For instance, MACH has provided guidance to the newly established United Nations Development Programme (UNDP)–/Global Environment Facility (GEF)–funded Coastal and Wetland Biodiversity Management Project on its approach to environmentally critical area management. MACH and Winrock partners have also been active participants in developing the national "Fisheries Sector Review and Future Development" document.

In addition, MACH has been directly involved in all activities leading to formation of the Arannayk Foundation (Bangladesh Tropical Forest Conservation Foundation). MACH has been the primary source of contact and information for USAID and various consultants to the Bangladesh NGO community. MACH financially supported Arannayk start-up activities including those required by the barrister who developed the documents required for foundation registration. The senior natural resource advisor assisted in developing terms of reference for board members and was responsible for placing advertisements and short listing potential board members for approval by GOB and USAID. MACH has supported the two USAID BIFOR missions as well as the forestry project preparation mission. MACH provided information, documents, and contacts and arranged trips and meetings for those teams. Many of the recommendations found in the documents produced by those consultants are the result of finding and discussions with MACH.

Lessons Learned and the Way Forward

The MACH project has generated a number of lessons on which to base future project phases and similar projects in Bangladesh and elsewhere:

- Bangladesh wetlands, which produce one of the largest freshwater fish supplies in the world, are negatively affected by reduced dry season standing water, reduced river flows, increased sedimentation (very rapid filling in of wetland areas), loss of natural connections between the floodplains and the rivers, significant pollution, and overfishing.

- Wetlands are valuable. In Bangladesh, they represent more than Tk 30,000 per acre, from which the very poor reap most of the benefits. This does not take into account the value of the wetland as a filter, that is, its pollution reduction function.

- Community-based comanagement of wetland resources works by sustaining and improving fish production and diversity in large floodplain areas.

- Sanctuaries combined with restricted fishing works. The best management practices of sanctuary establishment with community-restricted fishing helps sustain and even increase fish catch and fish diversity in large floodplain areas.

- Restoration of critical dry season habitat has significant impacts, allowing fish to survive the dry season and retaining fish diversity and numbers through to the wet season, when reproduction and repopulation takes place.

- Reintroduction of lost species of fish (particularly *beel* residents) into their habitat can succeed when coupled with sanctuaries, improved management, and habitat restoration.

- Local communities can achieve policy changes (policy reform) on land and water body leasing through clear plans, local government support for those plans, and a "champion" for change who works with all parties.

- Alternative income generation and training can lead fishers away from sole reliance on fishing for a living to other trades and businesses.

- Stakeholder participation is essential for changing management at the level of the wetland resource, as local-level planning and implementation is the only method that can be sustained. This should be the model for what happens with land and water resources.

- Tree and vegetation reestablishment along riparian corridors, pioneered by MACH and MACH groups, can produce long-term monetary benefits to communities and, by reducing bank erosion, help restore forests along rivers, reduce loss of valuable land, provide wildlife corridors and habitat, and increase plant and animal diversity.

The MACH approach has allowed communities to have direct management responsibility for their natural resources. Their decisions are strengthened and supported through locally elected union representatives as well as central government upazila staff. Neither Winrock nor its partner organizations envisage major changes in overall program operation under MACH phase II. The main difference will be a shift in focus to areas identified through the Mid-term Review the MACH RPT and MACH planning processes.

The key focus of MACH II will be sustainability of the systems and organizations developed by MACH. Those organizations and the activities initiated to support them will continue to receive support. Partners will continue to build institutional capacity at the local level, undertake physical interventions to restore wetland function, and work with national government and nongovernmental institutions to bring about policy changes. At the local level, capacity building, training, and strengthening of charters and linkages between the RMOs and local government at the union parishad and upazila levels will continue to take place. MACH has assisted a local NGO (FIVB) to work with ARD on the USAID-funded local democracy program. MACH is aware of the newly formed "gram sarkar," although the role and responsibilities of this new level of local government is still unclear, MACH will, if required, work with this new tier of local government. At the national level, MACH will expand its efforts to increase the involvement of the MOFL, the MOL and LGRD in wetlands and resource management. MACH will continue to build a constituency within government, civil society, and other donors directly and through the Bangladesh Wetlands Network. MACH's goal remains establishment of permanent, sustaining comanagement systems that have a legal basis and a practiced successful approach.

MACH phase II institutional systems will incorporate a comanagement approach that can be replicated in other areas with the support of the Ministry of Fisheries and Livestock (MOFL) and LGRD. MACH phase II will recommend institutional replication to the MOFL's Department of Fisheries (DOF) based on MACH successes. With the local government structure involving the upazila fishery officer in all phases of planning, the DOF is expected to disseminate the model successfully. MACH will work with DOF and the ministries through the steering committee to promote dissemination and replication of the approach.

MACH has undertaken a gender assessment of RMOs, RUGs, and MACH staffing to provide guidance in better integrating gender considerations in MACH II. The draft report, received in mid-August 2003, makes a number of gender-related recommendations, several of which MACH has already adopted.

During MACH II a wide range of physical habitat restoration interventions will take place using recently approved (April 2003) Investment Support to MACH Project (ISMP) fund (416b local currency funds). The ISMP fund will support the bulk of MACH phase II

physical activities and allow wider restoration of degraded or lost wetland habitats, reforestation of riparian and wetland areas, pollution mitigation in cooperation with the United Kingdom's Department for International Development (DFID)–funded Stockholm Environmental Institute and other outreach activities to spread MACH messages. MACH phase II will ensure to the extent possible the expansion of the Sreemangal, Sherpur, and Kaliakor sites to cover, as feasible, their entire hydrological units.

I. Introduction

A. Authorization

The Management of Aquatic Ecosystems through Community Husbandry (MACH) project of the U.S. Agency for International Development (USAID/Economic Growth, Food, and Environment [EGFE]) was implemented as a cooperative agreement (CA) (# 388-00-98-00051-00) under the USAID Food Security Team of the Dhaka USAID Mission. The original cooperative agreement carried an effective date of July 28, 1998, and was modified seven times; the last modification extended the time for completion from July 30, 2003, to October 29, 2003. Table 1 summarizes each contract modification.

This completion report has been prepared in partial fulfillment of contractual requirements for the MACH Program.

Table 1: Summary of Cooperative Agreement Modifications (Cooperative Agreement #388-A-00-98-00051-00)

MOD. NO.	PURPOSE
1	To fund the CA incrementally by $2,275,000, thereby increasing the total obligation to $2,770,267 to support MACH activities in Bangladesh through September 30, 2000.
2	To fund the CA incrementally by $1,000,000, thereby increasing the total obligation to $3,770,267 to support MACH activities in Bangladesh through December 31, 2000.
3	To incorporate the revised budget into the CA and to make other administrative changes.
4	To *(a)* revise the program description, *(b)* increase the total estimated cost, *(c)* revise the schedule of the award, and *(d)* update the standard provisions.
5	To fund the cooperative agreement incrementally by $1,310,458, thereby increasing the total obligation from $3,770,267 to $5,080,725 to support MACH activities in Bangladesh through September 30, 2002. Also, substituted "Economic Growth, Food, and Environment (EGFE) Team deleted for the original "Economic Growth & Agricultural Development (EGAD) team."
6	To obligate an additional amount of $1,410,785, thereby fully funding the cooperative agreement.
7	To extend the period of performance from July 30 to October 28, 2003, without any increase to the total estimated cost. The end date of July 30, 2003 was deleted wherever it appeared in the cooperative agreement and was replaced with October 28, 2003.

Note: The information provided in table 1 is extracted from the cover page of each modification.

B. MACH Overview

An agreement for the MACH project was signed between the Governments of Bangladesh and the United States in May 1998. In July 1998 a USAID selection committee with representation from Bangladesh's Ministry of Fisheries and Livestock (MOFL) selected Winrock International, based in Morrilton, Arkansas, as the grantee. The Winrock team included three national partner organizations: CARITAS Bangladesh, Center for Natural Resources Studies (CNRS), and the Bangladesh Center for Advanced Studies (BCAS).

MACH's inception period began October 1998. Its fieldwork began at two of the sites in June 1999 and at the third site in July 2000. The project demonstrated community-based comanagement approaches to floodplain and wetland resource management in Bangladesh that considers the entire wetland ecosystem. The program worked with the GOB through the MOFL and Department of Fisheries. This cooperative and collaborative arrangement took place at both the local and national levels.

The goal of MACH has been to promote ecologically sound management of floodplain resources (fisheries and other wetland products) for the sustainable supply of food to the poor of Bangladesh. The project's major purpose has been to demonstrate to communities, local governments, and policymakers the viability of a community approach to NRM and habitat conservation in Bangladesh that involves entire floodplains and surrounding watersheds. "communities" have included all people in a given area who depend either economically or nutritionally on the floodplain and/or its products. The program has emphasized and worked with poorer groups, including women and particularly fishers. To make the program truly sustainable, it has also included representatives from union-level local government as well as the local elite .

The MACH project objective has been to establish community-based management for the major water bodies and riparian zones within its three sites Community-based organizations were formed for the purpose of managing their local resources in an environmentally sound manner. MACH differed from other community-based projects in that its goal was to increase the sustainable productivity of all floodplain resources, including fish, plants, and wildlife and over an entire floodplain ecosystem *(beels,* seasonal floodplains, rivers, and *charas/jharas*), not just a single water body.[2] Additionally, MACH recognized that many wetland problems were actually upper watershed issues. At all three MACH sites, the project worked with communities to solve or mitigate those problems, where feasible. As reduction of fishing pressure was likely to be a critical part of reviving floodplain fisheries, MACH included supplemental income-generating activities focused on the very poor, who still totally depend on fishing. More than 30% of those who directly benefit are poor women.

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).[3] The project has also included work with local industries to reduce pollution; reestablish watershed function through revegetation and reforestation, where feasible; and reduce soil erosion by introducing suitable agricultural systems.

MACH Sites

MACH has focused on development of three major wetland/floodplain areas in Bangladesh, which were selected earlier by the project's National Steering Committee (see map 1, the site location map in annex 1 of volume 2). The sites are Hail-Haor, Turag-Bangshi, and Kangsha-Malijhi river basins (abbreviated, respectively, as HH, TB, and KM throughout the tables in this report). Located in three different districts, these sites include six *upazilas,* 26 unions, and 103 villages. According to the original project design, MACH was obligated by the agreement to work in one to two sites, but eventually MACH successfully implemented programs at three separate sites, described as follows:

Hail-Haor. Hail Haor, in the Sylhet basin, is located in the anticline between the Balishara and Barshijura Hills to the east and the Satgaon Hills to the west. Water originates from the

[2] *Charas* and *jharas* are streams originating in hills that enter wetlands after passing through croplands and settlements. *Chara* is the local term used in Sreemangal, whereas *jhara* is used in Sherpur.

[3] *Doha* or *kum* is the local term for river scour holes in Kaliakor, whereas *kur* is used in Sherpur area and *duar* in Sreemangal.

surrounding 350 small hilly streams (at present only 59 streams are active) and the Lungla/Bilashi river. The project site is located in five unions of Sreemangal Upazila and in two unions of Sadar Upazila of Moulvi Bazaar District. Wet-season wetland area is approximately 12,500 ha, and dry season area ranges from 2,000 to 4,000 ha. The population is approximately 200,000 people.

Turag-Bangshi site. This site is located in seven unions of Kaliakor Upazila under Gazipur District and in one union of Mirzapur Upazila of the Tangail District. The Turag-Bangshi site is typical of a floodplain/wetland ecosystem, whose water emanates from a major river system. As water rises in the major river systems at the beginning of the monsoon, usually ay the end of June, it spills into distributaries and large floodplain areas. The water then recedes quickly, leaving small pockets that have nearly dried up in recent years. The area of this floodplain is around 4,500 ha in the wet season, diminishing to 37 ha in the dry season. There are a total of 20 *beels*, of which ten are now perennial. The population of the area around the wetlands where MACH is working is nearly 300,000.

Kangsha-Malijhi site. This site is located in the north-central part of Bangladesh in Sherpur Sadar and Jhenaigathi Upazila of the Sherpur District. The area is geographically a part of Garo-Tura Hills watershed and includes the catchments of the upper Kangsha and Malijhi river system. This area was once covered with natural Sal forest; now only remnants of natural forest remain. The wetland/floodplain has an area of approximately 8,000 ha during the wet season, which diminishes to about 900 ha in the dry season. The floodplain area contains 47 *beels* or low pockets, of which 18 are perennial. The population of the area is approximately 620,000.

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

Local government 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. Upazila nirbahi officers (UNOs), the senior-most administrators, chaired the LGCs at all the respective MACH sites. The upazila fisheries officer served as the member secretary of the committee with support from MACH's site coordinators. Other members of the

committee were the union parishad (UP) chairpersons, nearly all of upazila officials, research management organization (RMO) representatives, other stakeholders, and MACH representatives. The LGCs have been the apex committee at the upazila level for integrating the 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 been responsible for many of MACH's successes in resource management of critical wetlands. contest

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 also provided local coordination for MACH, short-term specialists in policy reform as needed, and support services for GIS, hydrology, fishery biology, and other special areas.

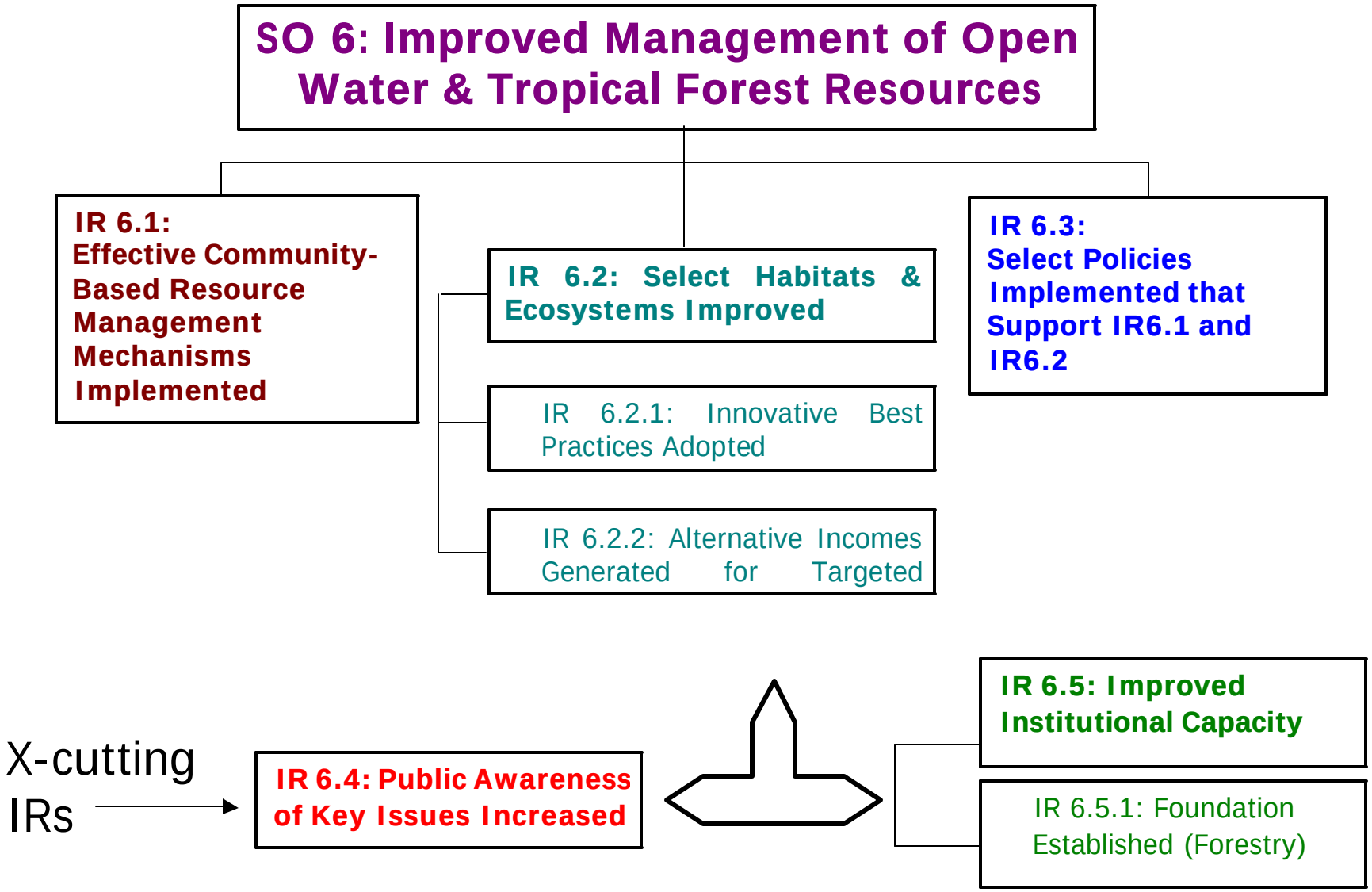
D. Strategic Objective Framework

The Strategic Objective Framework established by MACH's USAID Environment Team was modified in November 2001. The revised framework can be seen in figure 1 below, including

a summary table; section III of this volume and volume 4 provide complete reporting on the strategic objectives, intermediate results, and indicators, which discuss each of the performance targets and achievements of MACH in detail. The methodology and approach for collecting and reporting the data are illustrated with maps locating implementation areas and sampling regions.

Based on the mid-term review conducted in December 2001, MACH modified some elements of its activities, but MACH's approach was found to be valid and, therefore, was not changed; however, effort and resources on training, awareness, and strengthening of MACH RMOs and RUGs was increased.

Figure 1: Revised Results Framework



SO 6 Indicators at a Glance

SO 6: Improved Management of Open Water and Tropical Forest Resources

- **Indicator 6a: Extent to which best practices from USAID-funded projects are used elsewhere**
- **Indicator 6b: Increased production of natural resources in targeted areas**
- **Indicator 6c: Increased biodiversity in targeted areas.**

Intermediate Results	Indicators
IR 6.1: Effective Community Based Resource Management Mechanisms Implemented	Indicator 6.1a: Area of floodplain where sustainable management is implemented.
IR 6.2: Select Habitats and Ecosystems Improved	Indicator 6.2a: Aquatic habitats converted from seasonal to perennial in targeted areas Indicator 6.2b: Upland forest habitat improved in targeted areas Indicator 6.2c: Riparian habitat improved in targeted areas
IR 6.2.1: Innovations and Best Practices Adopted	Indicator 6.2.1a: Number of sanctuaries established Indicator 6.2.1b: Meters of channels rehabilitated
IR 6.2.2: Alternative Incomes Realized for Target Groups	Indicator 6.2.2a: Percentage increase in income of targeted beneficiaries
IR 6.3: Select Policies Implemented that Support IRs 1 & 2	Indicator 6.3a: Leases of water bodies to community resource management groups granted in target areas. Indicator 6.3b: Number of communities adopting the following key regulations in target areas: o Restrictions on the use of inappropriate fishing methods and gear o Restrictions on the fishing season and harvesting of fish fry o Restrictions on the areas of fishing
IR 6.4: Public Awareness of Key Issues Increased	Indicator 6.4a: Number of individuals reached by the public awareness activities
IR 6.5: Improved Institutional Capacity	TBD

II. PROGRAM IMPLEMENTATION AND ACHIEVEMENTS

In the course of the project to date, MACH has attained significant milestones and results. On the ground, the project has assisted communities and government in three project sites in securing dry season surface water, establishing wetland sanctuaries, maintaining riparian areas, and protecting surrounding watersheds. Recognizing and assessing the economic value of wetlands, particularly for the poor, MACH has worked to reduce fishing pressure through community development, including alternative income-generating activities. More broadly, MACH has appreciably influenced institutions and national and local wetland policy and widely disseminated lessons learned both within Bangladesh and in other countries. This chapter presents the underlying details for the project's achievements.

A. Wetland Resource Management and Environmental Improvements

The core activity of MACH remains sustainable community management of wetlands. The MACH approach calls for participation of the entire wetland resource community—users and other stakeholders—whose livelihoods depend on wetlands, including the most dependent: poor fishers, farmers, and the landless. Equally important has been MACH's direct involvement of local government in the project through its LGCs.

A total of 42 management organizations have been formed, including 16 wetland RMOs, nine *chara* resource management committees (RMCs), and 17 *doha* or *kum* RMCs. In addition, 1,747 community members have been elected to serve in these organizations. Beel RMOs include 715 MACH RUG members, who make up more than 60% of the membership. MACH continues to strengthen these organizations by providing specific training programs and other activities discussed below. Working with MOFL, DOF, and MOL, MACH has assisted RMOs in transferring 22 public beels for management by RMOs. With support from concerned communities, local governments, MOFL/DOF, and MOL, MACH had eight government water bodies turned into permanent community-managed sanctuaries. These RMOs now have more than 18,800 ha under improved management and have established 66 sanctuaries in their wetland areas.

Another aspect influencing the MACH approach is that many of the problems of wetlands lie outside the specific water body in question. As discussed below, MACH has, at all its sites, addressed issues or at least brought them to the notice of the community and government. One activity of the community organization involves awareness raising at several levels. MACH has to date conducted a variety of environmental awareness activities attended by more than 164,000 people.

Further details of MACH activities conducted are presented below, but the overall result has been increased production of fish at all sites, ranging from 57–65 kg/ha; an overall increase in catch per unit of effort by fishers; and increased consumption of fish by 20%–35%. In addition, MACH activities increased biodiversity in fish alone by 8–10 species. MACH activities have added at least Tk 59 million or $1.0 million to the annual value of those wetlands.[4] This figure is for additional fish production only and does not include other environmental services provided by wetlands.

[4] In this document, all dollar amounts are U.S. dollars unless otherwise indicated.

1. Resource Management Organizations

MACH and CNRS facilitated formation of RMOs and RMCs in each of the three MACH sites. The original estimate for the number of required RMOs was 20. Since inception of the project, a total of 16 beel RMOs have been formed, with eight in Hail-Haor, four in the Turag-Bangshi site, and four in Kangsha-Malijhi site (see table 2). In addition, another nine stream or *chara* RMCs and 17 *kum* or *doha* RMCs were formed, bringing the total number of community organizations formed to 42.

Table 2: Local NRM Institutions Formed in Three MACH Sites

MACH sites	Number of Local NRM Institutions Formed				
	Target	Achievement			
	RMOs/RMCs	Beel RMOs	Stream RMCs	Kur RMCs	Total
Hail-Haor	10	8	6	0	14
Turag-Bangshi	4	4	0	15	19
Kangsha-Malijhi	6	4	3	2	9
Total	20	16	9	17	42

The beel RMOs are formed around specific wetlands or sections of a large wetland (beels, *khals*, and rivers) and have primary responsibility for sustainable management of a particular wetland ecosystem within their respective jurisdictions. The beel RMOs are central to the overall MACH goals of community-based sustainable management of wetland resources.

