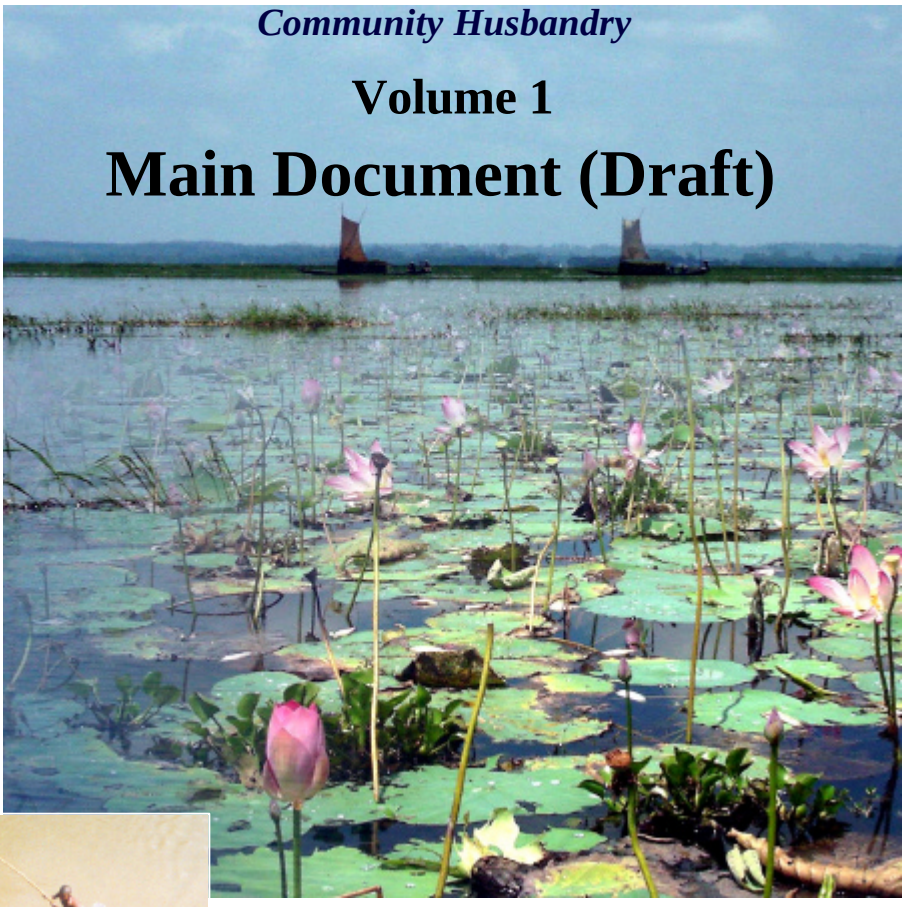
MACH

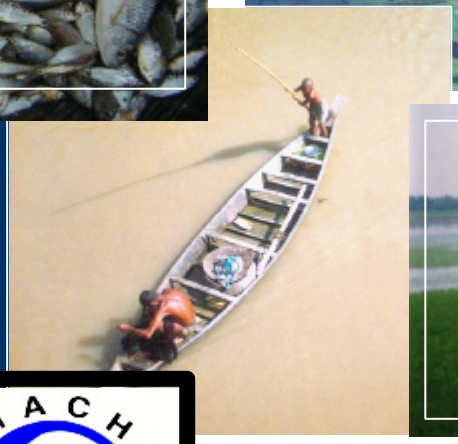
Completion Report

Management of Aquatic Ecosystems through Community Husbandry



Volume 1

Main Document (Draft)



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A project of the Government of Bangladesh
Supported by USAID
Project Partners:
Winrock International
Banglaesh Centre for Advanced Studies (BCAS)
Center for Natural Resource Studies (CNRS)
CARITAS Bangladesh

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PREFACE

The completion report that follows represents a summary of activities and achievements of the Management of Aquatic-ecosystems through Community Husbandry MACH. The project was initiated in September of 1998 and the contents of this completion report contain activities and achievements through August 31, 2003. The fieldwork of MACH began at two sites (Hail Haor in Srimangal and the Turog-Bangshi site in Kaliakor) in June of 1999 after an initial inception period. Fieldwork at a third site (Kongshaw-Maliijhee in Sherpur) began July the following year in 2000. This report represents the achievements in the field of 4 years in the case of two sites and 3 years in the case of the Sherpur site.

MACH has promoted ecologically sound management of floodplain resources including fisheries and other wetland products for the sustainable supply of food for the poor of Bangladesh. MACH is a Government of Bangladesh Project supported by the United States Agency for International Development (USAID). The project has been implemented Winrock International and its three partners, the Bangladesh Center for Advanced Studies (BCAS), Center for Natural Resource Studies (CNRS) and CARITAS Bangladesh. The main purpose of MACH has remained the demonstration to communities, local government and policy-makers of the viability of – and need for – community and ecosystem-based approaches to natural resource management 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 has considered all factors affecting the communities and their wetlands. MACH has used a multi-disciplinary, multi-sectoral, participatory process of planning and implementation for reviving wetland function including the fisheries.