Stream or *doha* RMCs are formed based on activities associated with or supplementary to wetland resource management, that is, stream bank protection (afforestation of *chara* and *jhara*) and sanctuary management in river *daha/kur/kum*.[5] For each such activity, one RMC is formed, whose responsibilities include management of a particular reach of a *chara* or *jhara* or a river sanctuary. The overall responsibilities of RMCs (stream or *kum)* are not as high as those of beel RMOs. Both the RMOs and RMCs are local institutions supported by MACH to ensure community management of wetland and watershed resources. A total of 42 RMOs have been formed during the first phase of MACH.

To achieve legal status, all of the beel RMOs with public water bodies transferred to them, are officially registered with the Department of Social Services. Each RMO has its own constitution approved by the GOB registering authority.

2. Environmental Awareness Programs

Awareness building on conservation and sustainable management of wetlands with communities and stakeholders is a preliminary step in RMO formation and a major activity of MACH. Total attendance at awareness-related activities has been approximately 164,000 for MACH CNRS activities and 141,000 for MACH CARITAS activities. Awareness-building activities were started at the outset of the project at the field level. The awareness programs covered a range of issues related to project goals and approaches to issues related to wetlands and watersheds.

MACH project introductory programs (meetings and workshops) were conducted with the union, upazila, and district levels targeting government officials, locally elected officials, and NGOs. In these meetings, project goals, objectives, and approaches were explained to the audiences. Site-specific issues and problems were discussed and potential solutions

[5] *Doha* or *kum* is the local term for river scour holes in Kaliakor, whereas it is *kur* in the Sherpur area and *duar* in the Sreemangal area.

identified. In addition, the reasons for choosing their wetland for MACH was discussed and explained.

At upazila-level meetings, concerned government officials, including the UNO, UP chairpersons, NGO staff, reports, and local elites attended. All concerned officials at the district level participated in the district-level introductory seminars. During MACH phase I, a total of 44 awareness events were organized in the three MACH sites at union, upazila, and district levels and attended by 1,287 participants (see table 3). In addition to meetings held at the start of MACH, the project held explanatory meetings as the senior government personnel changed at the district and upazila levels. In the course of the project, UP chairpersons, UNOs, and district commissioners have changed several times.

Table 3: Awareness Programs Conducted at Union, Upazila, and District Levels

Project Sites	No. of events	No. of Participants
Hail-Haor	20	456
Turag-Bangshi	13	324
Kangsha-Malijhi	11	507
Total	44	1,287

Awareness meetings directed at the village/community level. Each of the MACH sites covered approximately 50 villages. To achieve the goal of community-based management, it is important to cover nearly all the households to ensure that all community members are aware of and allowed to participate in program activities. The opportunity is taken to explain the purposes of the project as well as to sensitize community members to issues and problems and encourage their input in subsequent planning and implementation of management interventions.

Table 4: Uthan Baithaks Conducted up to August 2003

Project Sites	*Uthan Baithak* conducted *(no.)*	Villages covered *(no.)*	Participants *(no.)*
HH Site	118	31	5,260
TB Site	91	36	3,659
KM Site	272	36	3,929
Total	**481**	**103**	**12,848**

Uthan baithaks. Uthan baithaks are an effective tool to build rapport with communities and sensitize them to the issues relevant to the project. Organizing *uthan baithaks* involved the following approach: after early RRAs and a census, the project team sat in a courtyard of one household and began informal dialogues with the neighboring 10–15 household dwellers. The discussions covered problems and issues as well as introduced the project and how it could help solve these problems. To date, a total of 481 *uthan baithaks* have been conducted in 103 villages and have covered nearly 13,000 people in the three MACH sites (see table 4). All these *baithaks* were found to be effective in sensitizing communities and creating a positive attitude toward overall MACH goals, objectives, and approaches.

Village campaigns. Campaigns were conducted in villages, usually in the afternoon or evening, to which all residents were invited. At these events, various environmental messages are disseminated among the attendees relevant to their local area. Additionally, staff demonstrated how important the issues are nationally and even globally. They spoke on

issues, distributed materials (posters, leaflets, and so on), and showed project videos and other materials.

During the reporting period, a total of 470 village-level awareness events or sessions were conducted in 103 villages in three MACH sites, covering more than 17,000 villagers (see table 5). These programs are usually conducted during the nonwork periods (that is, after planting rice or harvesting) when villagers are freer to attend.

Table 5: Village Campaigns Conducted Up to August 2003

(number)

Project Sites	Sessions Conducted	Villages Covered	People Attended
HH	218	21	5,990
TB	90	36	5,548
KM	162	36	5,602
Total	**470**	**103**	**17,140**

Some village-level events were conducted on time-specific issues; for example, immediately before the fish spawning period, awareness campaigns encouraged allowing brood fish to spawn, stopping the use of certain fishing gear in certain locations during the spawning period, and so on.

In Hail-Haor, special awareness programs were organized with upland area villages where lemon and pineapple cultivation on hill slopes cause sediment problems in the *haor* basin. The purpose was to inform the people of the issues as well as results of MACH pineapple demonstrations that could help reduce hill erosion and sedimentation. A total of 77 such knowledge-sharing meetings with hill cultivators were held in Srimangal and reached 715 farmers/farm laborers.

International environment day observances. MACH uses the occasion of international environmental days to support its messages of sustainable resource use. Days observed included World Environment Day (June 5), Earth Day (April 22), World Wetland Day (February 2), and World Biodiversity Day (May 22). Activities on international environment days included, among others, mass rallies, discussion meetings, schoolchildren awareness meetings, field (wetland) visits, video shows, art competitions (wetlands and biodiversity), environmental quiz competitions, essay competitions, and tree planting at various institutions, primarily schools.

The U.S. Department of Agriculture (USDA)-funded BREAD Project provided a grant to CNRS to develop environmental awareness materials and use them in a number of areas. MACH-CNRS staff were able to take advantage of this at the three MACH sites. Various awareness campaigns at the village and school levels and development and design of posters and billboards at MACH sites were done through the BREAD-CNRS grant. The first observance of the World Environment Day in June 1999 was conducted at Hail-Haor through the BREAD project. The core slogan "Save Hail-Haor" at this observance in the Hail-Haor created mass awareness among the wider community and stakeholders. Table 6 shows the number and types of day observances at three MACH sites. Data show that a total of 40 events related to day observances were organized in three MACH sites, attended by more than 25,000 local people.

Table 6: Observance of Various Environmental Days Up to August 2003

Sites	World Wetland Day		World Environment Day		Earth Day		World Biodiversity Day	
	Times observed	People attended	Times observed	People attended	Times observed	People attended	Times observed	People attended
HH	5	3,069	6	3,780	4	2,671	1	130
TB	4	2,505	3	1,550	4	2,050	-	-
KM	3	2,250	6	4,250	4	2,900	-	-
Total	12	7,824	15	9,580	12	7,621	1	130

Baul songs. *Baul* (folk) singers and songs are a part of traditional Bengali village culture. *Bauls* are the Bengali equivalent of medieval troubadours wandering from village to village, tailoring their music to reflect local events and issues. Although not a religion, they follow customs combining elements of Islam and Hinduism. Local people living in remote villages have historically enjoyed *baul* songs, sung in local dialects, which reflect various aspects of social and economic issues.

MACH-CNRS introduced the idea of using *bauls* to spread environmental awareness at the village level. To sensitize local communities at village-level, *baul* songs on wetland and biodiversity management issues were organized at various public places in three MACH sites. Local *bauls* were identified and assisted in developing the songs on wetland issues. These songs helped create awareness among the communities in project sites.

MACH video. MACH commissioned a 24-minute video to document program purpose, approach, and achievements. Finalized in August 2002, this video has been and continues to be used at many functions and activities, including presentations to all RUGs and RMOs and at various day and baul functions. The video is also used to introduce MACH to local and national government personnel at Fish Week activities and at MACH America Week activities in Chittagong and Sylhet.

To date, a total of 171 video shows and events have been organized in different villages attended by approximately 67,000 people (see table 7). Some of the video programs have been organized in local schools attended by students, teachers, and UP chairpersons and members. The RMOs are involved in organizing these programs in their areas.

Table 7:* Baul *Songs and Video Shows Organized Up to August 2003

Project Sites	No. of Events	No. of People
HH	93	24,974
TB	40	14,017
KM	38	27,747
Total	**171**	**66,738**

Dramas. MACH conducted separate drama programs with environmental themes at all sites in 2001, 2002, and 2003. These traditional village events, generally seen at local festivals, were designed to introduce and support specific MACH concepts, namely, the importance of wetlands; the need to conserve fish, birds, and other wildlife; and communities working with local government to achieve success. The programs succeeded in reaching thousands of people with a message they tended to retain.

3. RMO Formation and Activities

RMOs in MACH were formed through a multistep process that included, as discussed above, awareness raising. The steps involved included:

- RRA and delineation of project sites
- Introduction of project (awareness)
- Identification of target villages and interventions
- Census to identify resource users
- Baseline surveys and monitoring
- Formation and support of RUG groups
- PRA/problem workshops
- Community identification of intervention sites
- Local government discussions and formation of LGC
- Formation of RMOs/RMCs
- Implementation of wetland activities
- Capacity building and other strengthening.

RMOs are composed of representatives from villages around a particular wetland, wetland cluster, or river section. A series of initial sensitization meetings are held during RMO formation. At these meetings, villagers are requested to select representatives in an open villagewide forum, to which each household of the village is invited. The selected members vote on the make up of the general body. Later in open meetings, the general body office bearers elect an executive committee from among the members. In these meetings, concerned UP chairpersons and members along with project staff facilitate and legitimize the process.

The composition of RMOs allows for representation from the entire user community and all social and occupational classes (fishers, farmers, wage laborers, elites, and women). In the initial stage of the project, based on open elections, the percentage of RUGs[6] and other poor members came to about 50% of all general body members. Later, local government and MACH partners agreed that the composition of RMOs should be composed of 60% RUG members, 30% non-RUG poor, and 10% other community members, including the middle class local elites. In addition, the RMO-revised constitutions ensure that at least 25% must be women members. The UP chairperson and a MACH staff member act as advisors to the RMO throughout the process.

MACH intends to demonstrate sound management of natural resources in floodplains through effective community participation and strong local management. Understanding the ecosystems through ecological assessment and community interaction with the resource systems is a prerequisite to implementing the concept. The idea of shaping resource users into managers of resources drove implementation of MACH. Motivation, knowledge sharing, and interaction with communities and related stakeholders at all steps of the project activities formed a platform from which to launch resource management practices by user communities.

MACH introductory meetings with the community at different levels and working relations developed between the project and local communities and other actors opened up

[6] Comprising fishers and poor people in project sites who largely subsist on wetland resources and are organized by MACH-CARITAS for alternative income generation.

opportunities for developing a common understanding of local problems, solutions, and approaches. During the planning ("Participatory Action Plan Development") workshops at local levels with communities of different social and occupational hierarchies, a draft guideline on community organizations and participation in NRM interventions was suggested.

On the basis of the decisions taken by the community participation and in consideration of the size of the natural resources to be managed, RMOs were formed and management areas for each of the RMOs delineated. The improved management area is defined as the area where any MACH intervention or a combination of interventions has been made, whether a swamp plantation, wetland sanctuary, habitat rehabilitation, riparian vegetation development, pineapple cultivation, or combination of these. It should be noted that all interventions are made within the jurisdiction RMOs. The RUG villages are also included in the improved management area of MACH.

Table 8 shows improved management area that has been brought under management by RMOs and where best management practices are now being put in place. A total of 18,866 ha of area (wetlands and uplands) have been brought under improved management compared with a planned target of 15,000 ha in the three sites.

Table 8: Area under Improved Management by RMOs

(hectares)

Sites	Resource Area	
	Project Target	Achieved Up to June 2003
HH	6,700	8,311
TB	4,200	4,280
KM	4,100	6,275
Total	15,000	18,866

Sustainability of MACH initiatives and approaches will result from strong and self-sustaining RMOs. It is also important that RMOs maintain proper coordination with and receive guidance from the authorities concerned, such as union and upazila parishads. It is thus important to strengthen the RMOs institutionally, build their capacity, and enhance their technical and managerial skills relevant to wetland resource management. MACH phase II would focus on activities relevant to capacity building and institutionalizing the RMOs. The main activities of MACH RMOs relate to establishment of management regimes to ensure the sustainable production of fish and income from their water body.

Resource conservation measures. Resource conservation measures include interventions leading to the wise use and protection of resources at a level that can support the maintenance of natural productivity of biological resources as a function of the ecosystem in pristine condition. To this end, RMOs have undertaken various conservation measures appropriate to local situations in wetland areas under their management. Major conservation measures have included those shown and described below:

- *Ban on use of harmful gears*. Some gears are recognized as harmful to fish, namely, current *jals* (monofilament nylon gill net) and *kafri*/net *jals* (fine mesh seine net). The government has declared a ban on production, possession, and use of current *jal*s and fine mesh nets. In all the RMO-managed water bodies, a notable reduction in use of current *jal*s and kafri *jal*s has occurred due to the motivational and surveillance efforts of the RMOs. The UP chairpersons and members and local DOF staff have also taken a proactive role in the ban on use of harmful gears.

- *Seasonal closure*. RMOs have also taken initiatives to impose seasonal closures on fishing. Almost every fish species in the floodplains prepares to spawn or begins spawning at the start of the monsoon in the months of March, April, and May. This time is crucial as water levels are low and fish are most vulnerable to fishers and predators. In Hail-Haor, all RMOs established a fishing closure in the early monsoon (March–May) to allow adult fish to spawn; whereas in Turag-Bangshi and Kangsha-Malijhi areas, the closure is applied from April–June each year. During seasonal closure, however, some small subsistence gears *(thela jal,* small traps, and *jhaki jal)* are allowed.

- *Halt on fry fishing*. Fish spawn in the early monsoon, and fry of some species move in shoals in the shallow areas of the edges of beels or ditches. In many areas, people (usually children) catch the small fry of snakeheads for family consumption as well as for sale in the markets. The concerned UP chairpersons and members took part in awareness campaigns to save the fishery by saving the fish fry. Partial success has been achieved in this effort.

- *Halt of dewatering of beels*. Although forbidden by the fish act, dewatering of beels in the dry season is a common practice in most areas of Bangladesh. This is highly detrimental to the short- and long-term sustainability of the floodplain fishery, as this practice leaves no fish in the beels for spawning in the next monsoon. MACH has taken the issue seriously and, with RMO and LGC support, continuously motivates fishers, government personnel, and more important, leaseholders not to dewater beels. MACH has been able to stop the dewatering practice in all the water bodies being managed by RMOs.

Establishment of sanctuaries. Saving fish stocks in the dry season is the key to maintaining sustainable fish production and conservation of biodiversity. Many beels become dry or nearly dry at the end of the dry season. Fish populations in the floodplain ecosystem thus become highly vulnerable to both fishing and natural mortalities. To protect the parent stocks of fish, efforts have been taken by MACH to create and manage wetland sanctuaries. Sanctuaries are established in RMO-managed water bodies in deeper parts of the *khals* or beels, either naturally or through reexcavation. Four sanctuaries have also been established in the river *kums* in the Turag-Bangshi and Kangsha-Malijhi sites. Thus far, 66 sanctuaries have been established covering an area of more than 30.35 hectares (see table 9).

Table 9: Number of Sanctuaries Established

MACH Sites	Sanctuaries Established		
	No.	Area *(ha)*	Probable impact area during wet season *(ha)*
Hail-Haor	26	39.65	10,586
Turag-Bangshi	19	23.98	5,537
Kangsha-Malijhi	21	12.11	4,898
All sites	66	75.74	21,021

Besides these small sanctuaries, MACH has advocated establishment of large and permanent government-sanctioned sanctuaries in three sites. MACH staff explored suitable large water bodies based on suggestions by the RMOs, local fishers, and leaseholders on the best locations for large and permanent sanctuaries. Upon finding suitable sites and arriving at a consensus with communities, the proposals were submitted to the LGC, which reviewed and approved the proposal. MACH with the community groups then prepared technical proposals,

which it submitted to the MOFL for review and approval. The MOFL raised the issue to the national steering committee for approval.

The MOL approved the proposal and issued an order for transferring eight water bodies to RMOs for establishment of permanent sanctuaries in 2003 (see table 9). Of the eight permanent sanctuaries, two are located in Hail-Haor, five in Turag-Bangshi, and one in Kangsha-Malijhi sites. Two large sanctuaries in Hail-Haor are beels (whole beel), two out of five in the Turag-Bangshi site are *daha* in the beel and three in the river *kums*, whereas in the Kangsha-Malijhi site, the sanctuary site is river *kur* (see table 10).

Table 10: Name and Locations of Government-Approved Permanent Sanctuaries

MACH sites	Area (a)	Remarks
Hail-Haor		
1. Jaduria Beel	100.50	Being established
2. Chapra-Magura Beel	21.88	Being established
Turag-Bangshi		
3. Mokosh Beel (Nawkhola Daha)	2.24	Existing
4. Alua Beel (Bara Daha)	4.44	Existing
5. Turag River (Galachipa Kum)	200 m up and down stream	Existing
6. Turag River (Lalkhar Kum)	200 m up and down stream	Existing
7. Turag River (Gabtali-Syedpur Kum)	200 m up and down stream	Existing
Kangsha-Malijhi	200 m up and down stream	Existing
8. Malijhi River (Part in Malijhikanda)	200 m up and down stream	Existing

Reintroduction of locally threatened fish species. Many fish species are now rarely or never observed in MACH sites. With RMO support, efforts have been made to reintroduce those species in the water bodies. Rare species include *deshi sharputi (Puntius sanana), shoal (Channa striatus), gozjar (Channa marulius), pabda (Ompak pabda), golsha (Mystus cavsius), foli (Notopterus notopterus), meni (Nandus nandus), goinnaya (Labeo gonius), rui (Labeo rohita), kalibaoush (Labeo calbasu), aair (Mystus aor), chital (Notopterus chitala),* and so on. Of these species, *meni* is available in Hail-Haor, but not in the Turag-Bangshi and Kangsha-Malijhi sites. Table 11 shows the list of threatened species reintroduced in MACH sites.

Table 11: Reintroduction of Species Since Inception (2000–03) in MACH Sites

Species Reintroduced	Hail-Haor	Turag-Bangshi	Kangsha-Malijhi	Total
Ayer (Mystus aor)	3,818	-	-	3,818
Gonia (Labeo gonius)	86,642	29,383	31,247	147,272
Rui (Labeo rohita)	117,253	135,944	28,259	281,456
Sarputi (Puntius sarana)	7,736	80	2,090	9,906
Kalibaush (Labeo calbasu)	17,321	154	17,115	34,590
Chapila (Gudusia chapra)	-	-	150	150
Shol (Channa striata)	-	-	11,250	11,250
Bata (Labeo bata)	-	-	6,534	6,534
Gulsha (Mystus cavasius)	-	-	30	30
Pabda (Ompok pabda)	-	12	137	149
Meni (Nandus nandus)	-	14	372	386
Gojar (Channa marulius)	-	-	1,390	1,390
Foli (Notopterus notopoterus)	-	20	-	20
Total	232,770	165,607	98,574	496,951

Habitat rehabilitation. MACH has been undertaking large-scale habitat restoration activities in its sites. Details of excavation, riparian, and other activities are to be found in section II.E.1 and in volume II appendix 4. All physical intervention activities are done at the request of specific RMOs and meet the MACH criteria of being biologically important, socially

acceptable, and technically feasible. The RMOs are involved in all aspects of planning and overseeing construction or planting activities.

4. RMO Strengthening and Sustainability

The existing RMOs are now managing their allocated wetlands and associated areas with technical and management support from the MACH project. Making them sustainable is a complex and a long-term process. To achieve sustainability, it is generally agreed that RMOs require at least 3-10 years of support for strengthening the capacity of the RMOs to operate alone.

A workshop on building sustainable solutions in NRM was held with the participation of all MACH staff in 2001. The focus was to develop guidelines for the RMOs for ensuring sustainable local management of wetland resources, thereby demonstrating sustained management of natural resources by the communities concerned. The workshop output provided guidelines on sustainable wetland resource management.

RMOs—as community organizations ensuring conservation-oriented approaches to management of renewable resources—should be seen as supporters of government policy in that they are enhancing productivity of aquatic natural resources which plays a role in the alleviation of poverty. MACH will continue to support efforts to encourage the GOB to supply incentives that encourage RMO formation and ensure their sustainability. Incentives to be considered by government should include longer leases and reduced costs for leasing, and provisions for training and capacity building supports. . The government should consider giving RMOs or similar organizations priority in allocation of wetlands and other water bodies for conservation and enhancement of natural resources. The project has taken various steps to build capacity. All RMOs formed in the three MACH sites have received support in various technical and managerial areas, including formal classroom training, interactive lectures with fieldwork, as well as on-the-job training in which RMO members work with project staff in accomplishing various NRM activities.

In 2002 all the RMOs received training and guidance on NRM planning that included detailed planning for their areas. A total of 321 RMO members participated in training sessions on NRM planning conducted at the sites. In addition to NRM planning, a total of 217 RMO members (2–3 members from each RMO) received training on plantation management.

Table 12: Wetland-Watershed Management and Organization-Building Training for RMOs and MACH Staff

MACH Sites	NRM Planning	Plantation Mgt.	Accounts Mgt.	Progress Review	RMO Sustainability	PM and E	Staff Training	Pineapple Cultivation	IPM
HH	109	113	25	249	131	26	58	72	80
TB	66	48	19	313	73	30	21	0	0
KM	146	56	16	303	74	21	23	0	0
Total	**321**	**217**	**60**	**865**	**278**	**77**	102	72	80

Given the importance of financial management to community RMOs, two to three members from each RMO have been provided with training on accounts management. After the formal accounts training, MACH accounts staff continuously assist each of the RMOs in maintaining their account books properly.

5. Institutional Arrangements

From its inception, MACH has been committed to inclusion of local government in MACH at the union, upazila, and district levels. Direct involvement of local government in both project implementation and community management has been one of MACH's more successful innovations. Once MACH sites were selected in 1999, a round of discussions and presentations were held, first with deputy commissioners and their staff at the various districts, then with concerned UNOs, UP chairpersons, and members. Based on those discussions, the project held formal introductory meetings at all sites for all concerned upazila officers and UP members. A major recommendation from the meetings was that LGCs be formed. The recommendations also included a statement of work identifying the members (UNO, UP chairpersons, concerned upazila officers, and MACH partners). LGCs were therefore formed at all sites with the UNOs as chairs and initially MACH site coordinators as member-secretaries. LGC meetings take place quarterly, and the project agreed that MACH activities would be vetted by the committee and approved as needed to ensure speedy implementation.

In 2001 the steering committee agreed to allow MACH to make the UFO the member-secretary of all committees and have RMO chairs and members attend these meetings. UP chairpersons were included, both as members of the LGC and advisors to RMOs. Other local government personnel were involved in every step of site implementation.

The MACH LGC encouraged local ownership of the program and ensured smooth relations with local government at all levels. This again showed that local government and local communities are capable of managing local natural resources.

6. Watersheds to Wetlands

A major threat to wetlands in Bangladesh is siltation and the consequent loss of perennial water bodies. Many perennial wetlands have become seasonal due to siltation. This problem is also common in MACH sites where siltation is severe at the Hail-Haor and Kangsha-Malijhi sites. As detailed in the hydrology report, approximately 5 cm of silt, amounting to 100,000 tons, is deposited yearly in Hail-Haor. Felling of trees and unplanned and unsustainable upland cultivation in the hill slopes in Bangladesh and India are the main reasons for increased soil erosion. The wetlands in Hail-Haor and Kangsha-Malijhi sites are seriously threatened by increased silt deposition, causing acute shortage of dry season water and thus affecting the natural productivity of capture fisheries.

The local communities in both these sites identified an increased rate of siltation and raising of beel beds as one of the major threats to the sustenance of wetland habitats and capture fisheries productivity. The severity of siltation is acute in some parts of the Hail-Haor, particularly where the *charas* fall in the *haor* as the silt is carried in through *charas* from the hills and catchment areas. Large amounts of silt coming into the *haor* through a number of *charas* originated from surrounding Satgaon and Balishira Hills within the country as well as from streams in India.

The communities wanted immediate steps taken to reduce siltation. The communities also reported that dry season diversion of water from *charas* by the farmers to irrigate *boro* rice further aggravated the dry season water shortage problem. To address the soil erosion and siltation issue, various activities have been taken up by MACH intending to increase tree

cover in watersheds to reduce the rate of soil erosion and thus protect wetland habitats. Activities included:

- Riparian and institutional vegetation cover along the streams and roads approaching wetlands
- Environmentally sustainable contour planted pineapple cultivation demonstrations on the hills surrounding Hail Haor.

Riparian and institutional vegetation development. During the project period, about 227,000 saplings of various species have been planted at the three sites in riparian areas and at various local institutions. The basic intention of the plantation program was to increase vegetation cover to arrest soil erosion, thereby protecting the wetlands from siltation. To the maximum extent possible, MACH organized and motivated all concerned at the site level for riparian vegetation development activities, putting the RMOs and UPs at the focal point in planning, implementation, and management. Table 13 shows the number of trees planted in riparian and institutional areas in three MACH sites.

Table 13: Number of Trees Planted in Riparian Areas and Local Institutions, Including Homesteads

MACH Sites	Riparian	Institutional	Total
HH	48,638	11,851	60,489
TB	23,092	23,522	46,614
KM	96,724	23,172	119,896
Total	168,454	58,545	226,999

The institutional plantation covered all suitable institutions in the project area, that is, schools, *madrasas,* mosques, cluster villages, and so forth, where potential existed for plantations and authorities were willing to care for the plants and agreeable to project-related conditions.

The project also considered biodiversity and social issues associated with the plantation program. The species planted included fruit trees (jack fruit and mango), timber trees (rain tree and mahogany) medicinal threes (arjun and bohera) and trees having habitat or environmental values (fycus and back berry). Species selection was completed in a participatory manner with the stream RMOs as well as with local people with land along *charas*.

To stabilize the river and stream banks, apart from developing tree cover (upper canopy), understory vegetation cover was initiated to protect the stream bank surface from soil erosion due to run off. To this end, vetiver grasses (a super soil-binding grass species) were planted along the *chara* banks, riverbanks, and roadside slopes. The roots of vetiver grass are long and penetrate deeply into the soil forming a mat on the surface, thereby stabilizing soil during run off of rain water.

A total of 120,000 tillers of vetiver grasses have been planted along the Turag River bank in the Turag-Bangshi site, where measures to protect the natural growth of *dholkolmi* shrubs were also taken. In the upper watershed around the Bandhabari Asrayan *prokolpa* pond in the Turag-Bangshi site, 140,000 tillers of vetiver grasses have been introduced.

In the Kangsha-Malijhi site, a total of 464,000 tillers of vetiver grasses have been planted along the Malijhi River from Paglar Mukh to Tinani Bazaar, Hasligaon Chairmanbari to Darger Khal and along the Kewta Beel complex (5 km, two rows). More than 200,000 tillers of vetiver grass were also planted in Hail-Haor along the *charas*.

B. Community Development and Supplemental Income Generation

The main objective of this component has been to ensure equitable access and participation by the poor in management of floodplain resources. In addition, recognizing that the reduction of fishing pressure and imposition of a closed fishing season is critical to reviving floodplain fisheries, MACH has included supplemental AIGAs as means to ensure that poor fishers and other RUG members are not unduly disadvantaged.

MACH, through its NGO partner CARITAS, has organized groups of economically or socially disadvantaged men and women, including fishers. A total of 225 groups with 4,598 members have been enrolled in MACH RUGs. Almost 60% of MACH RMO members (717 people) are from RUGs with women RUG members making up 18% of overall RUG/RMO membership. Additionally, the program has provided group formation and strengthening in a number of areas including group development, group accounting, literacy, awareness raising on environmental issues, and nutrition and health, among other relevant subjects.

MACH has worked closely with these poor groups to develop alternative sources of income, in part to reduce pressure on floodplain resources. Credit has been made available to support these income-generating activities. A total of 7,008 loans have been provided in 35 different income-generating activities. Total disbursal has been Tk 36.005 million; recovery to date has amounted to Tk 25.588 million. The average percent profit for the three credit ceilings was 43%, amounting to Tk 2,150 on an average loan of Tk 4,957. The increment to household supplementary income was 47%, as measured by CARITAS. With an average MACH RUG household income of Tk 35,580, the increment to overall household income was 6 percent.

1. Awareness-Raising Campaign

The MACH field program started with an extensive awareness-raising campaign targeting resource users, local elites, UP members, and upazila- and district-level government officials. The awareness topics covered project goals, objectives, and activities intended to develop sustainable wetland resource management and enhancement with direct participation of RUGs and the neighboring populace. A total of 141,701 RUG members and community people attended 683 awareness-raising sessions organized during the project period. The following summarizes the awareness-raising campaigns organized by MACH-CARITAS:

Para level. At the para level, awareness meetings were held as small gatherings at the farmers' courtyard, called *uthan baithok* (courtyard meeting). During the project period, 483 were held at the three project sites, attended by 14,237 participants. Topics discussed at these *baithoks* focused on RUG issues and included RUG organization building and their range of activities, the importance of closed fishing seasons, establishment of fish sanctuaries, and tree planting in wetlands for habitat restoration and fish conservation. Participants also talked about their socioeconomic conditions, livelihood hardships, need for supplemental income, and the past condition of their neighboring wetland/floodplain natural resources, including the major causes of wetland and watershed degradation. In addition, the goals and objectives of the MACH project were presented and efforts were made to convince participants to cooperate to achieve project goals.

Village level. At the village level, 170 awareness sessions were organized and attended by 107,352 RUG and other community members. Village awareness programs included the staging of live dramas highlighting problems of resource conservation; overexploitation of and degradation of resources; the MACH approach to local resource management; farmer field days on different agriculture and aquaculture demonstrations; awareness of plantation activities, besides exposure to MACH goals and objectives; and project implementation modes and methods.

Union parishad level. Introductory and awareness-raising programs were conducted at the UP level. MACH held these programs to mark various national and international day observances, such as World Environment Day, World Wetland Day, and World Earth Day. During the project period, 13,492 persons attended 18 such UP programs organized at the three project sites.

Annual rally and gathering. MACH-CARITAS staff facilitated RUG, RMO, and other community members conducting annual rallies and gatherings, following set objectives:

- Making RUG members and the wider community aware of the need for resource conservation and management
- Working with RUG members on the need for AIGAs to reduce fishing pressure
- Encouraging successful RUG group members by providing awards during the program
- Arranging get-togethers for all project participants (RUG, RMO, development allies, local elites, local government officers, and project staff) for sharing experiences on project activities and major accomplishments.

Nine such programs were conducted at the three MACH sites during the project period, attended by 6,620 RUG members and community people.

Drama. As part of the awareness campaign, MACH has conducted a total of 109 live drama shows at the three sites, attended by more than 95,000 RUG and RMO members, local and national government officials, and other members of the community. In addition, drama programs were also staged at the national level as part of the national DOF fish fairs, World Environment Day, and so on. The programs were performed in 2001, 2002, and 2003 by an NGO that specializes in village drama. The program has been found effective and popular at the village level. As a result, MACH plans to conduct additional dramas at different levels (school, community, and so on) in MACH's phase II.

The themes of these drama programs have mainly concerned the importance and need for sustainable community wetland management. Overall themes are as follows:

- Importance of wetlands to communities
- Issues of wetland resource degradation
- Population pressure and effect on wetland ecosystem
- Causes of fish and other resource decline
- MACH's approach to involving community people
- Community actions that can conserve wetlands

- Involvement of local government and local administration in successful conservation of wetlands.

Table 14: Status of Sitewise Cumulative of Awareness-Raising Programs

Level of program and participants		HH	KM	TB	Project	
					Target	Achievement
Para*	Prog.	170	137	176	240	483
	Parti.	5,595	4,633	4,009	8,400	14,237
Village	Prog.	38	78	54	74	170
	Parti.	23,771	55,224	28,357	23,600	107,352
Union Council	Prog.	6	8	4	16	18
	Parti.	6,600	5,435	1,457	12,000	13,492
Annual Rally	Prog.	3	4	2	10	9
	Parti.	1,650	3,085	1,885	7,600	6,620
Total	Prog.	217	227	236	340	680
	Parti.	37,616	68,327	35,708	51,600	141,701

o Para is a small part of a village.

Cross Visits. To share the success stories of RUGs and RMOs in different locations, the project arranged cross-visit programs for RUGs and RMOs. A total of 211 RUG and RMO members have participated in eight cross-visit programs (see table 15).

Table 15: The Status of Cross Visits

Particulars	HH			KM			TB			Project	
	Up to Dec. 2002	Achievements Jan–Aug 2003	Cumulative	Up to Dec 2002	Achievements Jan-Aug 2003	Cumulative	Up to Dec 2002	Achievements Jan-Aug 2003	Cumulative	Target	Achievements
Nos.	2	1	2	2	2	4	2	-	2	Need based	8
Participants	28	16	44	100	30	130	37	-	37		211

2. Resource Users Groups

The main focus of MACH community development activities has been the formation and support of RUGs, which are made up of poor wetland resource users. Approximately 70% of the members came from households directly involved with professional or subsistence fishing. A total of 225 RUGs were formed during the project period with a total current membership of 4,598. Of the 225 groups, 155 are male and 73 are female with 3,127 male and 1,471 female members respectively. Table 16 shows the sitewise status of organized RUGs.

Table 16: Status of Sitewise Organized Resource User Groups

Particulars		HH			KM			TB			Project	
		Up to Dec 2002	Achievements Jan-Aug 2003	Cumulative	Up to Dec. 2002	Achievements Jan-Aug 2003	Cumulative	Up to Dec 2002	Achievements Jan-Aug 2003	Cumulative	Target	Achievements
Men	Groups	52	3	55	74	1	75	25	-	25	147	155
	Members	1,115	55	1,170	1,431	23	1,454	509	-6	503	2,940	3,127
Women	Groups	30	-1	29	26	-	26	15	-	15	73	70
	Members	631	1	632	534	18	552	291	-4	287	1,460	1,471
Total	Groups	82	2	84	100	1	101	40	-	40	120 (220)*	225
	Members	1,746	56	1802	1,965	41	2006	800	-10	790	2000 (4,400)*	4,598

*The RUG formation target reset from 120 to 220 and RUG members from 2,000 to 4,400.

3. Alternative Income Generation, Credit and Savings

Alternative income-generating activities. MACH through its partner NGO CARITAS has implemented AIGAs in all project sites since April 2000 to help poor wetland users. A total of 7,008 loans have been provided to 4,058 individual RUG members to implement AIGAs in 35 trades. RUG members choose the type of activity; the most popular AIGAs are dairy (775), small trading (787), fish resale (794), cattle rearing for meat or draught animal (577), poultry/duck rearing (278), rice husking or resale (844), and rickshaw purchase and pulling (435).

Table 17: Status of AIGAs Implemented by the RUG Members

Kind of	HH			KM			TB			
AIGAs	Up to Dec 2002	Achie. Jan-Aug 2003	Cumu-lative	Up to Dec 2002	Achieve-ments Jan-Aug 2003	Cumu-lative	Up to Dec 2002	Achieve-ments Jan-Aug 2003	Cumu-lative	Project Achieve-ments
Total 35 types	2,401	806	3,207	1,893	849	2,742	830	229	1,059	7,008

Baseline income survey. A simple short opinion poll survey was conducted in December 1999 to arrive at some baseline data. The survey was intended to acquire income data on 416 individual RUG members at the start of the project. The survey revealed an average daily income of Tk 57 ($1) per individual only for the peak employment season (about six months, as working areas primarily devolved on paddy fields and fishing wetlands) with little or no supplementary income. A per capita annual income of $180 was considered the baseline income on which to measure alternative supplementary income.

Increase in alternative supplementary income. The increase in supplementary income has been tracked from December 2000. In the first year at Hail-Haor and Turag-Bangshi sites, the income of individual loan users increased notably by 19.44%. Of the 511 credit recipients who used the first credit ceiling of Tk 5,000 during the first year (by December 2000), 137 numbers that were surveyed showed a supplementary income increase to $35/capita/year (an increase of 19.44%). In the second year, the same users' income increased from the same baseline (i.e., per capita $180 per year on December 1999) to $56/capita/year (i.e., 31.11%). The data came from a survey of 183 individual users out of a total of 1,279 loanees in December of 2001. In the third year, a CARITAS survey of the same users as in December 2000 and 2001 found that supplementary income increased to 40.29% (37 samples from a population of 2000). At the Kangsha-Malijhi site, however, a survey conducted from the first day of project implementation (in 2001) revealed an increase of 30.13% in RUG members' income. In the fifth year of project implementation (i.e., the final year of the project), supplemental income increased by an average of 46.55%. The sitewise increase had been 52.02% at the Hail-Haor, 50.94% at the Turag-Bangshi, and 40.34% at the Kangsha-Malijhi sites.

Enterprise loan. MACH recognized that microcredit supplied through the project, although achieving the results expected, did not generate life-changing amounts of income. After discussion and agreement with CARITAS, the project agreed to initiate on an experimental basis small- and medium-enterprise (SME) loans of Tk 20,000–30,000. Selected RUG members were encouraged to expand their activities into larger business enterprises. To implement such programs, MACH-CARITAS imparted microenterprise development training to potential RUG members at all project sites. Eleven skilled and interested RUG members

took enterprise loans and successfully implemented microenterprise activities. The type of enterprises on which they embarked included poultry rearing, plant nursery establishment, carpentry, land tilling by purchasing a power tiller, cattle fattening, and so on. MACH-CARITAS reported that, as a result, earnings were in the range of Tk 4,000–8,000 per month. In addition, some have left the fishing profession altogether. Moreover, some of these entrepreneurs created job opportunities totaling 30 new jobs for poor neighbors.

Credit. Credit support has been provided to RUG members to ensure that poor fishers are not financial losers when RMOs require closed fishing seasons or sanctuaries. This encourages resource users to look for income outside the wetlands to reduce pressure on wetland resources. With this supplementary income, some fishers are now able to refrain from fishing at least part of the year. Operating through MACH-CARITAS, MACH utilized as seed money a fund of Tk 10 million that once had been utilized as a revolving loan fund. Of the original fund total, Tk 36.005 million has been disbursed and Tk 28.588 million recovered through August 2003. A total of 4,058 individual RUG members received credit services through 7,008 loan schemes during the project period (see table 18).

Table 18: The Sitewise Status of Loans, Credit Disbursement, and Recovery Status.

Particulars	HH			KM			TB			Project Progress	
	Up to Dec 2002	Achievements Jan-Aug 2003	Cumulative	Up to Dec 2002	Achievements Jan-Aug 2003	Cumulative	Up to Dec 2002	Achievements Jan-Aug 2003	Cumulative	Target	Achievements
No. of loans provided	2,401	806	3,207	1,893	849	2,742	830	229	1,059	Need based	7,008
No. of RUG members receiving loans	1,448	138	1,586	1448	374	1,822	565	85	650	4,420	4,058
Existing loanee*	-	1,106	-	-	1,651	-	-	592	-	-	3,349
Loanee repaid the first ceiling	1,095	304	1,399	445	619	1,064	295	125	420	Need based	2,883
Loanee repaid the second ceiling	246	383	629	-	28	28	32	86	118	-	775
Loanee repaid the third ceiling	-	26	26	-	-	-	-	-	-	-	26
Enterprise loan	4	4	9	-	-	-	-	2	2	Need based	11
Credit amount disbursed *(millions of taka)*	13.114	5.420	18.536	7.032	3.88	10.912	4.895	1.662	6.557	05 (10)**	36.005
Recovered amount *(millions of taka)*	10.948	5.685	16.635	3.680	3.639	7.320	3.209	1.424	4.633	05 (10)**	28.588
Recovery rate *(percent)*	98.44	99.62	99.35	94	89	89	99.02	99.42	99.26	100	96

* Indicates RUG members with loans during August 2003.
** The credit disbursement target reset from Tk 5 million to Tk 10 million, as the number of RUG members increased.

In its 2002 meetings, the MACH National Steering Committee recommended reexamination of the project loan disbursement and recovery procedures. To that end, a committee composed of MOFL, DOF, and MACH partners developed a detailed credit management procedure that was approved by the steering committee and will be implemented in MACH's phase II.

Savings by RUG members. MACH RUG groups, as part of the standard CARITAS and general microcredit group culture, have a forced savings program requiring members to make weekly deposits of Tk 5/week (minimum). These funds receive bank interest rates and can be

returned to the member in case of need or departure from the group. During the project period, RUG members accumulated savings of Tk 3.963 million. Of total savings, male groups accumulated Tk 2.673 million and female groups Tk 1.289 million., CARITAS keeps the money in scheduled commercial banks in fixed deposit receipt accounts to obtain higher interest rates (see table 19).

Table 19: Status of Sitewise-Accumulated Savings by RUG Members

(millions of taka)

Parti-culars	HH			KM			TB			Project	
	Up to Dec 2002	Achieve-ments Jan-Aug 2003	Cumu-lative	Up to Dec 2002	Achieve-ments Jan-Aug 2003	Cumu-lative	Up to Dec 2002	Achieve-ments Jan-Aug 2003	Cumu-lative	Target	Achieve-ments
Men	0.941	0.250	1.192	0.739	0.346	1.084	0.312	0.085	0.397	2.178	2.673
Women	0.518	0.128	0.646	0.272	0.154	0.426	0.152	0.065	0.217	0.762	1.289
Total	1.460	0.379	1.839	1.011	0.500	1.51	0.464	0.150	0.614	2.94	3.962

4. Training

Staff training. To support effective project interventions, CARITAS staff were exposed to a variety of both generic job and project-related training courses on a number of different subjects. Training was imparted in 45 sessions on various subjects. See volume 2 appendices for a detailed list of CARITAS staff trainings.

RUG training. To develop group and individual skills for RUG members MACH-CARITAS organized training as shown below and in table 20. A total of 814 training sessions were attended by 15,057 RUG members and community people. Group members received training on more than one occasion. Over a period of 2–3 years the average group member attended 3–6 training sessions. For more details, see table 20 and volume 2 appendices.

- *Group development training*. This is part of the standard group training program to develop better understanding and cohesion among group members. A total of 6,580 RUG members were trained in 337 sessions during the project period. Group development training included group management, leadership, and account-keeping matters. It is likely that individuals may have received training in more than one subject.

- *Resource awareness training*. Every RUG member attended training courses on resource awareness and learned about wetland resources, its management, conservation, and sustainability. During the project period, 4,087 RUG members received such training in 220 batches.

- *Skill development training*. Selected group members received skill development training from MACH, CARITAS, and government personnel on their chosen AIGAs. A total of 2,689 RUG members received training on a variety of subjects in 170 training sessions. Training covered poultry/duck rearing, tailoring, embroidery, cattle rearing, vehicle driving, vocational training in mechanical and electrical repairing welding, cane and bamboo handicraft making, microenterprise development in fish culture/nurseries, pen culture, cage culture, vegetable cultivation, plant nursery establishment, and others.

- *Primary health care and education training*. This is another standard training program directed at RUG members. During the project period, 1,539 RUG members, primarily women, received this training in 76 training sessions. Its primary purpose was to train participants in several health care areas, including primary health care, sanitation and nutrition, and teachers' training for conducting adult education.

- *Development allies training*. An innovative CARITAS activity conducted for MACH was to train elites and influential people in the community to encourage their support. The courses helped participants to understand the project concepts, development objectives, envisaged activities, and MACH implementation process. A total of 162 development allies (local elites, village doctor, teachers, UC chairpersons, members and other influential people) received this training.

Table 20: Type and Sitewise Status of Imparted Trainings to RUG Members and Community People

Type of training and batch participants		HH			KM			TB			Project	
		Up to Dec 2002	Achieve-ments Jan-Aug 2003	Cumu-lative	Up to Dec 2002	Achieve-ments Jan-Aug 2003	Cumu-lative	Up to Dec 2002	Achieve-ments Jan-Aug 2003	Cumu-lative	Target	Achieve-ments
Group Devt	Batch	116	12	128	136	8	144	60	5	65	NB*	337
	Parti.	2,141	250	2,391	2,787	146	2,933	1,165	91	1,256		6,580
Resource	Batch	56	22	78	96	5	101	39	2	41	NB	220
awareness	Parti.	1,061	414	1,475	1,776	92	1,868	714	30	744		4,087
Skill devt	Batch	47	12	59	52	14	66	35	10	45	NB	170
	Parti.	715	193	908	906	200	1,106	549	126	675		2,689
Health &	Batch	41	-	41	17	-	17	18	-	18	NB	76
education	Parti.	822	-	822	397	-	397	320	-	320		1,539
Devel-	Batch	4	-	4	3	-	3	4	-	4	NB	11
opment allies	Parti.	57	-	57	70	-	70	35	-	35		162
Total	Batch	264	46	310	304	27	331	156	17	173	755	814
	Parti.	4,796	857	5,653	5,936	438	6,374	2,783	247	3,030	13,000	15,057
* Need based.												