This completion report has been broken up into 5 volumes, each of which has been listed below:

Volume 1 *– Main Report*
Volume 2 – Appendices
Volume 3 – Fish Catch and Consumption Survey Report
Volume 4 – Performance Monitoring Report
Volume 5 – Geospatial Data Portfolio

I. Introduction

A. Authorization

The Management of Aquatic-ecosystems through Community Husbandry or MACH project of the U.S. Agency for International Development (USAID/EGFE) was implemented as a Cooperative Agreement number (# 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 28 July 1998. It was modified seven times with the last modification extending the time for completion from 07/30/2003 to 10/29/2003. Table 1 contains a summary description at 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	The purpose of this modification was to: a) incrementally fund the CA by $ 2,275,000, thereby increasing the total obligation to $2,770,267 to support the MACH activities in Bangladesh through September 30, 2000.
2	The purpose of modification 2 was to incrementally fund the CA by $1,000,000, thereby increasing the total obligation to $3,770,267 to support the MACH activities in Bangladesh through December 31, 2000.
3	The purpose of modification 3 was to incorporate the revised budget into the CA and to make other administrative changes.
4	The purpose of modification 4 was to: 1) revise the program description; 2) increase the total estimated cost, 3) revise the schedule of the award; and 4) update the Standard Provisions.
5	The purpose of this modification was to incrementally fund the cooperative agreement by "$1,310,458" thereby increasing the total obligation from "$3,770,267 to "$5,080,725" to support the MACH activities in Bangladesh through September 30, 2002. Also deleted from the original "Economic Growth & Agricultural Development (EGAD) team" and substituted "Economic Growth, Food and Environment (EGFE) Team".
6	The purpose of the modification 6 was to obligate and additional amount of $1,410,785 thereby fully funding the cooperative agreement.
7	The purpose of modification 7 was 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 where ever it appeared in the cooperative agreement and was replaced with the new end date of October 28, 2003.

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

B. MACH Overview

Management of Aquatic Ecosystems through Community Husbandry (MACH) Project was signed between the Governments of Bangladesh and the United States of America in May 1998. In July 1998, a selection committee in USAID with representation from the MoFL selected the international organization--Winrock International (Winrock International Institute for Agriculture Development), based in Morrilton, Arkansas, USA as the grantee. Three national partner organizations were also selected at the same time which was proposed by Winrock International. They were: CARITAS Bangladesh, Center for Natural Resources Studies (CNRS), and Bangladesh Center for Advance studies (BCAS).

The Management of Aquatic Ecosystem through Community Husbandry (MACH) Project had its inception period beginning October of 1998. The fieldwork actually began at two of the sites in June of 1999 and in July of 2000 at the third site. The project had been demonstrating community-based co-management approaches to floodplain and wetland resource management in Bangladesh and has considered the entire wetland ecosystem including the watershed. The program has worked with the Government of Bangladesh through the Ministry of Fisheries and the Department of Fisheries. This cooperative and collaborative arrangement has taken 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 major purpose of the program was to demonstrate to communities, local governments and policy makers the viability of a community approach to natural resource management and habitat conservation in Bangladesh over entire floodplains involving the surrounding watersheds. The 'community' has included all people in a given area that were dependent either economically or nutritionally on the floodplain and/or its products. The program has emphasized and worked with poorer groups including women, particularly fishers. It has also included representatives from Union level local government as well as the local elite in order to make the program truly sustainable.

The MACH project objective has been to establish community-based management for the major water bodies and riparian zones within its working area. 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. This was done over an entire floodplain ecosystem (beels, seasonal floodplains, rivers, chharas/Jharas) not just a single water body. Additionally MACH was aware that many of the wetland problems were actually upper watershed issues. At all three MACH sites, the project was involved in working with communities to solve or mitigate those problems where feasible. Recognizing that the reduction of fishing pressure was likely to be a critical part of reviving the floodplain fisheries, MACH included supplemental income generation activities that has been focused on the very poor that are still totally dependent on fishing. Over 30% those who directly benefit are poor women of the community.

The project has supported local communities in the formation of their own management organizations for over all management of the physical and biological components of selected ecosystems. MACH has emphasized conservation and rehabilitation of degraded or lost aquatic habitats. Major habitat restoration activities have included the re-establishment of dry season refuges for fish and others dependent on aquatic habitat (i.e. permanent beels and deep riverine kums or scour holes). Also included has been work with local industries to reduce pollution, the re-establishment of watershed function through re-vegetation and reforestation where feasible, and the reduction of soil erosion through introduction of suitable agricultural systems.

MACH Sites.

The MACH project has focused on the development of three major wetland/floodplain areas in Bangladesh, which were selected earlier by the projects National Steering Committee (see

Map-1 site location map in annex 1of volume 2). The sites are Hail Haor (HH), Turag-Bangshi (TB) and Kangsha-Malijhi (KM) River basin. These sites are located in three different districts that include six Upazilas, 26 Unions and 103 villages. According to the original project design MACH was obligated by the agreement to work in 1 to 2 sites but eventually MACH had successfully implemented programs in three separate sites. A brief description of each site follows:

Hail-Haor site. Hail-Haor, in the Sylhet basin, is located in the anticline between the Balishara and Barshijura Hills in the east and the Satgaon Hills to the west. Water originates from the surrounding 350 small hilly streams (at present only 59 streams are active) and the Lungla/ Bilashi river. The project site is located in 5 Unions of Sreemangal Upazila and in 2 Unions of Moulvibazar sadar Upazila of Moulvibazar district. Wet season wetland area is approximately 12,500 hectares and the dry season area ranges from 2,000 - 4,000 hectares. The population is approximately 200,000 people.