Adult literacy courses. MACH, among others, has identified literacy as a major factor in empowering economically disadvantaged wetland users. Adult education was highlighted in the inception phase and reemphasized by the mid-term report. Assessing field needs and mid-term report recommendations, MACH increased the target of adult literacy programs and increased the number of courses conducted at the three project sites.

Eighty-one adult literacy courses were conducted and attended by 1,620 RUG members. On completion, successful participants were able to a limited extent to read and write Bangla, browse newspapers, and maintain their day-to-day accounts (see table 21).

Table 21: Sitewise Status of Adult Literacy Courses

Particulars	HH			KM			TB			Project	
	Up to Dec 2002	Achieve-ments Jan-Aug 2003	Cumu-lative	Up to Dec 2002	Achieve-ments Jan-Aug 2003	Cumu-lative	Up to Dec 2002	Achieve-ments Jan-Aug 2003	Cumu-lative	Target	Achieve-ments
Course conducted	32	10	42	2	17	19	15	5*	20	60	81
Total student in batch	640	200	840	40	340	380	300	100	400	1,200	1,620
Graduate	334	-	334	20	130	150	106	-	106	500	610
Can read & write	414	-	414	20	145	165	166	-	166	700	765
Can read & sign	436	-	436	20	149	169	193	-	193	800	818
Can sign	466	-	466	35	308	343	223	-	225	1,000	1,069

5. Demonstration activities

The purpose of MACH demonstrations was to encourage profitable agricultural activities that use less water or are otherwise environmentally less damaging than existing practices. For instance, wheat, maize, and winter vegetables use much less water than winter rice. The use of *guti* (granular) urea reduces the amount of nitrogen that is released into the atmosphere or nearby water bodies.

MACH's innovative demonstration activities have been conducted to help poor wetland users better understand various aspects of sustainable wetland management. Some demonstrations were held year-round and others seasonally. After completion of each demonstration activity, an awareness-raising program (Farmer Field Days) helped disseminate useful aspects among interested farmers and others. The assistance of the upazila government officials (subject matter specialists) concerned were sought and obtained for the field days. A total of 6,368 RUG members and community people have taken part in eleven types of demonstration activities on 155 acres of land.

Demonstrations were also conducted in a variety of locations with the assistance of the International Maize and Wheat Improvement Center (CIMMYT), Bangladesh Agricultural Research Institute (BARI), Bangladesh Agricultural Development Group (BADC), CARE and other organizations connected with USAID-sponsored program implementation. These demonstration activities included fish culture (polyculture of carp, cage fish culture, pen culture, and fingerlings nursery); year-round vegetable cultivation; wheat, maize, potato, and elephant's foot taro cultivation; and beneficial aspects of granular urea fertilizer application (see table 22). For more details, see the volume 2 appendices.

Table 22: Sitewise Demonstration Activities

Items, Farmers &Area (decimal)		HH Up to Dec 2002	HH Achieve-ments Jan-Aug 2003	HH Cumu-lative	KM Up to Dec 2002	KM Achieve-ments Jan-Aug 2003	KM Cumu-lative	TB Up to Dec 2002	TB Achieve-ments Jan-Aug 2003	TB Cumu-lative	Project Target	Project Achieve-ments
Pond fish culture	Farmers	11	-	11	37	13	50	9	4	12	64	74
	Area	200		2020	475	175	650	98	104	202	645	1,052
Pond fish nursery	Farmers	5	3	8	11	3	14	-	-	-	18	22
	Area	97	42	139	190	110	300	-	-	-	180	439
Cage culture	Farmer	22	-	22	16	-	16	5	-	5	40	43
Granular urea	Farmers	23	-	23	25	12	37	19	2	21	67	81
	Area	714	-	714	746	187	933	328	140	468	1,752	2,115
Wheat cultiv.	Farmers	54	-	54	43	-	43	72	-	72	143	169
	Area	1,302	-	1,302	700	-	700	901	-	901	2,900	2,903
Vege-tables	Farmers	86	18	104	70	20	90	66	10	76	193	270
	Area	470	87	557	293	110	403	201	96	297	800	1,257
Elephant foot	Farmers	-	-	-	-	-	-	1	4	5	-	5
	Area	-	-	-	-	-	-	4	7	11	-	11
Potato cultiv.	Farmers	13	-	13	57	-	57	20	-	20	50	90
	Area	120	-	120	250	-	250	72	-	72	270	442
Home-stead Vegs.	Farmers	1,382	70	1,452	2,508	200	2,708	1,238	200	1,438	3,500	5,598
	Area	1,382	140	1,522	2,508	400	2,908	1,238	300	1,538	3,500	5,968
Maize cultiv.	Farmers	2	-	2	1	-	1	2	-	2	-	5
	Area	30	-	30	8	-	8	35	-	35	-	73
Pen fish culture	Farmers	-	-	-	19	-	19	-	-	-	-	19
	Area	-	-	-	220	-	220	-	-	-	-	220
Total	Farmers	1,598	91	1,689	2,787	248	3,035	1,432	220	1,652	4,075	6,368
	Area	4,315	269	4,584	2,882	982	6,372	2,877	647	3,524	10,047	15,460

6. Tree Planting Programs

RUG tree nurseries. The MACH project envisaged an extensive tree-planting program covering roadsides, swamplands, riparian zones, homesteads, and institutional premises. The primary focus is rehabilitation of wetland and riparian areas, but the project also encourages tree planting for homestead or group income. Substantial numbers of saplings were required for these programs. To meet this need and also enable poor RUG members to earn extra income, MACH encouraged and assisted interested RUG members in establishing tree nurseries based on guidelines developed by MACH. MACH-CARITAS staff then imparted nursery training and other assistance to nursery growers. In addition, the MACH plantation specialist assisted RUG members. It was also envisioned that the RUG members who learned the nursery trade well would continue nursery activities and sapling production. This is in keeping with the project goal of reducing fishing pressure by diverting subsistence fishers to other avocations.

Forty-seven RUG members who undertook nursery trade have produced 399,225 saplings of 15 different tree species for timber and fruit. These RUG nursery growers sold 143,307 saplings to MACH project plantation programs and the balance to other community people, earning a profit of Tk 615,514. At the close of MACH phase I (August 2003), 273,023 saplings remained in RUG nurseries, available for 2004 plantation programs or sale (see table 23).

Table 23: Sitewise Status of Sapling Produced in RUG Nurseries

Particulars	HH			KM			TB			Project	
	Up to Dec 2002	Achieve-ments Jan-Aug 2003	Cumu-lative	Up to Dec 2002	Achieve-ments Jan-Aug 2003	Cumu-lative	Up to Dec 2002	Achieve-ments Jan-Aug 2003	Cumu-lative	Target	Achieve-ments
Farmers engaged	16	3*	19	18	*	18	10	*	10	35	47
Saplings produced	134,000	35,755	169,755	54,932	27,395	82,327	98,361	48,782	147,143	192,000	399,225
Species	15	6	15	15	7	15	15	5	10	-	18
Saplings sold	39,445	25,680	65,125	17,110	19,518	36,628	27,947	13,612	41,554	-	143,307
Income *(taka)*	209,860	156,300	366,160	96,884	103,455	200,339	18,2992	151,302	334,294	-	900,793
Expensed (taka)	68,002	25,148	93,150	44,951	59,386	104,337	53,190	34,602	87,792	-	285,279
Profit *(taka)*	141,858	131,152	273,010	51,933	44,069	96,002	12,9802	116,700	246,502	-	615,514
Remaining saplings in nursery *(numbers)*	94,555	104,630	-	80,336	62,809	-	70,414	105,584	-	-	273,023

* Saplings produced by new and old nurserymen.

Roadside plantations. CARITAS organized roadside tree plantations to generate income for RUGs. These followed standard benefit sharing principles, including shares for *(a)* the RUG, *(b)* local UPs that own the road, and *(c)* landowners adjoining the road who will be impacted by the trees. The benefit-sharing percentages for RUGs, UPs, and landowners are respectively 40%, 20%, and 40%. During the project period, 48.2 km of roadside plantations were established by planting 45,087 saplings belonging to 13 tree species. Fifty-six RUGs were involved in this participatory tree plantation program (see table 24).

Table 24: Roadside Trees Planted

Site	Yearwise plantation kilometers and number of saplings planted								Grand Total	
	2000		2001		2002		2003			
	Km	# plants	Km	# plants	Km	# plants	Km	# plants	Km	# plants
HH	6.5	6,020	7.5	6,620	4	4,000	2	1,950	20	18,590
TB	4	4,200	6	4,725	3	2,287	0	0	13	11,212
KM	0	0	5.5	5,500	8.2	8,260	1.5	1,525	15.2	15,285
Total	10.5	10,220	19.0	16,755	15.2	17,547	3.5	3,450	48.2	45,087

Homestead plantation. In a bid to increase RUG members' individual incomes, supply of fruits for better food and nutrition, and supply of fuelwood and timber and to contribute to the overall increase of tree-covered surface area and biodiversity of project sites, plant saplings were distributed to RUG members at MACH cost for planting in their homesteads. A total of 17,307 fruit and timber species saplings were distributed to 3,680 RUG members (5 saplings per individual). The average survival rate was estimated at 75% (see table 25).

Table 25: Sitewise Homestead Plantation Status

Particulars	HH			KM			TB			Project	
	Up to Dec 2002	Achieve-ments Jan-Aug 2003	Cumu-lative	Up to Dec 2002	Achieve-ments Jan-Aug 2003	Cumu-lative	Up to Dec 2002	Achieve-ments Jan-Aug 2003	Cumu-lative	Target	Achieve-ments
Group members	1,060	-	1,060	1,400	400	1,800	828	-	828	3,100	3,680
Saplings planted	5,300	-	5,300	7,000	1,200	8,200	3,807	-	3,807	15,500	17,307
Tree species	9	-	10	5	4	8	5	-	5	-	10
Survivability *(%)*	97	-	97	65	85	75	73.55	-	70	80	75

7. Health Care and Sanitation Improvements

The MACH project identified several supporting activities for improving the lifestyle of poor RUG members (see table 26). These were:

?? Installation of pit latrines (2,596)
?? Sinking of tube wells (252)
?? Distribution of warm clothes (3,550).

Table 26: Sitewise Status of Installation of Pit Latrines, Sinking of Tube Wells and Distribution of Warm Clothes

Particulars	HH			KM			TB			Project	
	Up to Dec 2002	Achievements Jan-Aug 2003	Cumulative	Up to Dec 2002	Achievements Jan-Aug 2003	Cumulative	Up to Dec 2002	Achievements Jan-Aug 2003	Cumulative	Target	Achievements
Pit latrines	900	-	900	750	550	1,300	396	-	396	2,450	2,596
Tube wells	117	-	117	20	40	60	61	14	75	240	252
Warm clothes	1800	-	1800	900	-	900	850	-	850	2,600	3,550

RUG Members' Impact and Profile Survey. **A** RUG members' profile survey was deemed essential to understanding the pattern of changes in the economic status of RUG members due to various project assistance programs and loan schemes. A consulting group was hired to accomplish the survey, throughout which CARITAS collaborated closely with the RMC. CARITAS field staff collected data from 1,201 RUG members, and the RMC from 2,520. Data collection consisted of interviewing RUG members through structured questionnaires designed to obtain an overall picture of socioeconomic condition, base income, and impact of credit operations. The RMC survey revealed an average supplemental income increase through MACH-assisted first, second, and third ceiling loan money of, respectively, Tk 1,933; 2,482; and 5,019 (see table 27 for a breakdown of RUG members surveyed among the three sites).

Table 27: Sitewise Status of RUG Profile Survey

Particulars	HH			KM			TB			Project	
	Up to Dec 2001	Achievements Jan-Aug 2003	Cumulative	Up to Dec 2001	Achievements Jan-Aug 2003	Cumulative	Up to Dec 2001	Achievements Jan-Aug 2003	Cumulative	Target	Achievements
No. of RUG members surveyed	1,750	-	1,750	1,158	-	1,158	825	-	825	2,500	3,733

C. Policy and Institutional Considerations

Recent studies on fisheries policy in Bangladesh have found that policies have yet to address the major dilemma of maximizing benefits from natural resources, ensuring an acceptable degree of equity in benefit distribution and protecting ecosystems that support the resources.

As mentioned above, it is generally agreed that wetland policies have addressed national and sectoral agendas, but considerable overlap and lack of coherence has existed among them. Policymaking has tended to be top-down, originating from central government and favoring

the priorities and interests of the political group and influential elites in power. A wider range of stakeholders has seldom been consulted in policy formulation.

MACH has a voice in government, but that voice is greatly enhanced when joined with other like-minded agencies and organizations. MACH's approach to dealing with policy issues has been to coordinate efforts with allies in the GOB, NGOs, and wider donor community and champion joint efforts to effect change. This is reflected in MACH's work with the Bangladesh Wetlands Network and MACH's efforts to support the coordinated LCG initiative to produce the "Fisheries Sector Review and Future Development" study in collaboration with the MOFL/DOF. Through MACH, USAID has been a major supporter of that effort.

Among its NGO partners, MACH also has individuals who have been "champions" for policy change, particularly related to water resource leases. MACH has also worked directly with government at all levels, resulting in precedent-setting agreements enabling communities and the project to establish eight permanent government-sanctioned community-managed wetland sanctuaries. In addition, the GOB has agreed to another precedent-setting concept: "conservation easements" allowing the project to consider purchase of privately held land and enabling the community and the local government to establish critical conservation areas for all time. These initiatives will fully come to fruition in phase II of MACH.

1. MACH Land-Use Efforts

As a result of MACH work with local and national government, Winrock and its partners obtained full GOB support to designate eight public wetlands at MACH sites officially as permanent GOB-designated community-managed fish sanctuaries. MACH began discussing this issue with the communities in late 1999 and worked with all levels of stakeholders, including local government, to have these areas established as permanent sanctuaries. This decision required the GOB to relinquish income from some of the wetlands and agree to forego this income for the benefit of the overall fishery and the community. It is the first time an arrangement of this type has been accomplished in Bangladesh. The GOB action will positively impact biodiversity and production in MACH wetlands and establish a precedent of environmental importance for management of public lands (wetlands, state forestland, and other publicly held land) throughout the country. One of the areas is Jaduria, Magura-Chapra Beel within Hail-Haor. Apart from its importance to the fishery, it has been designated an "important bird area" by Birdlife International. In addition, the Hail-Haor itself has been designated as a potential "Ramsar" site.

2. Inclusion of Contour Plantation in Hill Leasing Contracts

Pineapple is grown on the hills and in the watersheds of the Hail-Haor project site. The traditional method of pineapple cultivation consists of planting pineapple suckers in vertical lines running up and down the hill. Such "across the contour" line planting on steep hill slopes around the *haor* causes soil erosion on a scale that is rapidly leading to wetland siltation. MACH has demonstrated to the pineapple growers an alternative method of contour planting and placement of more plants. The initial demonstrations in 2001 have led to participation of many more farmers in the demonstration and testing. More than 25 demonstration plots are yielding far higher pineapple production and improved coverage of hillsides, reducing erosion. MACH and GOB policymakers have advocated formulating pineapple cultivation regulations that make contour cultivation mandatory for all growers. The district commissioner of Moulvi Bazaar agreed to certain changes in the wording of lease arrangements, supporting this beneficial change to regulations.

3. Comanagement and Linkage with Local Government Institutions

The MACH project has developed and maintained a close relationship with local government institutions and seen progress in local institutions taking charge of their resource planning and management. RMOs are the basic grass-roots organizations established under MACH. In each, the local UP chairman functions as an "adviser," in effect, linking MACH project activities with the UP and allowing the project and its RMOs to function based on true public priorities.

The other important link is through the LGC at the upazila level. This committee is chaired by the UNO, the chief executive in the upazila. The members of the committee are the upazila-level officers of different nation-building departments of the government, the chairpersons of the UPs and representatives of the RMOs. By nature, it is a unique combination of government officials, local governance, and the community. MACH project activities emanate from the grass-root level of RMOs and are considered and agreed on at the LGC level. This process has resulted in benefits at multiple levels:

- MACH project activity is known to all local governance tiers and identification of problems and their resolution is smoother.
- All activities and interventions tend to be within the government's existing policy.
- Government officials of nation-building departments tend to act as resource persons for training RMO and RUG members, and their familiarity with the MACH project makes the efforts more effective.

4. Leasing of Water Bodies to MACH RMOs

Community leasing of water bodies can be initiated after formulation of the RMOs. The lease proposals are processed first through the respective LGC. With the committee's concurrence, the application is submitted to the MOL through the MOFL. Under the terms of memoranda of understanding signed by the two ministries, the MOL retains ownership of the water bodies, but they are transferred to the MOFL for technical management and improvement through the RMOs formed under the MACH project. The initial transfer is for three years, which can be extended to up to ten years, subject to satisfactory management.

Government policy had established the lease cost 25% higher than the last lease value and provided for a 10% increase in subsequent years. This increased the lease cost by nearly 100% in five years. Such acceleration is detrimental to sustainable management of wetland resources, and MACH and other projects of MOFL recommended a change in policy. The government conceded and, under the revised policy, after a 25% initial increase, no further increases are implemented during the five-year lease period. In its three sites, MACH RMOs have to date signed leases for 22 water bodies, except for two river areas, covering an area of more than 1,200 acres.

In all three MACH sites, water bodies were carefully selected before finalizing the leases to MACH RMOs according to the following criteria:

- Strategic location and size
- Vulnerability to siltation
- Availability, considering the term of existing lease
- Biological importance
- Social implications.

5. Bangladesh Wetlands Network

In its first year of operation, MACH saw the need for new policies as part of an overall strategy to achieve change in managing wetlands and natural resources. MACH recognized the need for cooperation and dialogue with a range of government and nongovernmental bodies to achieve this goal, resulting in the formation of the Bangladesh Wetlands Network. As a vehicle for policy interventions, MACH has been instrumental in developing and strengthening the network in collaboration with 30 other government and nongovernmental institutions concerned with floodplain and wetland management. The network has made recommendations to the GOB on policy aspects of beel leasing, fish sanctuary establishment, and resource management. In 2002 the network sponsored a wetlands conference with the theme "Water, Fish, People," supported actively by MACH and jointly sponsored by the MOFL, Ministry of Water (MOW), and Ministries of Land and Local Government. The conference agenda included five keynote addresses and 33 technical presentations and addresses by concerned ministers (MOFL and MOL) and secretaries (MOFL, MOL, Ministry of Environment, and MOW).

MACH policy concerns regarding beel and wetland leasing, sanctuaries, and land management are immediate. MACH's preferred avenue for change on these problems continues to be the Bangladesh Wetlands Network. Through the network, MACH has been able to gather input from a wider audience and seek support and cooperation of other government ministries, projects, and programs to pursue its policy dialogue with the GOB. In a meeting with the Secretary of Fisheries, director general of fisheries, and other government officials, the network, with the active involvement of the MACH project, has made specific recommendations regarding policy on beel leasing, the need for a national Freshwater Sanctuary System, and overall constraints to NRM within Bangladesh. These efforts along with others ultimately resulted, as discussed, above in modification by the MOL of its lease rate increase policy.

D. Monitoring

MACH carried out a baseline survey, followed by impact and monitoring of fish catch and household-level fish consumption at the three sites. Fish catch was measured at selected locations every seven days during the baseline period and every ten days in the impact period. Observers visited households every 7–8 days per month to physically measure fish to be consumed.

Data were also collected along permanent transects on aquatic vegetation and wildlife in the project sites for the baseline and two impact years. The fish catch data has been analyzed and interpreted as catch per unit of area (CPUA), catch per unit of effort (CPUE), and number of fish species to express the biodiversity scenario for the three sites by each monitoring location by site and year. The household fish consumption data have been interpreted as per capita fish consumption and species consumed by land-size classes by site and year.

MACH is confident in the precision of the overall data measurements, but as MACH is not a research project and given the large variances involved, questions always exist regarding overall data accuracy. MACH staff believe that the catch data indicate positive trends generated by MACH activities more than an absolute measure of production.

1. Fish Catch Monitoring

In addition to CPUA, CPUE, and fish consumption, MACH examined relationships of flood extent, increase in dry season water, and flood timing and their importance to fish production. These findings have importance for freshwater capture fisheries in the rest of the country. *The MACH Impact Report* (volume 3) describes the positive correlations among the extent of flooding, maintenance of dry season water levels, and fish production. The project also found a strong positive correlation between the timing of the flood and fish production: the earlier the beginning of the flood, the greater the production.

Catch per unit of area. CPUA has been expressed in kg/ha/year for a specific monitoring area or site. CPUA of the baseline and impact years, as observed by site, are as follows:

The CPUA of monitoring locations in Hail-Haor was 171.08 kg/ha/year, but 205.05 kg/ha/year, 190 kg/ha/year, and 287.28 kg/ha/year in, respectively, impact year 1, year 2, and year 3. The higher CPUA in the impact years than baseline year indicated the production of fish increased in the area compared with the baseline situation.

MACH utilized data from Hail-Haor for more detailed analysis of the impacts of hydrology on production. This was done as the project conducted more detailed hydrological studies at the *haor*. Bivariate (CPUA and water-level) regression analysis indicates a positive correlation (R=0.85) between CPUA and retention of water level during dry season (March–April). It indicates an increasing trend in CPUA during the four years. The value of R square explains that CPUA depends 75% on retention of water level in the dry season. Four years data are not sufficient, however, to draw conclusive remarks on the same trend analysis showing a positive CPUA trend at the Hail-Haor site.

The CPUA was found to be 124.75 kg/ha, 104.78 kg/ha, and 140.08 in, respectively, impact year 1, year 2, and year 3; whereas it was only 57.8 kg/ha in the baseline period. Like Hail-Haor, the highest CPUA of 140.08 kg/ha was observed in impact year 3, compared with other years. The quantity of catch jumped dramatically in impact year 1, possibly due to community enforcement of fishing norms (6 weeks' ban on use of harmful gears in beels and flooded areas) and establishment of sanctuaries in Kalidaha Beel and Kum sanctuary in Turag River.

The regression analysis (R=0.84) indicates a positive relationship between CPUA and the project intervention periods. The linear bivariate regression determined that (R square =0.67) the 67% variation in CPUA could be explained by project interventions. The trend of the CPUA was positive during the project intervention period.

This site was selected a year after the others. A higher CPUA of 149.16 kg/ha was observed in impact year 1, compared with 150.16 kg/ha in the baseline year, which indicated a slight decrease from that of the baseline period; however, in impact year 2, the CPUA was observed to be 273.37 kg/ha, which indicates an 82% increase over the baseline period; this may be due to establishment of fish sanctuaries in Katakhali, Darabashia, Kewta, and in Bailla-Bailsha Beel complexes.

Catch per unit of effort. CPUE has been expressed in kg/day/gear effort over a specific period of time (i.e., day, month, or year). The CPUE of the baseline and impact years as observed by sites are as follows:

A higher CPUE of commonly used gears in the monitoring locations of Hail-Haor was observed in impact years, compared with the baseline period (see table 28). A doubling of the CPUE was observed in the case of *thela jal* in the impact years, compared with the baseline period, whereas gear operation time in both periods was almost same.

Table 28: CPUE in the Baseline and Combined Impact Period of Three Years in Hail-Haor Site

Commonly used Gears	Baseline Period		Impact period (3 years)	
	CPUE	Av. Fishing Hours	CPUE	Av. Fishing Hours
Veshal jal	5.34	16.20	6.21	14.60
Ber jal	6.87	9.63	10.54	6.80
Thela jal	1.31	5.47	2.65	5.39
Current *jal*	0.18	10.80	0.20	11.24
Traps	0.06	12.36	0.11	16.50
Suta Jal	0.17	13.41	0.23	13.39

A higher CPUE for commonly used gears in the monitoring locations of Turag-Bangshi site was observed in impact years, compared with the baseline period, except for the current *jal* (see table 29). The fishing hours for most of the gears were less in the impact period except current *jal* and *dhore jal*. Highest increase of CPUE was observed in case of *dhore jal*.

Table 29: CPUE in Baseline and Combined Impact Period of Three Years in Turag - Bangshi Site *(kg/day/gear)*

Commonly used Gears	Baseline Period		Impact period (3 years)	
	CPUE	Av. Fishing Hours	CPUE	Av. Fishing Hours
Ber jal	1.91	5.88	3.37	3.73
Moi jal	1.50	4.82	1.76	4.33
Thela jal	0.50	2.63	0.76	2.36
Jhaki jal	0.49	3.47	0.62	2.26
Current *jal*	0.03	5.48	0.02	5.69
Dhore jal	0.04	3.49	2.88	4.72

The CPUE for most of the commonly used gears was observed to be reduced in the impact year compared with that of the baseline period except the *ber jal* (see table 30). The CPUE of *ber jal* was increased by about 412% in the impact year, compared with the baseline period.

Table 30: CPUE of Selected Gears in Baseline and Impact Year in Kangsha-Malijhi Site

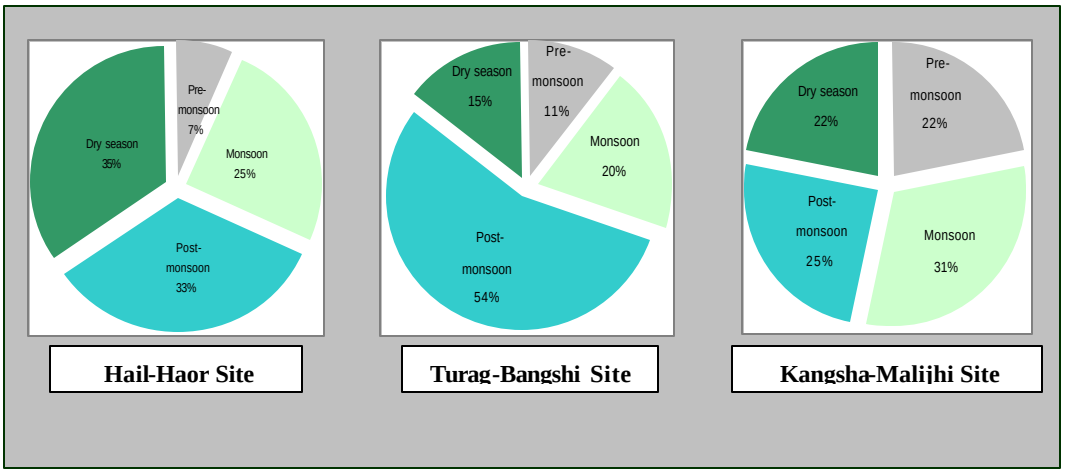
(kg/day/gear)

Commonly used Gears	Baseline Period		Impact period of 2 years	
	CPUE	Av. Fishing Hours	CPUE	Av. Fishing Hours
Ber jal	0.92	5.80	2.50	5.08
Thela jal	0.66	3.98	0.71	3.00
Dharma jal	1.46	9.29	1.23	10.40
Jhaki jal	1.27	5.64	1.53	4.00
Current *jal*	0.04	8.98	0.09	9.93
Guli/ghuni/chai	0.03	17.74	0.02	18.13

Seasonality of the catch. Fish catch in the floodplain beels varies by season largely due to changing water regimes by season, fishing practices, and fishing intensities. In general, floodplain beel catch is least in the premonsoon (April–June), when water level is low, major fishing from beels is done, and people are busy harvesting *boro* rice. The catch then starts to increase in the monsoon (July–September) with rising water levels due to rains and floods and peaks in the post-monsoon (October–December), which coincides with the recession, when fish tend to migrate back to rivers and deeper pools and are caught in large quantities. The catch then again starts to decline during the dry season (January–March) and reaches its lowest level again in the premonsoon.

The lowest catch was observed in the premonsoon in Hail-Haor, making up only 7% of the total annual catch. The catch rate then increased in the monsoon to 25% and further increased to 33% in post-monsoon. The highest catch (35%) in Hail-Haor was recorded in the dry season, which is unusual, but possibly happened due to the major catch of beels done *(katha* fishing and dewatering) by leaseholders.

Figure 2: Seasonal Catch Distribution in MACH Sites



As in Hail-Haor, in Turag-Bangshi site the lowest catch of 11% was observed in the premonsoon (see figure 2). The catch then increased as usual during the monsoon (20%) and peaked in the postmonsoon, contributing 54% of the total annual catch and then sharply declining to 15% in the dry season. The lowest catch in the dry season was associated with quick recession of water from floodplain beels and absence of perennial water in the beel area.

The seasonal catch distribution in the Kangsha-Malijhi site is more or less similar to that of the other two sites; however, catch quantities do not vary much among the seasons, as in the two other sites (see figure 2). The lowest catch of 22% was observed in the premonsoon, and the maximum of 31% was recorded in the monsoon.

Fish species diversity. Fish catch monitoring data have been collected by species, permitting assessment of the number of fish species observed during the whole monitoring period by monitoring locations. These data have been analyzed and expressed as the number of fish species observed in the baseline as well as the impact period.

The diversity of fish species was recorded as 71 at the baseline period and 85 species in the combined impact period of 3 years in Hail-Haor site. The presence of fish species in the impact years varied from year to year (69 to 76); however, increased diversity indicates the positive impact of conservation initiatives undertaken by communities with MACH support.

The diversity of fish species in the Turag-Bangshi site was found to be higher than that of Hail-Haor. During the baseline period, 82 fish species were recorded at the monitoring locations, whereas in the combined impact period of 3 years, 95 species were recorded from the same locations, indicating a positive impact on biodiversity of project interventions.

Compared with the two other sites, the diversity of fish species was found to be lower in the Kangsha-Malijhi site, ranging from 64 at the baseline to 71 in the impact year 2. Lower species abundance in the location may be due to habitat degradation due to increased siltation and consequent shortage of dry season water in the area. Higher species diversity in the impact year may be due to the combined effect of project interventions, such as reintroduction of locally threatened species, establishment of wetland sanctuaries, and restrictions on use of harmful gears.

2. Household Fish Consumption Monitoring

Fish consumption data have been collected from selected households in selected villages in each of the three project sites. The catch data have been analyzed and expressed as per capita consumption by social class, species consumed, and sources of consumed fish.

Per capita fish consumption for all social classes combined significantly increased: from 46.90 g at the baseline to 53.05 g, 54.98 g, and 60.89 g over, respectively, impact year 1, year 2, and year 3. The highest rate of increase of per capita fish consumption (40%) was found among the marginal farmers, followed by medium farmers (32%) and landless (29%) laborers. Fish consumption among the large farmers, although higher (50 g and higher per head/day), showed a bit of a reduction in impact year 3 (50.00 g), compared with that of the baseline (52.47 g) and impact year 1 (57.32 g) and year 2 (57.31 g).

Per capita fish consumption for all social classes increased from 27.32 g at the baseline to 29.18 g, 30.61 g, and 37.14 g for, respectively, impact years 1, 2, and 3. The highest rate of increase of 61.32% was found among the large farmers followed by 43.51% and 35.85% among the small and medium farmers respectively. Overall fish consumption at the site increased by 36% at the impact year 3 compared with the baseline period.

As in the two other sites, per capita fish consumption was observed to increase from the baseline figure of 22 g/head/day to 26.58 g/head/day in impact year 1. A higher rate of increase in fish consumption was observed among marginal farmers (29%), medium farmers (22%), and landless classes (20%), whereas only a 7% increase was recorded for the large farmers. Significant differences were observed between the impact and baseline situations (P-value <0.05).

3. Vegetation and Wildlife Monitoring

Vegetation diversity. In MACH project sites, a gross vegetation survey was conducted to determine the presence and absence of flora in terms of the number of species found in the area. The survey was conducted twice a year (dry and wet seasons). MACH started activities in the Kangsha-Malijhi site one year later than in the other two sites. The vegetation survey of Kangsha-Malijhi site was, therefore, done for the baseline and impact year 1 only. Table 31 summarizes the survey's comparative data at the three sites.

Table 31: Abundance of Hydrophytes in Baseline and Impact Years 1 and 2 in the Three Sites

	Baseline			Impact Year 1			Impact Year 2		
Project Sites	**Dry**	**Wet**	**Total**	**Dry**	**Wet**	**Total**	**Dry**	**Wet**	**Total**
Hail-Haor	85	84	107	83	92	95	91	98	117
Turag-Bangshi	19	39	51	31	41	48	44	53	60
Kangsha-Malijhi	47	43	55	58	64	72	-	-	-

In Hail-Haor, the total number of hydrophytic species was 107 in the baseline period, combining the dry and wet seasons in the Hail-Haor. The number of species diminished to 95 in impact year 1 and again observed to increase to 117 in impact year 2.

The abundance of aquatic vegetation was found to be low in the Turag-Bangshi site, compared with that of the Hail-Haor. A total of 51 species were observed in the baseline period, followed by 48 in impact year 1 and 60 in impact year 2. This was due to variations in the qualitative and quantitative features of the habitats. Compared with the Turag-Bangshi site, the diversity of habitats and surface area is larger in the Hail-Haor site.

In terms of annual abundance, similar trends were also observed in the Turag-Bangshi site, where a lower abundance was observed in impact year 1 than in the baseline period and impact year 2 as seen in the Hail-Haor. Lower abundance of aquatic vegetation was observed in the Kangsha-Malijhi site, which ranged from 55 in the baseline year to 72 in impact year 1. Data were not collected in Kangsha-Malijhi for impact year 2

Year-to-year variations in the number of aquatic vegetation species were possibly due to annual changes in water level and flooding pattern. In a year when early flooding contributed to sudden rises of water, less vegetation cover and diversity were observed, compared with years when the water level rose gradually.

Wildlife diversity. In all three MACH sites, a wildlife survey was carried out to document the gross abundance of wildlife population in the area. Monitoring was done twice a year, once in the dry season and once in the wet season, following selected transects drawn in each of the three sites. The same transact was used each year.

Field data were collected through direct observation along the transect lines as well as interviews of knowledgeable local persons. The project started one year later in Kangsha-Malijhi site, therefore, results were incorporated for two years only, whereas three years' worth of findings are presented for the Hail-Haor and Turag-Bangshi sites. Table 32 summarizes wildlife monitoring data for the three sites.

Table 32: Wildlife Species Recorded in Baseline and Impact Years 1 and 2 in MACH Sites

Organism	Baseline			Impact Year 1			Impact Year 2		
	Dry	Wet	Both	Dry	Wet	Both	Dry	Wet	Both
Hail-Haor									
Amphibians	5	5	5	6	6	6	5	5	5
Reptiles	18	17	20	19	19	19	21	21	21
Birds	56	88	119	110	96	110	132	101	133
Mammals	17	19	22	22	23	23	26	26	26
Total	96	129	166	157	144	158	184	153	185
Turag-Bangshi									
Amphibians	5	6	6	5	5	5	5	5	5
Reptiles	14	16	19	16	16	16	16	16	16
Birds	75	70	101	89	81	96	106	88	107
Mammals	14	16	19	18	16	19	21	21	21
Total	108	108	145	128	118	136	148	130	149
Kangsha-Malijhi									
Amphibians	5	5	5	5	5	5	0	0	0
Reptiles	17	18	18	19	19	19	0	0	0
Birds	83	83	84	108	93	108	0	0	0
Mammals	17	17	17	16	16	16	0	0	0
Total	122	123	124	148	133	148	0	0	0

In the Hail-Haor site, six species of amphibians have been recorded during the three-year monitoring period. During the baseline period and impact year 2, five species were observed, whereas in impact year 1, 6 species were recorded in the same locations. The reasons for the absence of one species in the baseline period and impact year 2 were not clear. No seasonal variation in the abundance of amphibian species was observed.

The abundance of reptile fauna ranged from a minimum of 19 in impact year 1 to a maximum of 21 in impact year 2 with a baseline figure of 20. No seasonal variation in the abundance of reptiles was observed in the area.

The abundance of birds was found to be higher in the Hail-Haor, ranging from a minimum of 110 in impact year 1 to a maximum of 133 in impact year 2. Records of impact year 1 revealed an abundance of 110 bird species. Seasonal variation was observed in the abundance of birds—a higher number of birds in the dry season, except in the baseline year—which may be due to sampling error.

Mammalian diversity was observed to range from a minimum of 22 in the baseline period to a maximum of 26 in impact year 2. No seasonal variation was observed in abundance of mammalian fauna in the area.

The total diversity of wildlife fauna in the Hail-Haor site ranged from a minimum of 158 in impact year 1 to a maximum of 185 in impact year 2. The number of wildlife species recorded in the baseline period was 166. An overall higher abundance of wildlife fauna was recorded in the impact years.

Six amphibian species were recorded in the Turag-Bangshi site during the monitoring period of three years. Six species were recorded in the baseline year, whereas five species were observed in the impact years. No seasonal variation was observed in amphibian diversity, except that six species were observed during wet season in Turag-Bangshi site.

The reptile population was also rich in the baseline year compared with impact years. A total of 19 species of reptiles were recorded in the baseline year, whereas 16 species were observed in impact year 1 and year 2. As for amphibians, no seasonal variation in the abundance of reptiles was observed in the area.

The population of birds in the area ranged from a minimum of 96 observed in impact year 1 to a maximum of 107 in impact year 2. An abundance of bird species in the baseline period (101) was a bit higher than that of impact year 1, but lower than impact year 2. A higher abundance of birds was observed in the dry season in the monitoring years than in the wet season.

Mammalian population recorded in the area ranged from a minimum of 19 in the baseline period and impact year 1 to a maximum of 21 in impact year 2. A higher abundance of mammalian fauna was observed in impact year 2, compared with the baseline and impact year 1. No seasonal variation in the abundance of species was observed.

In the Turag-Bangshi site, a total of 145 wildlife species were recorded in the baseline period, whereas 149 species were observed in the impact years. Combining all classes of species, a higher abundance of wildlife fauna was recorded in the impact years.

In Kangsha-Malijhi, five species of amphibians were recorded both in the baseline period and impact year. No seasonal variation was observed in the abundance of amphibians during dry and wet seasons.

The number of reptile species ranged from a minimum of 18 in the baseline period to 19 in the impact year. No seasonal variation in the abundance of reptiles was observed.

Fewer birds were observed in the Kangsha-Malijhi site, compared with the Hail-Haor and Turag-Bangshi sites. A total of 108 species of birds was observed in the area during the monitoring period of two years, of which 84 were observed in the baseline year and 108 in the impact year. A higher abundance of birds was observed in the dry season.

Mammalian diversity was found to be less in the area, compared with the two other sites. The presence of 17 species was recorded in the baseline year, whereas 16 were observed in the impact year. No seasonal variation was observed in the case of mammalian fauna.

The overall abundance of wildlife fauna was observed to be higher in the impact year than in the baseline year. In the baseline period, 124 species were observed, whereas 148 in the impact year. The increased number of species may be due to habitat improvement in the project site and awareness building among local people on the importance of wildlife; however, long-term management actions are required to enhance and conserve wildlife in any given area.

4. Hydrology Monitoring

Hydrology study is essential for the proper management of wetlands. Wetland ecosystems depend on upper watershed hydrology. Degraded watersheds cause high runoff and less infiltration, which is one of the reasons for insufficient water availability in the streams, rivers, and wetlands in the dry season. In addition, the high sediment load eroded from the degraded watershed is carried into the stream system and wetlands, causing rapid filling of streambeds and the Haor basin, consequently impacting biodiversity and the ecosystem of the Haor. For this reason, from the beginning of the project, MACH has evaluated the hydrology of wetlands as well as upper watershed.

At the three sites of the project, MACH is monitoring various hydrology parameters, such as, water level, rainfall, stream discharge, sediment load of streams, and sediment deposition rates.

Hail-Haor hydrology and sedimentation process. The word Haor is believed to be a corrupted form of the Sanskrit word *shagar* (sea) or the Arabic word *bahar* (sea). Thirty-five large *haors* exist in the Sylhet Division, some of which merge with one another. The Hail-Haor is a low-lying depression, located about three kilometers northwest of Srimangal in Moulvi Bazaar District. The Barsijura and Balishira Hills bound the *haor* to the east, the Atarmura Range to the south, and the Satgaon Hills to the west. The watershed area of Hail-Haor is about 600 sq km (237 sq mi). The basin water originates from the surrounding mostly hilly watersheds, of which approximately 85% lie in Bangladesh and 15% in India. The wet season

area of Hail-Haor is approximately 13,000 ha, whereas the dry season area varies from as low as 500 ha to 4,000 ha.

Due to a variety of man-made changes in the hydrological regimes, the only current outlet of the Haor is the Gopla River. The Gopla flows in a northerly direction from the Hail-Haor, then swings sharply and flows southwesterly into the Gunjajuri Haor. The Gunjajuri Haor then drains into the Barak River, which flows through Habiganj and enters into the Surma-Meghna River at Madna.

Hail-Haor was formerly connected with the Kushiyara and Manu River. A series of flood control dikes along these rivers and a sluice on the Kamerkhali Khal restrict riverine flows and fish access to and from the *haor*. Another dike, now in disrepair, was built around the northeastern and eastern sides of the *haor*, supposedly to reduce the impacts of flashfloods and to turn the *haor* into a large reservoir. The Shaka Borak River and Kamarkhali Khal pass through Boro Haor, north of Hail-Haor and, if it were not blocked, would connect Gopla with the Kushiyara River.

Most of the water in the *haor* originates from the 44 major hill streams or *charas* that flow into the *haor*. A large number of smaller seasonal streams also feed into the *haors*. Among the *charas*, Bilashi is the largest stream in the Hail-Haor stream system, accounting for about 30% of the total flow. Other major *charas* include the Udna, Jag, Shaon, Joinka, Kodali, and Alia. The overall length of the smaller streams range from a minimum of about 2 km to a maximum of 10 km, whereas the Udna-Lungla-Bilashi system has a length of around 15–20 km.

Hydrology studies of Hail-Haor. Given the importance of water to the people, to fish, and all the other natural resources of the *haor* resource base, MACH identified a number of hydrological parameters to measure systematically. These include rainfall gauge setting in two locations, water-level recording at four locations within the *haor*, stream flows and siltation recording at 22 *charas*, as well as silt deposition using silt traps located at different positions in the *haor*. The annual average sediment load of *charas* draining to Hail-Haor basin has been around 100,000 tons, and the annual rate of *haor* filling is about 5 cm in some areas. The detailed data and analysis results are incorporated in the MACH hydrology report in Volume 2, appendix 15 of this completion report.

Analysis of the water levels of Hail-Haor found that in 1999 the *haor* retained only a few centimeters of water during the dry season. Water level was higher in the dry season of 2000 because of comparatively more rainfall during that period. Year 2001 was a moderate year. Because of low water retention, MACH physical intervention in the *haor* continued until the end of April 2001; however, in 2002, the water level receded slowly until the end of March, and began to increase from early April. Water level usually begins to increase at the end of April or beginning of May. Also, in 2002 the water retention period was above 5.5 m PWD (about a water depth of 10 ft) longer than the previous two years. The year 2003 was also a moderate year; water in the dry period was relatively lower than in 2002. Early onset of the monsoon flood in 2003 was earlier than in the past four years.

Possible relation of fish yield with hydrology. From the five-year hydrology data, it is observed that the water level of Hail-Haor begins to rise in April–May. The date of premonsoon flood commencement is one of the major factors that impacts yearly fish production. The earlier the flood water level rises in April, the more potential for breeding, if

other conditions remain unchanged. Analysis shows that in the base year (1999), onset of the premonsoon flood took place on May 6, 1999, which is comparatively late, and fish production was only 171.08 kg/ha. Impact year 3 showed the highest yield of 287.28 kg/ha, because of the earlier flood onset. For Hail-Haor, therefore, April to May might be termed the critical period for total fish yield, that is, the earlier that the flood comes, the higher the production of fish.

Chara study. The *charas* (streams) of Hail-Haor have both year-round and seasonal flows, depending on the size and nature of their watershed. Flows in perennial streams are negligible in the dry season (January–April); little f any surface water reaches the *haor* (largely because of water used upstream for *boro* rice irrigation). In the wet season (May–October), all streams carry significant water to the *haor*. A total of 22 *charas,* including the secondary streams have been monitored regularly for water and sediment discharge from November 1999 to October 2000. From November 2000, only four charas, that is, Jag, Joita, Boula, and Alia, are being monitored regularly; monitoring includes recording the flow and sediment contents of the flowing water (these streams carry the greatest sediment and have water flow throughout the year), and water samples were collected once a week during the wet season.

Besides regular monitoring, MACH conducted an intensive hydrology monitoring in the Jag and Joita *charas* to investigate the rainfall-runoff-sediment flow relationship, correlating it to different land use patterns. The study results will help in appreciating the impact of various land-use types on watersheds and help define the appropriate management of the watershed and wetlands as a whole (the entire catchment).

Hail-Haor recommendations. One of the objectives of the study was to understand the status of the subwatershed regarding soil degradation. Analyses of the two *charas,* Joita and Jag, showed high siltation rates. The eroded sediments are carried by the streams and ultimately reach the *haor,* filling the wetland basin beds. If increased siltation rates continue for a decade, centimeter by centimeter, sediment will settle at the basin bottom and many beels will lose their perennial nature. Consequential effects will include loss of the expanse of dry season aquatic habitat and loss of brood fish. Remedial measures lie in undertaking activities that would slow down and reduce sediment transport. Remedial measures include bank protection, watershed restoration, regulation of watershed land use, riparian plantations, proper use of stream water, and so on.