Turag-Banshi site. This site is located in 7 unions of Kaliakoir Upazila under Gazipur district and in 1 union of Mirzapur Upazila of the Tangail district. The Turag-Bangshi site is typical of a floodplain/ wetland ecosystem where water emanates from a major river system. As water rises in the major river systems it spills into the distributaries and into the large floodplain areas at the beginning of the monsoon usually the end of June. The water then recedes quickly leaving small pockets that have nearly dried in recent years. The area of this floodplain is around 4,500 hectares in the wet season, reducing to 37 hectares in the dry season. There are a total of 20 beels of which 10 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 under Sherpur District. Geographically the area is a part of Garo-Tura hills watershed and includes the catchments of the upper Kangsha and Malijhi river system. Once this area was covered with natural Sal forest and now only remnants of the natural forest exist. The area of the wetland/floodplain is approximately 8,000 hectare during the wet season. This reduces down to approximately 900 hectares in dry season. There are 47 beels or low pockets of which 18 are perennial within this floodplain area. 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 in the management of programs and has been chaired by the Secretary, Ministry of Fisheries and Livestock (MoFL), the Ministry of Land (MoL) representative has been the Vice-chairperson and the DoF, DoE, ERD, MoE, IMED, Planning Commission, USAID and Winrock International have all had representation as members. This committee met at least once a year or as often as required.

Results Package Team (RPT). A Results Package Team or 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 meeting had the authority and responsibility to guide and see that decisions were carried out. The RPT was a self-directing and self-monitoring team that worked to formulate implementation strategies, monitor and review progress.

The Local Government Committee (LGC). The Local Government Committee (LGC) was MACH's most important committee at site or local level. This committee reviewed and approved program activities and offered recommendations and assistance when required. These Upazila level committees were established by the sites Union and Upazilla officials in the early project participatory meetings. At all MACH sites the LGCs were chaired by the respective Upazila Nirbahi Officers or UNO's. The Upazila Fisheries Officers served as the member secretary of the committee with support from MACH's site coordinators. Other members of the committee were the UP Chairpersons, nearly all of the Upazilla Officials of the related departments, RMO representatives, other stakeholders and MACH representatives. This committee has been the apex committee at Upazila level for integrating the Community-based organizations (RMOs) with all other nation building departments. This committed has had a very positive impact as a bcal level planning body and has been responsible for the success MACH has had in resource management of very critical and many times contested wetlands.

Partners. WINROCK International, the grantee, is a world leader in sustainable agriculture and natural resource management. The organization has considerable experience in the management and execution of USAID-funded projects world wide. Winrock is a non-profit, non-government organization. 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 the overall program management and the provision of specific technical inputs in GIS, fisheries biology and watershed management. Winrock headquarters in the US provided overall program and financial support.

CARITAS, Bangladesh is a large national NGO that has working in Bangladesh since 1972, established by the Catholic Bishops Conference of Bangladesh as non-profit organization. Through its activities Caritas is aiming towards integrated human development and welfare that contribute to the national development. In MACH they are responsible for community development and Alternative Income Generation activities. For alternative income generation and socio-economic development of the poor wetland resource users they have under taken and successfully implementing the activities like awareness campaign, RUG formation and mobilization, training for groups and skills development, credit support for AIGAs, demonstrations, education, healthcare & nutritional activities.

CNRS (Center for Natural Resource Studies) is a non-government development organization formed in 1993 focuses on ecological management of floodplain ecosystems through community-based management approaches with a mission to restore, conserve, enhance and wise use of natural resources supporting and influencing government strategies and initiatives. The center has demonstrated a variety of field interventions towards developing sustainable wetland and fisheries management approaches with due consideration to environmental and socio-economic issues. CNRS in this program was responsible for management of wetland resources through forming community-based resource management organizations, helping them to determine biological, physical and social areas for development. CNRS was also responsible for generating environmental awareness and monitoring of impacts of project activities.

BCAS (Bangladesh Center for Advanced Studies), the, is one of Bangladesh's leading environmental research and policy institutes. BCAS is a non-profit research NGO. Formed in 1984 BCAS has many years of experience contributing to the establishment of community

based open-water fisheries management. It was among the major contributors to the current National Environmental Management Plan (NEMP), which forms the basis for environmental regulation in Bangladesh. It provided local coordination for MACH, as well as short term specialists in policy reforms, as needed and support services for GIS, hydrology, fishery biology and other special areas.

D. Strategic Objective Framework

The Strategic Objective Framework established by the USAID Environment Team for the project was modified in November of 2001. The revised framework can be seen on figure 1 and the summary table that follows and complete reporting on the SO's, IR's and indicators can be found in the performance and impact section of this volume and Volume 4. In Volume 4 each of the performance targets and achievements of MACH are shown and discussed in detail. The methodology and approach taken in collecting and reporting the data have been shown with maps locating implementation areas and sampling regions. A summary of the project performance can be seen also in the section III of this volume.

Based on the mid-term review conducted in December of 2001 MACH modified some elements of its activities but the approach MACH had taken was found to be valid. The MACH approach was not changed but increased effort and resources were placed on training, awareness and strengthening of the MACH Resource Management Organizations (RMO) and the Resource User Group (RUGs) Organizations.

E. Organization of the Report

The completion report has been presented in five volumes of which this Volume 1 represents the main report. This volume does not contain the project maps and other appendices which are presented in Volume 2. This volume has been structured in 5 sections as follows:

Program Implementation and Achievements

Project Performance and Impact
Cooperation with and Support to Other Organizations
Financial Resources Utilized
Lessons Learned and the way forward

Further details can be found in the supporting volumes 2 through 5 as listed below:

Volume 1 – Main Report
Volume 2 – Appendices
Volume 3 – Fish Catch and Consumption Survey Report
Volume 4 – Performance Monitoring Report
Volume 5 – Geospatial Data Portfolio

This Completion Report presents the accomplishments of MACH through its partners and collaborators since inception to the end of August 2003.