Hydrology and water resources of the Turag-Bangshi project area. The Turag-Bangshi river basin is located in the north central region of Bangladesh, bounded by the Jamuna, Padma, Old Brahmaputra, and Sitalakha river systems—Jamuna on the west, Old Brahmaputra on the north and northeast, and Sitolakha on the east. Anther important waterway is the Dhaleswari-Kaliganga River, which crosses the southwestern part of the region. Besides these main rivers, the region is drained by many small rivers such as Bangshi, Pungli, Banar, and so on. The MACH project area consists of a portion of the Turag-Bangshi River and adjacent wetlands within Kaliakoir Upazila of Gazipur District and a small portion within Mirzapur Upazila of Tangail District.

Typical of most low-lying floodplains of Bangladesh, the Turag-Bangshi River runs through the site with numerous beels on either side of the river. At the beginning of the rainy season, as floodwaters enter the upstream portions of the Bangshi, water spills over the riverbanks through canals/*khals* that connect the river to those adjacent beels. Fish, for the most part, move from the rivers to the beel/floodplain areas for spawning or nursing and then into the

deeper perennial portions of the beels or back into the river, as water recedes after the rains. Due to the dry season reduction in water levels caused by Farraka Dam in India, ground and surface water extraction for *boro* rice irrigation, and reduced flows due to deforestation in local and upper watershed areas, dry season water levels in the local rivers and beels are much reduced. In drought years, flows cease in the formerly perennial Turag River. The fish remain only in *kums* and in the deepest portions of the beels. Annual fish production depends largely on the size of the breeding populations that remain in the *kums* and *dohas* through the dry season.

Within the Turag site, a total of 26 beels exist with a water surface area of approximately 10,000 ha at full flood, which diminishes to less than 700 ha at the end of the dry season. The Turag River runs for approximately 30 km through the site and another 28 km of *khals* exist within the area. The hydrology of the Turag-Bangshi Flood Plain, like that in all similar areas of Bangladesh, is determined principally by the monsoon occurring May–October followed by a dry period in November–April. The availability of water determines fish production, agricultural cycle, and lifestyle of the area's people. At the Turag site, rainfall, river, and beel water regimes including tidal effects have been studied. The project study also included water extraction from the Turag within the project area.

Rainfall data are obtained from the Bangladesh Water Development Board (BWDB) rain gauge station at Mirzapur. The records show that on average less than 3% of rainfall occurs in December–March, less than 20% in the premonsoon period of March–May, and the remainder in June–October. Water level and tidal variation have been obtained from BWDB records at Kaliakoir town and from water gauges set and monitored by the project in Mokesh and Alua Beels and the Turag River. Historical data have shown that, although rainy season flows have maintained the same levels in the past 50 years, dry season water levels have declined. The primary cause is the worsening effects of Farraka Dam in India and, more recently, water extraction for dry season *boro* rice irrigation and upper watershed deforestation.

Water-level variation in the beels. Water levels have been monitored in the two major beels of the site, Alua Beel and the Mokesh Beel. Two manual gauges were installed in the beels in May 1999. Another gauge has been placed in the Turag River in 2000. The inflow and outflow of Mokesh and Alua beel are being monitored. Water-level readings have been taken daily since installation. Because the two beels lose their connection with the Turag in the dry season, no tidal fluctuation is visible in the beels during this time.

The water levels of Mokesh Beel were analyzed for 2000, 2001, 2002, and 2003. In four years, a similar trend is observed from January to May. Water level began to rise in May 2002, but in the previous year, water levels were far lower during the same period. At the end of June 2002, water level exceeded 2001's level due to the heavy downpour during that month. In 2003, water levels followed the same trend of 2002.

Malijhi-Upper Kangsha Basin (Sherpur) hydrology. The Sherpur project site is a flash flood–prone area. The farmers of the site repeatedly suffer heavy damage of their crops by flooding from the Shomeswari, Malijhi, and Chellakhali Rivers. Each year, flash flooding occurs in these rivers more than once and water spills over river banks, flooding a large portion of the project area. These flashfloods discourage intensive pond aquaculture in the area. Continued flood damage to the monsoon crop forces farmers to shift to dry season *boro*. The resulting

increase in extraction of surface and ground water for irrigation pose potential damage to wetlands and the environment in general during the dry season.

Five water-level gauges have operated in the Sherpur site from June 2000. These are Malijhi river at Tinani Bazaar, Chellakhali River, near the Kapashia Bridge, Baitkamari Bridge, and Dholi Beel of Jhenaigati Union. Another two gauges have operated at Kewta Beel and Tenachura Bridge from May 2001. It is commonly believed that rivers of the Kangsha-Malijhi basin drained only into Malijhi River. After field investigation, it was observed that a large portion of the basin water drains into Mrigi river of Sherpur town and ultimately to the Old Brahmaputra. This new phenomenon started about seven or eight years ago. The change of course is due to siltation at the Shomeswari-Malijhi confluence and digging of Tenachura *khal*, which connects Mrigi River. A gauge has been placed at the Tenachura Bridge on the Tenachura Khal near Votpur village of Sreebordi Thana to monitor water levels as well as flow direction of the *khal*.

The water levels of Dholi beel of the Kangsha-Malijhi site were analyzed for the year 2001, 2002, and 2003. The site received higher intensity rainfall in the year 2002; rainfall was 3,416 mm (January–December 2002), almost double the previous year's rainfall of 1,835 mm. Flash flood occurrences were also observed through MACH analyses. Five to seven floods usually occur a year due to local rainfall as well as rainfall from outside Bangladesh. Field data show that water levels began to rise in the first week of April in 2002, but two weeks later in 2001. Premonsoon flood onset was earlier in 2003.

E. Special Programs

1. Investment Support to MACH

From its inception, MACH has recognized the need for specific physical interventions to restore function to wetlands and surrounding riparian habitats. These activities have included reopening canals and other fish migration pathways, reexcavating lost beels, revegetating or reestablishing riparian and wetland forests, reintroduction of lost fish species, establishing permanent sanctuaries, pollution abatement, and other tasks.

MACH activities are site specific and based on community requests through local resource management organizations. Local currency funds to start large-scale physical restoration and rehabilitation of degraded habitats were finally received in April 2003. Delays in the release of those funds have since 2001 slowed MACH physical intervention progress. Interventions in the period through June 2003 have focused on minor habitat restoration through excavation to reestablish permanent water bodies, excavation to reconnect habitats to allow for fish migration, fish sanctuary–related interventions and a variety of riparian and wetland plantation-related issues.

All physical interventions undertaken by MACH must meet three basic criteria, that is, *(a)* have a biological impact, *(b)* be socially acceptable, and *(c)* be technically feasible. The interventions must offer quantifiably positive impacts for the wetlands concerned and the communities that live around them. The potential impacts must be of sufficient size to justify the intervention cost. Interventions must be acceptable to the community as a whole and benefit the entire community. MACH engineers determine the technical feasibility of reexcavation and other earthwork, structures, and other similar concerns. MACH in addition requires that if excavation is to take place, a portion of the area excavated must become a sanctuary.

Interventions are undertaken only on specific requests from RMOs, community groups, and other CBOs. Interventions require the support of the union parishad and MACH LGCs concerned. At all sites, the Local Government Engineering Department LGED engineer is a member of the LGC. Given that excavation is difficult in these wetlands, MACH involves the concerned LGED engineer directly to assist the project in technical areas as well as work with MACH engineers to establish excavation rates for each scheme.

Earthwork and construction related. Details of specific earthwork interventions are to be found in volume 2 appendices, but some of the project's completed scheme areas shown in table 33.

Table 33: Beel and Khal Excavation 2003

	Beel Reexcavation				Canal Reexcavation			
Site	Achieved through 2002 *(hectares)*	Achieved 2003 *(hectares)*	Total Excavation	Total Influence Area *(hectares)*	Through 2002 *(meters)*	Achieved 2003 *(meters)*	Total	Total Influence Area *(hectares)*
HH	9.6	2.0	11.6	2,429	3,576	3,220	6,796	557
(HH#)	(9)			(11)	(4)			(7)
KM	3.4	1.2	4.6	155	1,419	2,578	3,997	390
(KM #)	(3)			(4)	(3)			(6)
TB	5.4	3.8	9.2	720	500	-	500	191
(TB #)	(6)			(8)	(1)			(1)
Total	18.4	7.0	25.4	3,364	5,495	5,798	11,293	1,138

Sanctuary demarcation. Sanctuaries are a key feature of MACH wetland management initiatives. Sanctuaries assure the survival of significant numbers of brood stock from year to year and are essential to the sustainable use of wetlands in Bangladesh. Ensuring the permanent viability of the sanctuaries is important to the success of the project. A number of physical interventions were conducted to support MACH sanctuary–related activities. These included establishment of permanent boundaries, addition of fish-aggregating devices (FADs) and structures that prevent illegal fishing (see table 34).

Table 34: Sanctuary Activities

Sl. No.	Particulars	Unit	Achieved thru August 2003			
			HH	TB	KM	Total
01	Mould Construction (for tetra pod and pipe)	No.	90	50	35	175
02	Hexapod mould	No.	01	0	9	10
03	Tetrapod (RCC-No.)	No.	1,305	902	950	3,157
04	Ring Pipe (RCC- No.)	No.	218	550	401	1,169
05	Hexapod construction	No.	1	0	200	201
06	Demarcation pillars (RCC-Sanctuaries)	No.	138	450	70	658
07	Permanent signboard	No.	17	26	4	47

Tetrapod/pipe construction. A major community concern about sanctuaries, even those with brush pile FADs, is illegal fishing, particularly fishing with seine nets or similar gear. In an effort to ensure the permanent nature of the sanctuaries and reduce the annual recurring costs

of temporary FADs, such as brush piles, the project with the support of several RMOs has introduced on an experimental basis concrete FADs in several sites. Three designs have been used: tetrapods, hexapods, and concrete pipes. The tetrapod and hexapod have been used successfully in the United States and Africa, whereas the pipe is a standard fishing device used in Bangladesh and abroad. Both of these were purposely heavy (more than 100 kg) to prevent movement and theft. As shown in table 34, the project has introduced this technology in sanctuaries to secure these critical areas permanently as conservation areas and to prevent fishing. In the coming year, planning will include hexapods, tetrapods, and/or pipes in all permanent sanctuaries.

Watershed/riparian plantation activities. Degradation of the vital aquatic and terrestrial habitats of the project command areas has left those resource bases in critical condition. Habitat restoration, biodiversity enhancement, and soil and water conservation of these critical wetland and watershed habitats through reforestation and afforestation are also prime goals of MACH.

In recent years, participatory tree farming on marginal public lands has proved successful in generating income for rural poor. In keeping with MACH's quest to secure project sustainability from environmental, biological, social, and economic viewpoints, MACH worked on participatory tree plantation scheme.

With experience and expertise gained in initial years of MACH, a truly participatory approach has been undertaken in all subsequent phases of the reforestation program starting with the identification of schemes, preparation of planting plans, choice of species, and community involvement in field program execution. RMOs and RUG committees selected the restoration/reforestation sites in close coordination with project staff. The local UP chairpersons and ward members reviewed and recommended scheme sites, whereas the LGCs accorded policy approval. The local people (especially adjacent private landowners) who are to some extent adversely affected by shade to their rice crop and also directly benefit from a percentage of harvesting, were informed of the program and motivated through regular dialogue. The local community primarily decided what to plant. Project staff assisted them with technical information and recommended a group of biologically appropriate tree species from which to select. Mostly high-valued timber and fruit-bearing trees and medicinal plants dominated species selection. Guaranteeing distribution of ultimate benefits to various partners at final harvest was ensured by executing formal written agreements on Tk 150 nonjudicial stamps (a standard procedure practiced in Bangladesh).

During the project (1999–2003), a total of about 333,037 saplings belonging to 55 different tree species (see volume 2 appendices) were planted in the three project sites on wetlands, riparian zones, watersheds, rural road slopes, homesteads, and institutional premises with a promising 80–90% success. MACH has thereby significantly contributed to enhancement of the country's biodiversity. In terms of resource building, considering that 40% of the planted saplings will develop as mature trees at times of harvest in fifteenth year, timber production from these plantations is likely to attain a volume of 10.5 million cu ft, whose value at current prices amounts to Tk 261.6 million ($4.5 million). Apart from being significant biological resources, these reforested areas will provide new and additional habitat for increased production of fish and wildlife. They will also generate substantial income for the sustainability of RMOs and RUG organizations (see table 35).

Table 35: Reforestation by Type

Site	Riparian	Swamp	Roadside	Institution	Total
HH	48,638	26,307	18,590	19,986	113,521
TB	23,092	1,828	11,212	27,329	63,461
KM	96,724	12,674	15,285	31,372	156,055
Total	168,454	40,809	45,087	78,687	333,037

Pineapple demonstrations. Pineapple is a major crop cultivated on the steep hillsides of the Hail-Haor watershed. The farmers traditionally cultivate this crop in rows that descend the hillsides. Such "across contour" line planting on the steep hill slopes is one of the causes of increased soil erosion in the watersheds. To improve the retention of soil on the hillsides, MACH began demonstrating contour cultivation to farmers in 2001. Observing the very encouraging positive results of MACH-established demonstrations in 2001, eight more farmers adopted the new system in eleven demonstration plots in 2002 and nine more farmers expanded the program on seventeen plots in 2003 (see table 36). This has been a significant breakthrough in farmers' attitudes.

In the meanwhile, the first year's demonstration plot began bearing fruit. Project staff monitoring of fruiting incidence, size and quality of fruits, and overall income to owners brought to light significant positive and attractive results. Adopting the contour planting method, farmers could plant about 4,000 (30%) more plants per acre, compared with the traditional vertical line planting system. In contour-planted gardens, fruiting percentage was 30–35% at the close of the first year and 70% in the second year, whereas the same figures for traditional vertical line planting system are, respectively, 20–25% and 60–65%. Fruit size registered an increased weight of 0.5 kg/fruit (3 kg for contour plantation, but 2.5 kg for the traditional method). At the close of the second year, the net increased income from the contour plantation system amounted to 54,000 taka per acre, compared with the traditional system. Soil conditions are improving.

Through future MACH phase II and the Investment Support to MACH ISM efforts, MACH plans to advocate for policy changes by convincing policymakers to formulate government pineapple cultivation regulations. At the program level, motivational work will continue in subsequent years to expand contour pineapple gardens with continued MACH extension support.

Table 36: Pineapple Demonstration Plots Established at Hail-Haor Site

Year	# Demo plots	Demo plot location	Area (acre)
2001	2	Foyzabad	1.20
2002	11	Mozaherabad, Balishera Hills Foyzabad, and Ziranpur Hill	4.74
2003	17	Foyzabad, Boulashir, Mohazerabad, Mosaibazaar, and Dolu Chara	24.68
Total	30		30.62

Reintroduction of indigenous fruit trees of the tropical forest. Indigenous fruiting species of the tropical forest are themselves important for supporting wildlife biodiversity, particularly bird populations. The GOB's past policy for high-yielding timber stand production by creating man-made plantations (mostly monoculture or a limited number of species culture) has sacrificed tropical forest fruit species (normally less valued as quality timber and volume production). This has led to a significant reduction in the diversity of the forest species .

For restoration of both plant and wildlife biodiversity, MACH identified eleven of the most important forest-based fruit species and produced saplings of these species in nurseries. Seedling production in nurseries produced 7,340 saplings of the species shown in table 37.

Table 37: Forest-Based Fruit Tree Saplings Produced for MACH Plantations

Serial No.	Name of the Forest-Fruit Species		Number of Saplings Produced
	Local Name	Scientific Name	
1	*(Jongli) Amra*	*Spondias pinnata*	270
2	*Bohera*	*Terminalia belerica*	600
3	*Bot*	*Ficus religiosa /F. bengalensis*	540
4	*Chailta*	*Dillenea indica*	1,180
5	*Dewa*	*Artocarpus lakoocha*	790
6	*Dumoor*	*Ficus semicordata*	380
7	*Horitoki*	*Terminalia chebula*	110
8	*Jolpai*	*Elaeocarpus robusta*	1,410
9	*Khude Jaam*	*Syzygium fruticosa*	1,230
10	*Kaw*	*Olea dioca*	290
11	*Lotkon*	*Bixa orellana*	540
Total			7,340

These species have been mixed with others in wetland and riparian areas where the project is reestablishing native forest species.

Miscellaneous activities. MACH is attempting a number of innovative activities utilizing ISMP funds. One that took place in September–October 2003 is the use of a hydraulic dredger to deepen sanctuaries and beels in areas where manual labor methods cannot work. Other items shown below are either underway or to be conducted once ISMP funds are fully available.

An important part of protected area (sanctuary) management is the demarcation of the area. In addition, a continuing problem in Bangladesh is the loss of public wetlands to encroachment. The addition of boundary pillars assures that community members become aware of the location of both public wetlands and community sanctuaries. In cooperation with the MOL, MACH has this year produced and fixed a total of 80 pillars. It is an ongoing process for both demarcation of beels, as well as sanctuaries. Another bird-friendly pillar/signboard has been designed and constructed to convey the message to the community and has been posted at the entrance of several sanctuaries. A major effort will be made in the coming year to ensure that all year-round sanctuaries are permanently marked.

To protect riverside road and roadside plantations, after discussion with the community and a feasibility study, project engineers have successfully constructed small spars. Concerned communities reportedly claim that it functioned successfully and as they expected during the rainy season, as a result, saving roads from further erosion and protecting road plantations.

Table 38: Miscellaneous Physical Intervention Activities

Sl. No.	Particulars	Unit	HH	TB	KM
01	Spar Angle box	No.	4	0	0
02	Permanent signboard	No.	0	0	4
03	Bagher Vita road maintenance	cu ft	0	0	10,000
04	Kalagosha Jhora repair	cu ft	0	0	38,000
05	Earthwork at Abashan Prokalpa	cu ft	0	0	25,000

2. Pollution

The Turag-Bangshi MACH site in Khaliakhair Upazila, Gazipur District lies on the periphery of the Dhaka-Savar-Tongi industrial triangle. The Turag-Bangshi/Khaliakhair community identified industrial pollution as one of the major factors affecting their wetlands. In response to community requests, in 1999 MACH began working directly with concerned industrialists to reduce pollutant discharge to identify innovative ways to reduce pollution in the Ratanpur Khal and to monitor industrial effluents.

Industrial effluents, an unwelcome consequence of economic development and growing industrialization in Bangladesh, are widely threatening local fisheries, wetlands, water supplies, and human health. In 2001 MACH completed the first phase of the special pollution project in March and held a final workshop in June. MACH is awaiting the arrival of ISMP funds before undertaking additional activities. Leveraging ISMP funds, MACH and BCAS in 2002 encouraged the Stockholm Environment Institute (SEI) of York University in the United Kingdom to undertake the DFID-funded project "Managing Water Pollution from Small-Scale Industries in Bangladesh" in MACH areas. That program began in early 2003 and will continue through 2005.

Pollution problems. The Khaliakhair project area is home to eleven industrial plants. Further industrial expansion is expected. The polluting industries identified were Apex Tannery, Aymon Textile, Rahim Textile, Gumti Textile, Bangladesh Thai Aluminium, Devine Textile, Newtex Mill, Uttra Textile, Apex Weaving, Purbani Fabrics, and some 300 poultry farms. Most of the resulting effluents flow into Ratanpur canal, which then discharges into Mokeshh Beel and thence into the Turag River, which in turn connects with the Buriganga and Shitiylaka Rivers.

MACH and the follow-on DFID-funded SEI program have documented problems caused primarily by effluents from these plants. Analysis of wastewater and sediments near the discharge points of some local industries indicate that industries are discharging toxic sulfides, possibly heavy metals and other chemicals in contravention of national and international standards. The heavy metals identified are, if the analysis is correct, in concentrations that far exceed national and international standards, including cadmium, chromium, lead, arsenic, and zinc. High levels of petroleum distillates, dyes, and sulfites also exist, as well as high chemical and biological oxygen demands and pH (see MACH 2000 Annual Report). In all cases, the concentration of heavy metals, sulfides, and biological and chemical oxygen demands were found to be higher than allowed by national standards. Significant seasonal variation was also observed; the pollution level was naturally higher during the dry season. The Ratanpur Khal is biologically dead for much of the dry season.

Apart from a lack of treatment, it has been found that much of the pollution results from poor industrial processes, particularly dyeing. Plants are inefficiently run, and manufacturers practice false economies using poor dyeing regimes, poor use of water and power, poor quality dyes, and improper chemicals, resulting in large amounts of poisonous effluent flowing into streams. Within the factories exists a general lack of professional personnel and understanding of the chemistry behind the manufacturing processes.

Pollution has many technical aspects, but is at heart, like other environmental problems, a governance issue. In the long term, national and local land use management and zoning ordinances require effective implementation.

Activities and achievements. In 1999–2001, MACH undertook activities to identify problems, begin a dialogue with industry, and undertake efforts to identify biological and in-house technical methods to clean up the pollution. "End-of-pipe" samples of the most polluting industries were tested. Sampling and measurement of contaminants was conducted in the water and sediments of the Ratanpur Khal and Mokhesh Beel. An environmental inventory was undertaken in two textile and dyeing units to assess and benchmark the environmental performance of these industries and provide draft suggestions to clean up operations. In addition, workshops were held first with community members, industrialists, and then, at the end of the first phase, a combination of government, industrialists, and community members. A final report was drafted and submitted in April 2002 and is available from MACH.

In addition, an experiment was conducted using large clusters of water hyacinths placed at different points in the *khal* to assess the extent of absorption of heavy metals and other pollutants. The results were encouraging and are to be found in the "Final Report on MACH-Kaliakor Pollution Project", April 2002.

MACH took up two other pollutants in the study area, poultry farm wastes and kerosene. Several poultry farms in the area fail to dispose of poultry wastes properly. MACH succeeded in convincing one of the larger farms, Kajoli Khamar, to use their poultry waste to produce biogas for their internal use. MACH through the Farmer-to-Farmer (FTF) program, funded by the United States Department of Agriculture, worked with a poultry waste specialist to meet with smaller farmers to identify means for safely disposing of wastes. These mainly involved composting. MACH also convinced farm owners to use a degradable kind of chemical, not DDT, to curb the fly problem. Kerosene use in some textile factories to rinse fabric after dying had affected the odor of fish caught in Mokesh Beel. MACH was able to convince the users to replace kerosene with an environmentally friendly chemical, Albatose SE. This has drastically reduced the kerosene concentration in Mokesh Beel and Ratanpur Khal and improved water quality.