II. Program Implementation and Achievements

A. Summary of Significant Achievements and Milestones

Bangladesh is faced with ever decreasing dry season surface water and the ground water tables have dropped in many areas beyond the range of shallow hand pumps. These trends are likely to continue into the future as the need for water upstream increases, the local need for water by competing uses continues to increase and widespread watershed degradation continues to send much higher sediment loads down onto the floodplains of Bangladesh. Wetlands and in particular the fishery within these wetlands is very dependent on dry season surface water patches that remain during the dry season. These are becoming increasingly scarce for the reasons stated above. It is with this reduced dry season surface water that fish have come under increasing pressure to make it through the dry period. Either beels and river scour holes that previously retained water now do not or they retain less. Rivers in the MACH areas have in some cases had up to 40% flow reductions. In one case a river previously navigable became navigable due to reduced dry season flows. Fish have fewer and fewer opportunities to escape capture in these reduced water situations. Tidal wedges previously only felt in the major river systems are now seen in many of the feeder channels and smaller rivers. Such is the case with the Turog River (a distributary of the Jamuna) and this has come about because of reduced dry season flow volumes in the major rivers such as the Ganges.

With these decreasing trends for the dry season surface water MACH has worked with community groups and local government in three large floodplain wetlands to secure and sustain as much dry season surface water as possible (creation of areas for fish retention). This has been done through the projects own funds with additional support at the end of the project through local currency 416b funds through a project implementation letter signed by the GoB and USAID. MACH with these habitat restoration funds has helped communities through their Resource Management Organizations (RMO) to re-excavate and restore critical fish (and other aquatic life) habitat to a perennial water state. The communities re-excavation/restoration of its beels and canals has resulted in year-round standing water which had earlier disappeared and it has led to (along with other MACH interventions) increases in fish catch and consumption in all three MACH sites.

Through MACH, communities surrounding the three large floodplain wetlands in which MACH works have been able to intervene and secure dry season wetland function. They have been successful at all three sites in securing the following:

- Perennial water areas (dry season surface water)
- Year around wetland sanctuaries
- Fishing time closures during critical spawning and both pre and post-spawning periods
- A halt to destructive fishing practices in the managed areas
- Conservation of re-introduced endangered or threatened fish species

Through these measures the fish catch has not only been maintained for the last three years but increased. The data on the increases can be seen on and is also found in volumes 3 and 4. Just to be able to maintain the fishery in these three very large floodplains is an accomplishment with the degradation of habitat and its loss and the over-fishing which is

taking place. What has also been found is that the consumption of fish has also not only been maintained but it has also increased in all three sites.

Fish and plant diversity has also been enhanced at all sites both through the creation of sanctuary areas and perennial water and through re-introduction of selected previously present species. The re-introduction of selected fish species has been done into the newly created deep sanctuary habitats both in beels and rivers. MACH has reintroduced mature adults of species that have disappeared and with some of the species it was seen that they successfully reproduced. The fish that have been re-introduced have largely been of a beel resident nature. Data supporting can be found in this volume as well as volume 2 & 4

Communities through their RMO's and with the support of the MACH Project have been able to gain access to leases for periods of upto 10 years in some cases. In other cases previously leased water bodies have been handed over permanently to the communities and the local government officials. The first milestone crossed by the project was to gain access of leased waterbodies for more than 3 years. This was accomplished and 24 leases have been handed over to MACH supported RMO's for improved management and conservation. In all of these leased water bodies RMO's have formed sanctuaries in a part of the lease that are maintained and off limits to fishing. In addition to lease access for MACH groups MACH has been able to support the communities and the local government institutions in gaining a permanent acquisition from the Land Ministry for water bodies (jhalmohols) previously leased for the use by the communities as permanent sanctuaries. The entire previously leased area will from now on be a sanctuary for conservation only. There are a total of 8 permanent central sanctuaries in the three sites that will be continue to be protected and provide fish shelter throughout the year. The revenue from the previously leased water bodies has been given up by the Government in lieu of the sanctuary establishment and future benefits to the whole area from its creation.

Wetland communities in at least two MACH sites have indicated that upper watershed land use is one of the major factors in the decline of wetland habitat. MACH, in collaboration with Winrock's Farmer-to-Farmer Project, initiated improved watershed management practices with selected pineapple growers in the Hail Haor basin of Sreemongal. The demonstrations have been very successful and the contour method of planting adopted in the demonstrations is now spreading to other farmers in the watershed of Hail Haor wetland. The contour planting (previous planting was in vertical rows) not only has reduced soil erosion but has also been a more productive method of growing pineapple. MACH II plans to continue support to contour planting and to securing further land use policy changes at the district level.

MACH originally was only to work in the wetlands or lowlands. During the baseline survey and the participatory community planning sessions, it became evident that the problems that existed in the wetlands originated in the hills, particularly at the Hail Haor site in Srimangal. The communities cited increased erosion in upper watersheds as one of the major reasons for the filling in of the wetlands. MACH then decided to apply resources to some of the most degraded areas of the hills and to address pineapple land use that has been most detrimental to the hill areas of Hail Haor. MACH has demonstrated very successfully with growers the benefits of contour planting methods which have reduced hillside erosion. The Deputy Commissioner of Moulvi Bazaar has agreed to change the conditions of the future leases where pineapple is grown to reflect the contour planting regimen.

The other watershed improvement that has been very successful is the riparian tree restoration program. MACH has planted very successfully some 47 indigenous riparian species and a total of 168,454 trees in the riparian areas where none existed at the time of planting. The benefits will be in 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.