Findings from MACH phase I pollution issues. In general, MACH recommends a bottom-up participatory community-based approach to resource management; however, in the case of industries and industrial pollution, community action has had little or no influence on the activities of industrialists. Ongoing publicity campaigns in national dailies, legal action by national dailies, and attempts to work directly with the industries have not been as successful as hoped. It is unlikely that a community-based approach by itself will be fully successful in reducing effluents.

MACH in its relations with industrialists purposely took and continues to take a nonconfrontational approach, attempting to establish rapport that will encourage their cooperation. Industrialists work with MACH on a voluntary basis. These industrialists sometimes also include some of the most politically powerful people in the country. It has become apparent that this approach is only partly successful.

Bangladesh has the national legal framework to control industrial pollution. At present DOE is the only body empowered to bring prosecution under environmental legislation and regulation; however, enforcement of existing laws and regulations does not happen, primarily

due to lack of DOE capacity in terms of political will, qualified manpower, and physical resources.

MACH has found that industries pay lip service to environmental issues; some industries go so far as including effluent treatment plants and in some cases even meeting with the Bangladesh Environmental Conservation Act of 1995 and Environmental Conservation Rules of 1997. These treatment plants, however, not operated and environmental management plans are not implemented. As for many environmental issues, a lack of accountable local and national government agencies and effective local planning and zoning ensures lack of change. Pollution has many technical aspects, but at heart, like other environmental problems, is a governance issue. Given current realities, it is admitted by most industrialists and agreed by environmentalists that:

- In the short term, control of industrial effluents will only occur when required by buyers or their host nations or encouraged by international bodies such as the World Trade Organization.
- In the short term, some reductions in effluent are possible through better industrial practice.
- Independent third-party audits leading to performance as well as management certification are an essential prerequisite. In the long term, empowerment of elected and accountable local government to determine community land use, based on national goals and standards and backed up by aggressive GOB regulators, is a fundamental requirement.

MACH-SEI collaboration. In addition, MACH responded positively to a request by DFID to work with SEI-York on a community-industry pollution abatement program in the Khaliakhair. MACH will fund this through ISMP.

This project, funded by DFID under the Knowledge and Research Programme, is being conducted by a multidisciplinary research team from SEI, University of Leeds, and BCAS. The project is being undertaken in collaboration with MACH.

Many of these factories are owned by powerful and influential people who can deter any investigation of their factories. Improving the situation requires a participatory approach to working with industry to reduce future pollution levels and mitigate present and future effluent levels. The project is working with industrialists to develop an appropriate method for determining the type and level of water pollution from industrial operations, leading to adjustments to production processes to reduce future pollution. Methods to treat the residual pollutants are also being developed. As pollution levels are reduced, water quality will gradually improve. If this takes place to a significant degree, the associated aquatic ecosystems will begin to recover and with time livelihoods that draw on water resources will be enhanced. Major MACH interventions using ISMP funds will include, but are not limited to:

- Consolidation of earlier activities
- Provision of technical support for pilot treatment that will economically reduce biological oxygen demand, color, and heavy metal concentrations
- Exploration of establishing an “artificial wetland” to reduce pollutants.

3. Wetlands Valuation Study

A study was undertaken to develop a methodological framework to calculate an estimate of the economic value of the MACH Hail-Haor wetland. The estimated value in this study should be considered a conservative lower bound to the wetland's economic value. Estimation of wetland value is an important and complex task that has not been previously addressed in Bangladesh. To justify water resource preservation and investment to improve productivity, it is important to establish that sustainable management of water resources results in generation of economic value that exceeds the economic value produced under alternative arrangements.

Wetland areas produce a wide variety of economic benefits. Some benefits can be more readily identified and quantified than others. Direct benefits such as fisheries and aquatic vegetation production and products can be estimated from sample surveys and monitoring of beneficiaries. Other benefits, such as recreational value, flood control value, water quality improvement, pasture value, biodiversity, and water table impacts, have real and significant economic value, but are much more challenging to estimate. Failure to include the economic value of all wetland outputs has clearly biased development efforts in Bangladesh toward conversion of wetlands to agricultural use and neglect of wetland areas.

To facilitate application of the approaches developed for this study, a bioeconomic model was developed. It is an Excel-based application that can serve as a tool for researchers and practitioners in understanding, refining, and extending the economic analysis performed for this study relating economic and biological parameters.

Results. The annual economic output value estimated for Hail-Haor is Tk 454 million ($8 million). The net present value of this benefit stream during 15 years is Tk 4.7 billion ($83 million). Table 39 presents the net annual value of nine selected Hail-Haor wetland economic outputs. Value is presented in both absolute terms for Hail-Haor and per hectare of the Hail-Haor maximum area. It should be noted that the per hectare values are for the total Hail-Haor output divided by the maximum Haor area. For this calculation, the recorded 1999 maximum water area was used (12,300 ha).

Table 39: Annual Value of Estimated Hail-Haor Economic Outputs

Hail-Haor Returns	Total Returns *(taka)*	Current Returns *(Tk/ha)**	Percent
Commercial fisheries	56,272,221	4,575	12.4
Subsistence fisheries	83,651,052	6,801	18.4
Nonfish products	126,056,499	10,248	27.7
Recreation	7,025,634	571	1.5
Flood control	23,443,167	1,906	5.2
Tea estate vegetation use	1,916,761	156	0.4
Project/biodiversity funds	43,650,600	3,549	9.6
Transportation	8,758,318	712	1.9
Pasture value	40,292,840	3,276	8.9
Boro rice value	63,857,500	5,192	14.0
Water quality	Not Done	Not Done	
Aquifer charge	Not Done	Not Done	
Existence values	Not Done	Not Done	
Total *(taka)*	454,924,591	36,986	
Total *(dollars)*	$7,981,133	$649	

* This figure is total output value divided by total *haor* area (12,300 ha recorded in 1999).

Commercial fishing represents 12.4% of total value, and subsistence fishing accounts for 18.4% of the annual Haor value. Significantly, the annual value of nonfish aquatic products, including aquatic grasses, plants for human consumption, snails, mussels, and other products, is 28% of the total value. This is the largest single economic output. The importance of dry season pastureland is, at 9% of total value, also very significant. The share of value for recreation and flood control are, respectively, 2% and 5%. It should also be noted that the current value of *boro* rice produced within the Haor wetland area is included (Tk 63 million).
The development project investment attributed to biodiversity preservation is Tk 43 million (9.6%). This represents the discounted value of the MACH project investments and likely foreign development assistance to be provided to Bangladesh due to the biodiversity aspect of the Hail-Haor wetland. A number of foreign aid programs and efforts (International Union for the Conservation of Nature, WorldFish Center (ICLARM), DFID, and DANIDA) strongly emphasize investment for biodiversity preservation.

The estimated annual values for wetland economic outputs are very conservative, because important economic outputs such as water quality improvement and aquifer charge were not included, but represent significant economic outputs. It should also be noted that the Hail-Haor has already been substantially degraded from overuse, loss of water body connections, water diversion, pollution, conversion to *boro* rice, and sedimentation from mismanagement of the surrounding watershed. This means that the value of wetland economic outputs would be much greater for a healthy ecosystem managed sustainably.

Table 40 presents the value of output for specific category groupings of economic outputs. It is significant to note that both overall value per hectare Tk 36,986 (see table 39) and returns to wetland natural outputs Tk 31,794 exceed the value of *boro* rice production, Tk 18,254 per hectare (BBS 1999). This strongly shows that maintaining and managing wetland resources offers higher economic benefits than conversion of wetlands to *boro* rice production. It should be noted that this comparison is done on the basis of net economic returns. It was

beyond the scope of this study to estimate value addition by each economic output. The value added, from Haor economic outputs, however, will exceed *boro* rice value added because *boro* rice cultivation requires costly inputs (fertilizer, seeds, and insecticides), whereas harvesting for the majority of *hoar* outputs requires little capital and cash cost.

Table 40: Hail-Haor Economic Value by Output Groupings

Groupings	**Current Total Returns** *(Taka)*	**Current Returns** *(Tk/ha)**	**Comments**
(1) Returns to wetlands	391,067,090	31,794	Returns without *boro* rice value
(2) Returns to wetlands (no biodiversity)	347,416,491	28,245	Returns without project funds and *boro*
(3) Returns with no biodiversity funds	411,273,991	33,437	Returns without project funds

The economic returns to the MACH project were also estimated using the bioeconomic model. Table 41 presents the key parameters and results of this analysis. The parameters used were highly conservative. It was assumed that the project would bring into place an annual increase in productivity for natural resources of 2% a year and prevent a degradation of 3% a year during the next 15 years. Based on these conservative estimates of productivity improvements, the B/C ratio is 7.4 and the IRR is 63% for the MACH Hail-Haor investment. An IRR of 63% for a project tasked with developing approaches to improved wetland management is highly significant.

Table 41: Returns to MACH Hail-Haor Investment.

Parameters	**Annual Project Caused Increase** *(percent)**	**Annual Project Caused Loss Avoided** *(percent)**
Fisheries	2	3
Nonfish products	2	3
Recreation	5	0
Results		
B/C	7.4	
IRR	63	

Note: The time horizon 15 years, and the MACH investment is $2.2 million, with a one-year delay in benefits.

III. PROJECT PERFORMANCE AND IMPACT

A. Performance in Meeting Project Targets

The original project indicators were changed midway through the project by the SO6 Environment Team. Some of the original indicators of project success were dropped, or they were shifted up or down depending on their perceived importance. The performance of the project is discussed below in relation to the changed set of indicators established in November 2001.

Indicator 6.a. *Extent to which best practices from USAID funded projects are used elsewhere.*

This indicator was not one of the project's original strategic objective indicators. It was added in November 2001 during revision of the performance indicators by USAID. It should be noted that the project cannot force others, particularly other projects, to use approaches found successful in MACH.

MACH has continued and continues to demonstrate to others through example and field demonstration. MACH is also the founding member of the Bangladesh Wetland Network in which, as described earlier, all major and minor organizations involved in resource management, particularly in wetlands, meet and exchange ideas and develop policy recommendations for government.

As the project cannot guarantee that other programs and groups will take up the approach, this indicator is termed a "special status" indicator.

The examples of "best management practices" specified in the performance monitoring plan are:

- Comanagement of natural resources
- Sanctuary development
- AIGAs for natural resource–dependent populations.

The unit of measure is the number of times these are used by other organizations (i.e., projects, NGOs, GOB, and communities).

The approaches and best practices most widely adopted elsewhere are:

- Sanctuary establishment and shelter provision
- Restoration of wetland *beel* habitat through deepening
- Restoration of terrestrial and wetland tree habitat
- Comanagement/local government involvement in resource management
- AIGAs
- Establishment of river sanctuaries.

Volume 4 presents details of the extent or number of times any of the above have been used elsewhere.

Indicator 6.b. *Increased production of natural resources (fish and trees) in targeted areas.*

With the high degree of hydrological variability in the floodplain, it has been recommended that this indicator be used to look at gross trends only. Volume 3 and volume 4 of this report present detailed results of fish catch monitoring. Based on the catch survey, it appears that fish catch has gone up during the short life of the project, in some cases quite significantly. Based on monitoring done by the project and anecdotal evidence provided by local fishers, provision of sanctuaries, restricted fishing during critical periods, securing increased dry season water, and reintroduction of lost species have evidently all contributed to increased fish yields and consumption in the three areas. Fish yield increases have occurred in all MACH project areas during the life of the project. The increases have been on average more than 70 kg of fish/ha/year for the three sites, resulting in as much as 1.8 million kg of new fish produced. Volume 3 and 4 present the full details of the fish catch study. In addition, more than 330,000 trees have been planted, which will provide significant wood yields and habitat benefits in the years to come. A total of nearly 500,000 indigenous fish have been reintroduced into MACH areas by the project, many of which have reestablished themselves, adding to production and diversity.

Indicator 6.c. *Conserve existing and increase future biodiversity in targeted areas.*

The timeframe set for the project is far too short to be able to see diversity changes from habitat improvement, which takes years to occur. Recognizing this, the project has created, for example, sanctuary areas within the wetlands and reintroduced species of fish and trees that used to exist on the site, but no longer do. By providing early protection in the preferred areas of these species, it was hoped that reestablishment of some would be jumpstarted. The project is doing this with some species that can naturally reproduce within the floodplain and do not rely on the river. This has been particularly successful with a number of native fish species such as *shol, gozar, poda, pabda, meni, sarputi, foli, gonia,* and *kalibaush*. Volume 4 provides additional details on performance monitoring. MACH has seen species diversity increases from reintroductions. The reintroduced species have reestablished themselves and exceeded the planned targets. Diversity should increase further in the future as large permanent sanctuaries become established.

Indicator 6.1a. *Area of floodplain where sustainable management is implemented.*

Through formation of RMOs at the local level, the major areas of the wetlands where MACH has worked have been incorporated into management plans that have successfully established best management practices in more than the targeted 15,000 ha of area. This indicator has been fully completed with more than 18,000 ha under improved management. A total of 42 RMOs of different types have been established. In MACH phase II, the existing organizations will be further strengthened. The details of the coverage, including maps of the areas covered, refer to volume 4 on performance monitoring.

Indicator 6.2a. *Aquatic habitat converted from seasonal to perennial in targeted areas.*

The increase in perennial wetland area will likely have some of the most pronounced and prolonged impact on the function of the wetland and thereby fish production and diversity, an important indicator of success that has been fully accomplished by the project. MACH has exceeded the target set and has continued to establish additional perennial water area through the recently provided local currency fund of the GOB. A total of 236 ha of water body area have been converted from seasonal to perennial. Significant conversion to perennial water is

anticipated to continue through the future MACH phase II program. This intermediate results indicator was not one of the original project indicators of success.

Indicator 6.2c. *Riparian habitat improved in targeted areas (ha/km).*

This intermediate results indicator was not one of the original project indicators of success. MACH was not obligated to perform in this area, but because of the importance of the watershed and in particular the riparian area, MACH has put resources forward on selected demonstration *charas*. The planned levels are all additional to what was originally set out for the project in the way of outputs.

Benefits accrue to both the communities managing riparian habitat, in terms of the trees' future value, which is considerable, and to the stream itself through improving bank stability. The trees provide structure to the stream banks and income to the communities that was previously not there. Additionally, the riparian area, when mature, provides potential movement and shelter corridors for birds and other animals (forest to wetlands). MACH exceeded the targets set despite the late arrival of local currency funds with more than 160 km of riparian area planted with 55 different species of trees.

Indicator 6.2.1a. *Number of sanctuaries established.*

Sanctuaries are important today because of the extreme loss of habitat for fish in the dry season. The sanctuaries form a very important link for replenishing the stocks of fish in floodplain ecosystems.

The number, location, and size of the sanctuaries established by MACH can be seen in volumes 2 (in the list of sanctuaries) and 4 under indicator tab 6.2.1 a. All the sanctuaries have been established based on RMO decisions and long-term plans. Brush piling with tree branches, bamboo, and concrete structures has been made in all sanctuaries to improve habitat quality as well as protect fish. Signboards, slogans, and red flags have been erected at sites to draw the attention of local people. MACH has also supported the RMOs in using, for the first time, permanent structures (concrete hexapods) to create shelter for fish and aquatic invertebrates as well as provide permanent protection from inadvertent or planned netting. The RMOs using MACH support have established 66 sanctuaries, although the original target of the project was 50. Eight of these water areas have been permanently declared by the MOL to be sanctuaries.

Indicator 6.2.1b*. Meters of channels rehabilitate.*

This intermediate results indicator was not one of the original project indicators of success. The project has restored only those channels or canals that will not alter the wetland area that currently exists and rejects any excavation or restoration that would reduce the size of the wetland area. Only those channels that will allow for improved migration of fish among *beels* have been rehabilitated. Rehabilitation to make certain portions deeper to serve as refuges for dry season fish stocks has been advantageous to production. A total of more than 11,000 m of canal have been reexcavated.

Indicator 6.2.2a. *Income of targeted beneficiaries.*

The intention all along for this indicator has been the consideration of MACH alternative or supplemental income, recognizing that the reduction of fishing pressure during critical periods is a key element to the revival of the floodplain. MACH in the beginning of the project suggested that the credit program seek to increase alternative or supplemental incomes by 50% or more. The overall finding of both MACH surveys completed by CARITAS and RMC/Socio-consult was that project credit is having a positive impact and exceeding planned targets. In MACH phase II the program will use more quantitative targets to track credit activities. The results of the surveys can be seen under indicator 6.2.2a of volume 4 on performance monitoring.

Indicator 6.3a. *Lease of water bodies to community resource management groups granted in targeted areas after a reasonable time period.*

Some of the critical water bodies in the floodplain areas of MACH sites have been leased for up to 10 years to RMOs by the MOL in collaboration with the MOFL. In addition, MACH has been successful in getting the GOB, through the MOL, to grant MACH community groups perpetual rights over eight areas in MACH wetlands. These eight locations will be permanently secured as sanctuaries.

MACH has also worked through its connections at the site level and within the MOL and MOFL to promote removal of the current 25%/10%/10% increases that the MOL imposes on the lessees of the water bodies. this policy of increasing the lease rate every year has been detrimental to the resource and has promoted the "take everything" attitude prevailing in MACH areas at the beginning of the project. The MOL has reduced the percentages and for the first time dropped the entire lease value of a *jhalmohol* for MACH groups for a permanent sanctuary status.

MACH currently has 24 water bodies granted by the MOL to RMOs formed in MACH areas. Eight of these have been granted for use by the communities as permanent sanctuaries or conservation areas. Although this was not one of the original indicators, the planned accomplishments have been achieved.

Indicator 6.3b. *Number of communities adopting two or more of the following key regulations in targeted areas.*

The communities have adopted time closures for fishing during the critical premonsoon season for varying periods of up to three months. The time closure varied among the sites, as variation exists in the inundation period. In Hail-Haor, the time closure is typically for a period of three months from March to May, whereas in the Turag-Bangshi and Kangsha-Malijhi, it is from April to June.

The communities have also instituted regulations on harvesting of fish fry within their management areas. The communities have monitored and regulated the destructive harvest of certain species that have schooling young. With local government support, the communities are limiting small-mesh gill nets according to the countrywide ban.

Communities through RMOs have adopted regulations preventing fishing in sanctuary areas and secured a minimum buffer of 200 ft around *beel* sanctuaries. This has been done to prevent gill netting of species coming in and out of sanctuary areas. In river sanctuaries, communities have regulated fishing within and 200 m on either side of sanctuaries.

A total of 103 villages have now adopted resource management regulations, and the project has met its target for this indicator. The project has defined the number of communities to be those villages surrounding the critical resources adopting management regulations. Within managed water bodies, the communities have stopped dewatering in the dry season as a method of fishing. Dewatering was particularly destructive as it claims all species and generally all fish in an area.

Indicator 6.4a. *Number of individuals reached by public awareness activities.*

During the project period, more than 300,000 people in the resource management area took part in the project and RMO-sponsored awareness programs. These programs have taken place at all levels, including the para, village, union, upazila, and district. School-level programs and dramas, fairs, and exhibitions were also forums for awareness building, for the environment and wetlands in particular.

MACH has conducted continual awareness campaigns at the central government level, resulting in significant policy changes, particularly at the MOL. MACH has worked extremely hard at educating senior officials in government on the benefits of proper resource management through workshop and field visits. MACH has conducted awareness-building field visits and made critical presentations seeking policy changes, particularly regarding land and water leasing policies. MACH through its awareness programs has achieved permanent sanctuary status for eight water bodies in the three project sites. This is the first time that the MOL has foregone revenue for a conservation measure.

MACH has also worked hard through many workshops, cross visits, special functions, and LGC meetings to convince local administrators of the need and value of community-based comanagement of natural resources. This target has been fully met.

Indicator 6.5a. *Improved wetland management in stitutional capacity.*

This intermediate result of "improved institutional capacity" was not one of the original indicators of success and was to be determined. Volume 4 presents an indicator on "number of local government meetings where resource management issues discussed and the process institutionalized." No previous targets were set for this, but the numbers and a brief description of the activities can be found on tab 13 of volume 4.

B. Impact on Project Areas

A major impact on the areas has, of course, been the increasing trend in fish production at all MACH sites. This is reflected not only in the data, but in year-to-year anecdotal evidence from fishers and community members. For example, in the Turag-Bangshi site in certain areas of Mokes *beel*, aquatic plants are proliferating for the first time in many years due to the restricted netting imposed by the community on themselves. This has increased habitat, which likely has allowed for better survival of juvenile fish and shrimp. Blooms of certain species that benefited from this were seen in both the catch data and from observation of the general trend. Overall fish and plant diversity has also impacted the yields as well as increased fish available for consumption. Fish consumption has increased in the management areas, which heavily benefits the poor; the very poor are reaping more than 60% of the benefits.

All of the project areas have been positively impacted by reforestation programs and stocking of indigenous and often *beel* resident stocks that have been lost.

MACH has been able to demonstrate an approach that brings the community-based RMOs together with local government authorities in an integrated planning and implementation framework. This comanagement between government and local communities is a model through which integrated resource planning can be conducted successfully. A good example of the impact of this coordinated planning at the local level has been in conflict management and resolution and establishing from the ground up permanent sanctuaries in each of the areas.

The project has impacted the lives of more than 4,500 of the poorest families through its AIGAs, which included training, credit, savings, literacy, health, and sanitation. Project impacts have come from more than 900 demonstrations, followed by numerous farmers' field days. Both the communities and local government have widely accepted the project, and improving trends in the fisheries have positively impacted the attitudes of the communities for continuing their management role.

C. Impact on Other Projects and Institutions

MACH has worked hard to demonstrate successful comanagement of wetland resources in major floodplain areas in Bangladesh. The project has been termed by the director general of fisheries as one of the DOF's most successful projects. MACH has provided guidance in development of strategies to be followed in the future in open floodplain resources. MACH's work with both the wetland network and the Fishery Sector Review has led to development of pro–resource management improvement strategies for the poor and those dependent on open access resources. MACH has had major impacts on water body–leasing policies and procedures of the government through its awareness and knowledge-sharing campaigns. Impacting the MOL has translated into real benefits to major fishery resources and the communities that depend on them. The project through its physical restoration work has impacted government at both the local and national levels so much that the government has allocated funds to continue this work into 2005.

Because of MACH's successful approach, the NGOs working within MACH are exporting the ideas to other programs of a similar nature in which they are involved. Examples of this are CNRS and CARITAS, as they are also involved in Community-Based Fisheries Management (CBFM), Sustainable Environmental Management Programme (SEMP), and parts of the Fourth Fisheries Project. BCAS also retains some key positions in projects such as the Fourth Fisheries Project, which has exchanged staff with MACH.