As mentioned above the riparian areas on selected degraded streams is being re-established through selective planting schemes that have matched the habitat with native species. There have been community groups formed that plan, implement and maintain the stream riparian areas. These groups are limiting the grazing and planting native species to bring back the degraded stream banks. In addition to stream bank restoration MACH has also begun the process with the communities of replanting many of the wetland areas that previously had swamp forests of hidjal and karoch. The project has successfully through the resource management groups, established these wetland swamp species in the middle of Hail Haor. When grown these will provide tremendous habitat and feeding area for all aquatic animals as well as birds. With the more than 333,000 trees planted during MACH it is expected that the communities will yield from just the trees alone, more in value than the original cost of the project.

MACH very early on realized the value of the wetland areas where the project was working particularly to the poor. It was also clear that the real value of the wetlands of Bangladesh had not been determined and that it was an important valuation to accomplish. Through MACH's early surveys of the wetland areas it was clear that there were benefits that had not been accounted for in past studies. MACH completed the wetland economic valuation for Hail Haor and found that even in a semi-degraded condition was far more valuable than had in the past been stated. It was also found as one would expect that the very poor are the largest group of beneficiaries of the wetland as more than 50% of the benefits go to the very poor. One realizes from this study that the removal or degradation of these wetlands could be extremely harmful to the poor's livelihood strategy. The full results of the valuation can be found in Volume 2 of this completion report, appendix 16.

It is generally agreed that over the past 30 years, a large number of policies have addressed both national (overarching) and sectoral agendas, but there has been considerable overlap and lack of coherence between them. Policymaking has tended to be top-down, originating from central government and favoring the priorities and interests of the political group in power and influential elite. Little effort has been 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, NGOs and the wider donor community to work jointly to effect change. This is reflected in MACH's work to support the coordinated LCG effort to jointly produce the Fisheries Sector Review in collaboration with the MOFL/DOF. Through MACH, USAID has been a major supporter of that effort.

A MACH finding that is being spread to a wider audience of government, NGOs and donors is that aquatic resources are of major economic importance to surrounding communities and are, in most cases, more valuable as common pool wetlands than as agriculture land. Most

importantly, those aquatic resources provide major benefits to the rural poor. Because poverty alleviation and support for the poor is the main goal of the Integrated Poverty Reduction Strategy of the GOB, it makes sense to include preservation of these national assets in the government's overall poverty reduction plan. MACH has worked with Government, the LGC and others to ensure that the country's capture fisheries and wetlands are recognized as critical to rural poverty alleviation strategies. MACH has been a leader within the sector in the use and development of strong local partnerships at local government level. All other programs doing community-based management have been looking at the MACH approach and all agree that this is the most appropriate. Another MACH achievement has been the ongoing discussions with the GoB project, 4th fisheries and others on the future strategy for open water/wetland management. The main institutional approach being suggested is that of MACH's which is community-based but with very strong ties to local government institutions at the Upazila and Union level.

MACH worked closely at the Upazila level with Department of Fishery UFO's and the open water work has become a priority. MACH through the UFO and the local administration supported efforts at conflict management. MACH has been successful in strengthening the local government professionals in resolving complex problems and conflicts. The UFO is the Member/Secretary of the LGC which was very effective in resolving conflicts and supporting the plans of the resource management organizations. MACH has been able to influence the thinking and direction of the DoF and the MoFL through its many presentations and site visits that were provided.

Another MACH success has been its ability to involve 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/Ministry level GOB staff. At the Union level, 51 elected Union Parishad representatives are involved with RMOs. Elected Union Parishad chairpersons are included as advisors to community organizations managing wetlands and riparian areas at MACH sites and serve as members of MACH-initiated Local Government Committees (LGCs). The LGCs work in partnership with the project at the Upazila level with the concerned Upazilla Nirbahi Officers (UNOs) serve as chairpersons, the Upazila Forestry Officer (UFO) as member/secretary, and other officers as members. The project also taps the services of other central government Upazila officers as technical resources, with agriculture, fisheries and livestock officers assisting in skill training for resource users and forestry, engineering, and fisheries officers providing technical guidance to the project. On the job natural resource planning skills have been developed among the LGC members.

MACH has established and involved organizations at various levels to implement the program. The institutional setup of MACH consists of a Project Steering Committee (PSC), which meets once a year to provide guidance to the project with the involvement of MOFL, DOF, the MOL and other GOB partners. The next level is the Results Package Team (RPT), chaired by USAID, which meets regularly (at least monthly) and includes members from the DOF and the project partners. At the field level MACH and local government institutions have established Local Government Committees (LGC) chaired by the Upazila Nirbai Officer (UNO) with the Union Chairpersons and other Upazila officers as members. Project partners are also members as are representatives from the RMOs. Aquatic resource areas were identified, the communities consulted through a multi-step process and community-based organizations (RMOs) established through consensus among the resource users surrounding the wetland or aquatic resource area. These organizations are formed either around an entire continuous wetland or around portions of larger ones. The RMO is composed of fishers, grass

harvesters, cattle and duck forage users and other wetlands resource users such as rice growers. The general body of the RMO typically has anywhere from 50 to 160 members depending on resources and population.. The RMO elects a 11-21 member executive committee every 2 years for the planning and development of the resource management plan.

MACH was able to successfully acquire for its area & communities, additional funds for the important work of habitat restoration through physical intervention. Acquiring these funds so MACH could do the required large-scale restoration works required a tremendous amount of effort (in time and money) but in the process the project was able to educate many senior level officials on the issues surrounding wetlands and their need for restoration and protection.

By its very existence MACH impacts GOB policy. MACH activities have changed the views of the GOB as to the efficacy of working with communities and union government. MACH has established precedents for DOF and others, including extending leases for community managed wetlands to 10 years and establishing permanent and seasonal sanctuaries. One of the most important precedents has been the first agreement by the GOB to hand over formerly leased beels as permanent sanctuaries to be operated by communities. This is a very significant change in policy. In addition, MACH has received the GOB's agreement, in principle, to enable MACH to assist the government in the acquisition of critical wetlands now in private hands using ISMP funds.

MACH has been instrumental in encouraging policy level coordination between the GOB, the wider NGO community and donors in the sector. With IUCN, BCAS and the World Bank, MACH encouraged and was instrumental in the formation of the Wetlands Network. The Wetlands Network is a loose confederation of organizations and agencies working or otherwise active in Bangladesh wetlands. The Wetlands Network brings together 29 institutions and organizations actively involved in floodplain and wetland management projects. It represents a combination of concerned government agencies, NGOs, projects and donors working together to share experiences and jointly pursue mutually beneficial policy changes. The best way to effect policy change is to ensure wide consultation and cooperation from all of those concerned with the change. MACH is achieving a cooperative joint approach to policy change through the Wetlands Network. The formation of the Bangladesh Wetlands Network as a vehicle for policy interventions has been one of MACH's successes.

In one MACH site industrial pollution has a significant impact on one aquatic system where communities rely on fish for food and livelihood. The project has been able to effect some changes in the views of the industries and change in some of the harmful processes used. MACH has already intensified efforts by supporting and cooperating on a DFID grant to reduce pollutants in the site.

A feature of the MACH approach has been to ensure that all community resource users have a voice in management decisions and equitable access to wetland resources. MACH is especially concerned with rights and access of poor and disadvantaged resource users, especially fishers living around the wetlands. Seasonal fishing bans and the creation of fish sanctuaries are necessary (and are being implemented) to manage the wetlands sustainably. MACH recognizes, however, that this can be disadvantageous to the poorest groups dependent on the resource. As a result MACH has, from its inception, stressed the importance of supplementary or alternative income in its work with fisher and other disadvantaged groups.

Winrock and its partners have had many years of experience with micro-credit in Bangladesh and have worked with many of Bangladesh's premier credit organizations, including Grameen and BRAC. As experience with micro-credit has shown, small loans cannot, by themselves, lift any individual 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 the communities through the RMOs impose upon themselves.

Through CARITAS, MACH instigated a survey of the credit system and benefits to its members. The overall finding was that on average each annual loan supplied a profit of 30% above and beyond the loan and interest. This amounted to 2,150 tk./loanee/year on average. In addition, this survey showed that loan income increases for RUG members as they gain experience and as loan amounts increase. Results from the survey show a first loan income of Tk 1,152, second loan income of Tk 2,482 and a third loan income (on a limited numbers of loans) of Tk 5,019. One of the achievements has been that the management of the wetlands has required that restricted fishing periods be established in which all fishing is prohibited. This may be for as little as 2 weeks up to 2-3 months depending on the nature of the fishery. The supplemental income programs have buffered potential negative impact to the poorest. Only the very poor fishing families have access to these alternative income generation programs.

Cross-visits and outreach sessions have taken place with Government, fishers and administrators from Bangladesh and other countries, other projects, donors and members of civil society. Other projects visiting MACH sites, included the Fourth Fisheries Project of the Department of Fisheries (DOF), the DANIDA-financed aquaculture and fisheries programs of Mymensingh, Noakhali and Patuakhali, and the UNDP/GEF-funded Coastal and Wetland Biodiversity Management Project, the DFID funded CBFM Project of the DOF, the RNE funded Integrated Coastal Zone Management Project of WARPO, the CIDA funded Dempara project of WDB. MACH has also provided cross-visit opportunities for donors and government policy makers (Ministry of Land, Ministry of Finance Ministry of Fisheries and Livestock,, Economic Relations Division, Planning Commission, Implementation Monitoring and Evaluation Division and others) in the demonstration of the MACH approach and dissemination of methods. MACH has received foreign visitors from Brazil, Vietnam, Nepal and the United States. To promote communication of results, MACH has completed a video used widely for dissemination of the approach. MACH activities have also been broadcast nationwide on popular Bangladesh television programs Mato-o-Manush (Soil & Human). MACH funded posters have been used widely for dissemination of project concepts.

The MACH Results Package Team (RPT) has facilitated dissemination of the MACH approach. The RPT consists of representatives from the GOB (MOFL and DOF), USAID, Winrock, the Bangladesh Center for Advanced Studies, the 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 very high levels in land, water, fisheries and other natural resource issues. Through experience gained on this project partners export MACH knowledge and best practices through workshops, seminars, donor discussions and GOB meetings. MACH has provided guidance

to the newly established UNDP/GEF-funded Coastal and Wetland Biodiversity Management Project on its approach to environmentally critical area management. MACH and the Winrock partners have been active participants in the development of the national Fisheries Sector Review and Future Development documents.

Informally MACH, both in Dhaka and in the field, meets on an almost daily basis with various GOB officers in the fisheries, land, LGRD, agriculture, livestock, cooperatives and other agencies as needed. MACH has developed close and continuing relationships with government at all levels. In MACH II, relationships with government will take on more importance as the project institutionalizes the MACH approach.

MACH has successfully facilitated site visits for the Secretary, Ministry of Fisheries, Joint Secretary MOL, the Director General of the DOF as well as concerned Planning Commission and most of the senior MoFL personnel. MACH will continue to encourage field visits by senior government staff.

B. Program Achievements

a. Policy and Institutional Considerations

i. Overview

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

Further, it is generally agreed that over the past 30 years, a large number of policies have addressed both National (overarching) and Sectoral agendas, but there has been considerable overlap and lack of coherence between them. Policymaking has tended to be top-down, originating from central government and favoring the priorities and interests of the political group in power and influential elites. Little effort has been made to consider or involve a wider range of stakeholders 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 the wider donor community to champion joint efforts to effect change. This is reflected in MACH's work with the Wetlands Network and MACH's effort to support the coordinated LCG effort to jointly produce the Fisheries Sector Review and Future Development (FSRFD) in collaboration with the MOFL/DOF. Through MACH, USAID has been a major supporter of that effort.