The second phase of the CBFM project has incorporated elements not in the first phase, but do exist in MACH. Their project review recommended and the project has accepted the need for closer project links to local government institutions where they are working. CBFM is also relying on the same group of national NGOs as MACH; the approaches they use will be successful elements used in MACH. The CBFM review referred to the MACH project approach with local government as one they favored adopting. For additional examples of where MACH has impacted other programs, refer to volume 4, indicator 6a.

IV. SYNERGIES AND COLLABORATION WITH OTHER PROGRAMS

To further its goals for improved management of Bangladesh's aquatic resources, MACH is collaborating with a variety of GOB agencies, national and international NGOs, donors, and other USAID projects. A major success of MACH has been its ability to spread its message and engage in collaborative associations with both national and international groups. Major efforts in this regard include the Bangladesh Wetlands Network as mentioned in the policy section, support to the "Fisheries Sector Review and Future Development" study (see below) as well as the ongoing program undertaken with DFID and SEI called, "Managing Water Pollution from Small-Scale Industries in Bangladesh." In addition, MACH has made a sincere effort to work with other USAID programs as well as other donors working in areas of concern to MACH.

A. Other Donors

MACH has pursued collaborative partnerships with a number of other donors. Most important, in the last year MACH has encouraged and DFID has agreed to fund a collaborative project entitled: "Managing Water Pollution from Small-Scale Industries in Bangladesh." This program has and will continue to work jointly with MACH as well as industries in the Turag-Bangshi basin that pollute MACH project wetlands. The program has worked collaboratively with MACH and is conducted by SEI-York. The focus of the program has been and will continue to take MACH efforts in the pollution area and expand on those efforts. Activities involve cleaner production, as initiated by MACH, and low-cost effluent treatment efforts. In addition, efforts have and will continue to be made to work with buyers and concerned GOB agencies.

In addition, project collaborations have also occurred between MACH and the DFID-funded CBFM project, the CIDA-funded Dampara Water Management Project (completed in 2003) and the ongoing World Bank–financed Fourth Fisheries Project (GEF and non-GEF) of the DOF. MACH has worked closely with the DANIDA-funded DOF extension programs in Mymensingh, Nohakali, and Patuakhali-Barguna. In addition, MACH has worked with the DANIDA-funded planning support to the MOFL. All of these have and will continue to receive full MACH field and data support in MACH phase II.

MACH has had visits from international groups of fishers, fisheries professionals and others from Mexico, Brazil, Vietnam, and Nepal fishers and fisheries experts supported by DFID, International Union for the Conservation of Nature, DANIDA, and FTF. Volume 2 of this report presents a full list of all the visitors to MACH sites. MACH has worked with CARE Bangladesh (DIFD funded), which provided training and support for MACH cage-culture activities. MACH is also cooperating with the Centre for Environmental Geographic Information Systems that evolved from the USAID-funded Irrigation Support Project for Asia and the Near East (ISPAN) program. MACH and the center shared the costs of Landsat images to be used in determining the actual decline in wetlands area during the past 20–30 years.

MACH used the relevant experiences of other programs to promote project goals. Foremost among these was the 15-year Watershed and Wetland Restoration Project on the Owens River of Eastern California conducted by Ecosystems Sciences. Additionally, MACH has gained from the experiences of the World Bank–funded Agriculture Research Management

Project. Many of the fisheries and other relevant research produced by that project has benefited MACH.

Fisheries Sector Review and Future Development Study. In 2001 the fisheries LCG suggested a need for a major review of the fisheries sector. The World Bank produced the last review of the sector, which took place in 1990. MACH attended the LCG fisheries forum on behalf of USAID. MACH encouraged an approach that included joint participation by a number of donors to ensure wider dialogue and acceptance of recommendations by both GOB and donors. The program was eventually funded by DFID, DANIDA, and USAID; supported by the World Bank; and approved by the LCG. A special GOB steering committee was formed by the GOB to deal with this year-long program.

The review, entitled "Fisheries Sector Review and Future Development Study," involved a year-long study that produced 17 sector papers, five theme documents (economics, legal, livelihoods, policy, and institutions), and a summary document. The main recommendations have been available and shared since December 2003 in a number of meetings and documents. The draft document was approved by the LCG and was printed and forwarded to the MOFL in June 2003. This challenging sectoral review has been working with the GOB and donors to review the sector and produce a series of recommendations and roadmap for the future development of the sector.

The review's documents should be considered the first step in a process, not a final outcome. The findings and recommendations will require review by the DOF, MOFL, and other GOB agencies; it is hoped that further dialogue will be shared in 2004 with civil society, fishers, and others in the industry . MACH phase I through phase II expects to continue to support the review and efforts for dialogue through the wetlands network, DOF, MOFL, and others in the donor community. Through MACH, USAID has been a partner in this process of review and development of recommendations for the sector.

B. Arannayk Foundation

The MACH senior natural resource advisor (SNRA) and MACH have provided the primary development and backstopping support that has allowed formation of the Arannayk Foundation (Bangladesh Tropical Forest Conservation Foundation). MACH has been directly involved in all steps involved in forming the foundation:

- Supplied logistical support for the two BIFOR missions of Chemonics International, including providing information, documents, and contacts and arranging trips and meetings.
- Served as the primary source of contact with the NGO community and provided detailed information on the proposed sites.
- Involved directly in developing the memoranda and articles of agreement that formed the legal basis of the foundation.
- Identified and financed the activities of the attorney used to develop the MOA and AOA.

In addition, SNRA assisted in developing the terms of reference for board members and was responsible for placing advertisements and short listing potential board members for approval by the GOB and USAID. SNRA was also involved in the work of the two missions by Chemonics International, one in 2000 and the other in 2001–02, to strengthen and prepare for formation of the foundation. Both teams used the administrative services of MACH in

implementing their programs. Many of the recommendations found in the organizations documentation are a result of discussions with the MACH team and the SNRA.

C. USAID Tropical Forest Program

The new USAID Tropical Forest program is modeled after MACH. MACH provided support to this program in its conception phase, providing field, office, and administrative support to the design team. When the commercial implementation group from IRG arrived, MACH again provided administrative support in terms of personnel policies, arranging reservations for site visits, providing documents and otherwise supporting the startup of this project. In addition, MACH has provided project documents and other materials.

D. Synergies with other USAID Programs

MACH has made a major effort to work with other USAID programs. MACH has pursued FTK, Helen Keller International (HKI), CIMMYT, Asian Vegetable Research and Development Center (AVRDC), Agro-Based Technology Development Program (ATDP I and II), the current ARD Democracy Program, CARE, the Job Opportunities and Business Support (JOBs) program, and others. MACH continues to work and is appreciative of the cooperation it has received, particularly from CIMMYT, ICLARM, CARE and the ARD Democracy program.

MACH has received a great deal of support from CIMMYT and as a result continues to conduct a large number of farmer demonstrations in wheat and maize. MACH's interest in crop diversification is related to the high amounts of water required for *boro* rice when compared with wheat or maize. MACH encourages crops that use less water from dry season wetlands. ATDP I introduced *guti*-urea, a pelleted form of urea that releases less nitrogen into the environment than broadcast urea. As a result, MACH conducts demonstrations in the use of this fertilizer. AVRDC worked in the production of vegetable seed and cooperated with MACH. Vegetable production can be a year-round source of nutrition to poorer households and commercial production a source of year-round income. In addition to AVRDC, MACH utilized seeds and educational materials provided by HKI in its home gardening–vegetable nutrition program. In the year 1999 and 2000, several MACH workers were allowed to attend JOBs entrepreneur training. In 2002 MACH held discussions with ARD and, as a result, encouraged NGOs to submit proposals for funding under the ARD small grants program. One NGO, Friends in Village Development in Bangladesh received a grant to work with community-based organizations and the UP in MACH areas in Sreemangal.

MACH recognizes that natural resource issues in the Bangladesh context cannot be solved without taking into account all the issues affecting the resource. MACH lacks the resources and authority to work in areas outside its natural resource mandate. MACH has welcomed (and will continue to welcome in MACH phase II) additional support in three critical areas:

- *Democracy,* particularly support for capacity building of UPs and local CBOs
- *Education,* particularly adult literacy directed at fishers and other resource users
- Job creation and enterprise development
- Land tenure and land use planning.

Regarding the latter, the GOB needs support to modernize its methods of land mapping and registration. MACH and Winrock have significant land-use planning experience, but this needs institutional backing to be fully effective. Land and the existing nontransparent means of registering and transferring land is a continuing problem throughout the country.

In the five years of MACH's existence, not one USAID project approached MACH to ask for its cooperation. If USAID wants cooperation among programs, it needs to require this of partners and contractors. USAID could, it is hoped, identify a staff member specifically to identify areas of cooperation and ensure this cooperation actually occurs.

E. Farmer-to-Farmer Program

MACH has greatly benefited and obtained considerable support from the Farmer-to-Farmer Program. FTF has provided a specialist on poultry farm waste management, skilled volunteer in pineapple/lemon farming, watershed management specialist, improved poultry management and fish production specialist, and IPM specialist. FTF provided MACH with a volunteer in tilapia production, and MACH jointly conducted a workshop with ICLARM and FTF in Dhaka on tilapia with the FTF volunteer as the keynote speaker. The FTF collaboration has been particularly valuable for MACH and in some cases resulted in significant benefits to producers and recipients.

Of particular note have been the contributions of the FTF volunteer in pineapple and citrus production, Mr. Roy Beatty, who has twice visited Bangladesh. Mr. Beatty, a former manager of Dole Pineapple plantations throughout Africa and Hawaii and a noted citrus expert provided the impetus to MACH's successful contour pineapple program, which, as described above, is working to change the traditional vertical planting method to using better quality plants along land contours, significantly reducing erosion on steep hillsides. Because of the pineapple specialist, pineapple growers in Sreemangal have been able to increase net returns by more than Tk 50,000 per acre.

F. Bangladesh Wetlands Network

MACH has been instrumental in encouraging policy-level coordination among the GOB, wider NGO community, and donors in the sector. With the International Union for the Conservation of Nature, BCAS, and the World Bank, MACH encouraged and was instrumental in forming the Bangladesh Wetlands Network. The network is a loose confederation of 30 institutions and organizations in Bangladesh actively involved in floodplain and wetland management projects. This combination of concerned government agencies, NGOs, projects, and donors are working together to share experiences and jointly pursue mutually beneficial policy changes.

MACH has been active with other partners and will continue to be active in the network's activities. This has taken the form of regular meetings to present findings and new information; a national conference on wetlands issues attended by a range of concerned ministries, department, and other stakeholders; and, most important, use of the forum to pursue policy issues jointly at the national level.

V. FINANCIAL RESOURCES UTILIZED

Project funds were administered in accordance with the terms and conditions set in USAID 22 CFR 226, entitled "Administration of Assistance Awards to U.S. Nongovernmental Organizations." The sole responsibility for fund distribution and the financial authority resided with the grantee, Winrock International.

Winrock submitted a "Financial Status Report" (SF269a) on an actual basis and quarterly to USAID/M/FM/CMP and USAID Dhaka. Moreover, Winrock and its partners were also subject to standard USAID financial controls, including annual USAID financial audits.

Administrative and financial details through the entire period of the project are not presented here, as the complete expenditures will not be available until the end of 2003. The project will close the books on MACH phase I on October 28 and open new books the following day for MACH phase II. The full financial statement will be provided at the beginning of 2004.

Tables 42 and 43 below show the financial activities and person-months utilized through July 2003 only.

Table 42: Financial Progress, Period Ending July 2003

Line Item	Year 1, 2, 3 & 4 Expenditure 48/M *10/1998–09/2002*	Year 5 Expenses 10/M *10/2002—07/2003*	Expenses 58/M *Total to 07/2003*	Percent of Budget spent *Total Budget*
Salaries & fringe benefits	980,634	125,319	1,105,953	90
Short-term specialists	39,279	-	39,279	88
Travel and per diem	53,992	6,991	60,983	87
Allowances	287,885	66,340	354,225	96
Procurement	217,810	28,028	245,838	96
Project activities: GIS	97,402	99,130	196,532	92
Other direct costs	549,325	241,522	790,847	102
Total direct costs	2,226,327	567,330	2,793,657	95
Subcontracts	1,810,582	587,121	2,397,703	95
Indirect costs	793,643	104,678	898,321	87
Total	4,830,552	1,259,129	6,089,681	94
Cost-sharing match	1,476,831	3,120	1,479,951	135
Total project costs	6,307,383	1,262,249	7,569,632	100

Table 43: Utilization of Person Months, Period Ending July 2003

Line item	Status	No. of Persons	Year 1–4 Person-Months Used 10/98–09/03	Year 5 Person-Months Used 10/98–09/03	Total Person-Months Used
WINROCK INTERNATIONAL					
Home office support	ST*	3	13	1.5	14.5
Chief of party/team leader	LT*	2	52.5	9	61.5
Natural resource advisor	LT	1	28.5	8	36.5
Expatriate consultant-ST	ST	3	8	1.5	9.5
Local consultant	LT	1	26	7	33
Local consultant	ST	1	13	6	19
Local consultant, MACH PI	ST	9	137	78	215
Dhaka administration/ accounts/supports	LT	14	396	140	536
Subtotal		34	674	251	925
BCAS					
Sr. consultant	ST	3	24.5	9.5	34.0
Local coordinator	LT	1	37.3	10.0	47.3
Database manager	LT	1	33.5	5.8	39.3
Hydrologist	LT	1	42.1	8.0	50.1
Fisheries policy	ST	1	10.6	2.0	12.6
Ecotoxicologist	ST	2	15.4		15.4
Consultants/others	ST	3	13.1		13.1
Data entry & supports	LT	6	178.2	60.0	238.2
Subtotal		18	354.7	95.3	450.0
CARITAS					
Project officer/coordinator	LT	1	56.91	10	66.9
Field coordinator	LT	2	92.8	20	112.8
Program officer	LT	1	19		19.0
Field officer	LT	5	181.3	49	230.3
Asst. field officer	LT	26	590.5	237.5	828.0
Accounts & supports	LT	37	730.1	351.5	1,081.6
CNRS					
Floodplain ecologist	ST	1	21.1	3.5	24.6
Monitoring coordinator	LT	1	30.3	5.6	35.9
Fisheries biologist	LT	1	24.7	0	24.7
Training coordinator	LT	1	44.5	10	54.5
Natural resource planner	LT	3	139.3	30	169.3
Database programmer	LT	1	49.7	8	57.7
Training & comm. officer	LT	1	42.5	7	49.5
Jr. natural resource planner	LT	4	60.1		60.1
Field officer/field biologist	LT	33	601.4	224	825.4
Data entry & supports	LT	5	48	48	96.0
Consultants/others	ST	4	6.5	2.5	9.0
Subtotal		55	1,068.1	338.6	1,406.7
Grand total		179	3,767.41	1,352.9	5,120.31

* ST stands for “short term,” and LT stands for “long term.”

VI. LESSONS LEARNED AND THE WAY FORWARD

A. Lessons Learned

Bangladesh wetlands, which produce one of the largest freshwater fish supplies in the world, are negatively affected by reduced dry season standing water, reduced river flows, increased sedimentation (very rapid filling in of wetland areas), loss of natural connections between the floodplains and the rivers, significant pollution, and overfishing.

MACH in its inception phase conducted a number of problem identification sessions with communities living in and around the large floodplain wetlands of MACH sites. The problems identified were those that most affect the fishery and wetlands food output. People near the wetlands attributed reduced dry season water and increased filling of deeper areas to heavy sediment loads from upstream watersheds.

MACH hydrological and sedimentation studies helped clarify that dry season water in the wetlands is threatened by lowered river water flows and watershed degradation, which has dumped larger sediment loads into the wetlands than would otherwise have occurred with forest cover. Because of these findings, the communities and local authorities insisted that programs address the upper watershed and reexcavation of holding areas for fish.

Wetlands are valuable.

Early project work and MACH surveys made obvious the value of wetlands, including in providing services to neighboring communities. MACH conducted a wetland valuation survey (see volume 2 for details), whose results indicate a significant per acre value (more than Tk 30,000 a year), from which the very poor reap most of the benefits. The study showed that the very poor depend on wetlands far more than others, because of the open access nature of the resource. This valuation did not take into account the value of the wetland as a filter, that is, its pollution reduction function.

Community-based comanagement works. Community-based comanagement of wetland resources can work to sustain and improve fish production and diversity in large floodplain areas.

"Comanagement" of wetland resources by community-based organizations with local government is key. It works, providing both a potentially sustainable system, in which local government provides direction and support as well as supervision and oversight. Community organizations benefit from this institutional support, particularly on land issues and rights. MACH, in effect, has launched a local-level planning framework.

Sanctuaries combined with restricted fishing works. The best management practices of sanctuary establishment with community-restricted fishing works to sustain and even increase fish catch and fish diversity in large floodplain areas.

MACH has found that best management practices, when put in place by community-based organizations, improves fish catch and the quantity of fish consumed in and around wetland areas. Sanctuaries and community-restricted fishing are two best practices with direct

immediate benefits and returns, as these practices allow for fish populations to grow because of the increase in the reproductive potential of the fish populations in the wetland.

Restoration of critical dry season habitat has significant impacts.

MACH has pioneered the restoration of *beels* and other water areas to promote dry season storage as fish habitat. The restoration of dry season water area and creation of sanctuaries within these areas have allowed fish to survive the dry season. By retaining surface water, these *beels* have retained fish diversity and numbers through to the wet season, when reproduction and repopulation takes place.

Reintroduction of lost species of fish (particularly beel residents) into their habitat can succeed when coupled with sanctuaries, improved management, and habitat restoration.

MACH has successfully reestablished populations of fish (threatened or lost) by combining reintroduction of adults and offspring into year-round sanctuaries and restoring deep *beel* areas. Successful breeding has been indicated by the adults stocked and increase of offspring numbers to a viable level in some MACH areas.

Local communities can achieve policy changes (policy reform) on land and water body leasing through clear plans, local government support for those plans, and a "champion" for change who works with all parties.

MACH has been highly successful in supporting communities in managing wetlands by developing recommendations for management and getting them approved at the local, district, and central government levels. MACH has been instrumental in setting up linkages between communities and local governments by strengthening the ability of communities and local users to take control of resource management. In addition, RMOs with the support of MACH have received long-term leases of valuable water bodies; MACH and other projects have successfully lobbied for reduced rent increases, and permanent sanctuary status has been granted to critical resource areas, benefiting the resource and communities (see volume 4 for more information).

Alternative income generation and training can lead fishers away from sole reliance on fishing for a living to other trades and businesses.

MACH has found that it is critical to offer other options for income and livelihoods to poor resource users in order for community management groups to reduce fishing during critical times. Poor fishers have indicated that MACH training on fishing alternatives has been quite valuable. Also long-term training trades and other opportunities has been well received and helped make younger members of fishing families aware of other pathways to earning a living. In some cases, the alternative income activity has turned into a business and brought enough income to allow poor fishers to leave fishing entirely.

Stakeholder participation is essential for changing management at the level of the wetland resource.

MACH has found that involving all stakeholders is essential to achieving management that is sustainable. The top-down approach has not worked in the past and local-level planning and implementation is the only method that can possibly be sustained, as the incentive is there, if

the planning has been done locally. Integrated planning and management at the local level should be the model for what happens with land and water resources. Stakeholder participation is essential for management actions to take place and be sustained.

Tree and vegetation reestablishment along riparian corridors can produce monetary benefits to communities as well as physical benefits to streams by reducing bank erosion.

MACH and MACH groups have also pioneered this program, which will bring long-term gains by restoring forests along the riparian corridor of rivers, contributing to long-term bank stability and reduced erosion and loss of valuable land; by providing long-term income from the forests themselves for the managing community groups, and by providing wildlife corridors and habitat, leading to increased plant and animal diversity.

B. The Way Forward

The immediate way forward is to secure the sustainability of the institutions established in MACH phase I and further support implementation of the MACH approach in other areas. As a result of recommendations made by the mid-term review, the MACH Steering Committee, and the USAID-led MACH RPT, a MACH phase II has been proposed and was planned to begin on October 29, 2003. The immediate way forward is the same as the objectives of the extension of MACH phase I to a phase II, which are to:

- Ensure institutional sustainability of RMOs and related institutions and RUGs
- Intensify wetland, riparian, and environmental conservation and rehabilitation activities, so impact can be more fully assessed
- Fully establish MACH approaches as replicable models
- Capture entire ecological and hydrological units to the degree possible
- Continue to spread MACH best practices and pursue policy changes at the national level in a number of critical areas through the Bangladesh Wetlands Network and other channels.

The mid-term review found that the overall MACH approach remained valid, but that more time was required for MACH community-based organizations to be fully sustainable. It is the experience of CARITAS and other credit-giving NGOs that a minimum of five to seven years of training and support are required to solidify such groups. Other resource management programs in Bangladesh have reached similar conclusions. For example, the CBFM-II program believes, based on its experience, that group support is necessary for ten years. Sustainability continues to be an issue of concern to all community-based resource management programs in Bangladesh. Most authorities believe that at least five to ten years of continuous support are necessary to ensure sustainability, whereas MACH has been working with its RMOs for one to three years and the RUGs supported by MACH-CARITAS have been receiving alternative income credit and training support for two to four years.

During phase II, MACH will continue to focus on community comanagement involving all stakeholders, but will increase its support to RMOs, RUGs, and related institutions. MACH will also in the immediate future actively pursue appropriate policy changes directly through the project and, more important, in cooperation with concerned government and NGOs through the Bangladesh Wetlands Network. MACH will expand its awareness and outreach programs and pursue use of communication tools, including drama and video. MACH will use recently released ISMP funds (GOB 416b local currency funds) to address rehabilitation

issues associated with critical wetland habitats. Much of this will go toward securing permanent dry season water habitat for maintaining and increasing food production.

MACH phase II will continue to pursue the following objectives:

- Fully develop community-based RMOs and related institutions and beneficiary groups and ensure their sustainability
- Consolidate and intensify wetlands rehabilitation activities so their impact can be fully assessed
- Further develop the constituency for comanagement of natural resources through an expanded outreach/public education effort
- "Roll out" the MACH comanagement approach to the wider GOB and donor communities.

Beyond MACH phase II, the way forward is for government agencies and institutions to accept community-based comanagement of wetland resources fully as the approach to follow by establishing sanctuaries and conservation areas in every major wetland across the country and multiplying opportunities for employment to reduce pressure on existing and future resources. The other major emphasis for protection of the existing and future fishery is that dry season water be adequately retained and preserved to attain adequate numbers of native populations for regeneration during the subsequent rainy season. Continued emphasis by government and nongovernmental entities alike should be directed at wetland resource management solutions for maintaining or increasing wetland products, such as fish through community-based comanagement efforts and the local level