MACH has also among its NGO partners individuals who have been "Champions" for policy change particularly in the way water resources have been leased out. In addition MACH has worked directly with government at all levels which has resulted in precedent setting agreements that has allowed communities and the project to establish 8 areas as permanent government sanctioned community managed wetland sanctuaries. The GOB has in addition agreed to another precedent setting concept. The concept is one of "conservation easements"- in this case allowing the project to look into the purchase of privately held land to allow the community and the local government to establish critical conservation areas for all time. These items will fully come to fruition in phase II of MACH.

ii. MACH Land Use Efforts

Following from MACH's work with Local and National Government, Winrock and its partners obtained full GOB support for officially designating eight public wetlands at MACH sites 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 stakeholder 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 benefits to the overall fishery and the community. This is the first time this has ever been done in Bangladesh. This 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 these Jaduria, Magura-Chapra Beel within Hail Haor, apart from its importance to the fishery has been designated an "Important Bird Area" by Birdlife International. In addition the Hail Haor itself has been designated as a potential "Ramsar" site.

iii. Inclusion of Contour Plantation in Hill Leasing Contract

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 stopped. Such 'across the contour' line planting on the steep hill slopes around the haor causes soil erosion on a scale that is rapidly causing the wetland to fill in. MACH has made an effort to demonstrate to the pineapple growers an alternative method of planting with the contour and the placement of more plants. Observing the results from initial demonstrations in 2001 has resulted many more farmers demonstrating and testing. There have been more than 25 demonstration plots yielding far higher pineapple production and better coverage of the hillside reducing the erosion every year. MACH has advocated with the GOB policy makers to formulate government pineapple cultivation regulatory rules, making contour cultivation a mandatory obligation for all gardeners. The DC Moulvi Bazaar has agreed to certain changes in the wording of lease arrangements and has supported this beneficial change to the regulations.

iv. Co-management and Linkage with Local Government Institutions

The MACH project has developed and maintained a close relationship with local government institutions and because of this has been able to see progress in local institutions taking charge of their resource planning and management. Basic grass root organizations established under MACH are its RMOs or Resource Management Organizations. In each of the RMOs, the local Union Parishad Chairman functions as an "Adviser". This has linked MACH project activities with the Union Parishad, and, at the same time, allowed the project and its RMOs to function based on true public priorities at each of the resource levels.

The other important link is through the Local Government Committee (LGC) constituted at the Upazila level. This committee is chaired by the Chief Executive in the Upazila, the Upazila Nirbahi Officer or UNO. The members of the committee are the Upazila level officers of different nation building departments of the government, the Chairmen of the Union Parishads and the representatives of the RMOs. By nature, it is a unique combination of govt. officials, local governance and the community. MACH project activities emanate from the grass-root level of RMOs and are considered and agreed upon at the LGC level. This process has resulted in a two fold benefit. One, the MACH project activity is known to

all local governance tiers and identification of problems and their resolution is smoother. Secondly, all activities and interventions tend to be within the governments existing policy. Thirdly the government officials of the different nation building departments tend to act as resource persons for the training of the RMO and RUG members and their pre-knowledge of MACH project makes the efforts more effective.

v. Leasing of Water Bodies to MACH-Resource Management Organizations (RMO).

The process of community lease of water bodies comes after the formulation of the RMOs. The proposals for a lease are processed first through the respective Local Govt. Committees LGCs. With the LGC concurrence, the applications are submitted to the Ministry of Land (MOL) through the Ministry of Fisheries and Livestock (MOFL). Under the terms of MoUs signed by the two ministries, the MoL retains the ownership of the water bodies, but the water bodies are handed over for ten years to the MoFL for technical management and improvement through the RMOs formed under the MACH project. The initial handing over is for three years which is extendible up to ten years subject to satisfactory management.

The policy of the government regarding fixation of lease money @ 25% higher than the last lease value and the provision for 10% increase in subsequent years with repetition of the whole process at the time of each fresh lease, increased the lease money by more than 100% in about five years time. Such acceleration being detrimental to sustainable management of the resources, MACH and other projects of MoFL recommended for change in this policy. The government conceded and under the revised policy, after 25% increase of lease money at the initial lease, the lease is to remain valid for next five years without any further increase. In its three sites, MACH-RMOs have taken lease of twenty two water bodies (excluding two rivers' parts) covering an area of 1236.80 acres.

In all the three sites of the MACH Project, water bodies were selected carefully before the lease to MACH-RMOs was finalized. The criteria were:

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

vi. Wetlands Network

In the first year of operation, MACH saw the need for new policies as part of an overall strategy to achieve change in the management of wetlands and natural resources. MACH recognized the need for cooperation and dialogue with a range of government and non-government 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 Wetlands Network in collaboration with 30 other government and non-government institutions concerned with floodplain and wetland management. The Wetlands Network has made joint recommendations to the GOB on the policy aspects of beel leasing, fish sanctuary establishment and resource management. In 2002 the Wetlands Network sponsored a Wetlands Conference, the theme of which was Water, Fish, People. MACH actively supported the conference, which was jointly sponsored with the Ministries of Fisheries, Water, Land and Local Government over. There were 5

keynote presentations, 33 technical and addresses by concerned Ministers (Fisheries and Land) and Secretaries (Fisheries, Land, Environment and Water).

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 Wetlands Network. The Wetlands Network contains a loose confederation of GOB agencies, projects, donors and NGOs involved in various wetland activities. The Wetlands Network was initiated and continues to be supported by MACH and others. The purpose of the network is to share experiences, seek areas of cooperation, and jointly pursue mutually beneficial policy changes. The Wetlands Network represents the broader stakeholder interests of the wetland community and offers the GOB a partner in policy development.

Through the Wetlands Network MACH has been able to gather input from a wider audience and seek the support and cooperation of other government ministries, projects and programs to pursue its policy dialog with the Government. In a meeting with the Secretary, Director General of Fisheries and other government officials, the Wetlands 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 the overall constraints to natural resource management within Bangladesh. These efforts along with others resulted in the MoL ultimately modifying its lease rate increase policy by reducing the rate of increase.

b. Wetland Resource Management

i. Overview

The core activity of MACH remains the sustainable community management of wetlands. The MACH approach calls for the participation of the entire wetland resource community- users and other stakeholders- whose livelihoods are dependent on the wetlands. These include poor fishers, farmers and the landless who are most dependent on these resources. Equally important has been MACH's direct involvement of local government in the project through its Local Government Committees (LGCs).

A total of 42 management organizations including 16 wetland RMOs, 9 charra (riparian stream) RMCs and 17 doha or kum (river scour hole) RMCs have been formed. In addition 1,747 community members have been elected to serve in these organizations. Beel-RMOs include 715 MACH RUG members who make up over 60% of the membership. MACH continues to strengthen these organizations through the provision of specific training programs and other activities discussed below. MACH working with the MOFL, DOF and MOL has assisted RMOs in the transfer of 22 public beels to be managed by the RMOs. MACH with the support of the concerned communities, local governments, MOFL/DOF and MOL had eight government water bodies turned into permanent community managed sanctuaries. These RMOs have over 18,800 ha under improved management and have established 66 sanctuaries in their wetland areas.

Another aspect of the MACH approach is that many of the problems of wetlands lie outside that water body. As discussed below MACH has, at all of its sites, addressed issues or least brought these to the notice of the community and government. A part of the community organization involves awareness raising at several levels- MACH has to date conducted a variety of environmental awareness activities attended by over 164,000 people.

Further details of activities conducted are shown 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 on the order of 20-35%. In addition MACH activities increased biodiversity on 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. This figure is for additional fish production only and does not include other environmental services provided by wetlands.

ii. Resource Management Organizations

MACH-CNRS facilitated the processes of RMO and RMC formation in each of the three MACH sites. The original estimate for the number of required resource management organizations was 20. Since inception of the project, a total of 16 Beel-RMOs have been formed, with 8 are in Hail Haor, 4 in Turag-Bangshi site and 4 in Kangshaw-Malijhi site (Table 1). In addition another 9 stream or charra RMC's 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	No. 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
Kangshow-Malijhe	6	4	3	2	9
Total	20	16	9	17	42

The Beel-RMOs are formed around specific wetlands or sections of a very large wetland (beels, khals and rivers), their prime responsibilities are 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 resources management viz. stream bank protection (afforestation of chara and jhara[1]) and sanctuary management in river daha/kur/kum[2]. For each such activity, one RMC is formed and their responsibilities include management of 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 resource management organizations have been formed during the first phase of MACH.

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

[1] *Chara* and *jhara* are the streams originating from hills and falling in wetlands after passing through croplands and settlements. *Chara* is the local term used in Sreemongal while *jhara* in Sherpur.
[2] *Daha* or *kum* is the local term of river scour holes in Kaliakoir, while it is *kur* Sherpur area and *duar* in Sreemongal area.

iii. 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 have been approximately 164,000 for MACH-CNRS and 141,000 for MACH-CARITAS activities. Awareness-building activities were started at the very 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 identified. In addition the reasons for choosing their wetland for MACH was discussed and explained in these meetings.

At Upazila level meetings, concerned government officials including the UNO, UP Chairmen, NGO staff, reports, and local elites attended. In the district level introductory seminars, all concerned officials at the district level were participated. During the phase1 period, a total of 44 awareness events have been organized at Union, Upazila and District levels in three MACH sites, which were attended by 1,287 participants (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 Upazilla levels. In the course of the project UP Chairpersons, UNOs and DCs 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-Malijhee	11	507
Total	44	1,287

Awareness Meetings Directed at 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. In addition this opportunity is taken to explain the purposes of the project as well as to sensitize them to the issues and problems and encourage their input in subsequent planning and the implementation of management interventions.

Table 4: Uthan Baithaks conducted up to August'03

Project Sites	Uthan Baithak conducted (no)	Village 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 baithak is an effective tool to build rapport with the communities and sensitize them to the issues relevant to the project. The approach followed in organizing uthan baithaks is that the project team, after early RRAs and a census, sat in a courtyard of one household and began informal dialogues with the neighboring 10-15 household dwellers. The discussions

cover problems and issues as well as introducing the project and how the project could work with them to help solve the identified problems. To date a total of 481 uthan baithaks were conducted at 103 villages and covered about 13,000 people in the three MACH sites (Table 4). All these baithaks were found very effective in sensitizing the communities and bringing positive attitude towards the overall MACH goals, objectives and approaches.

Village campaigns were conducted at the village level where all the villagers were invited, usually in the afternoon or evening. In these events various environmental messages are disseminated among the attendees relevant to their local area. Additionally staff used these opportunities to show how the issues are important nationally and even globally. The project spoke on issues, distributed materials (posters, leaflets, etc.) and showed project videos and other materials.

During the reporting period a total of 470 village level awareness events/sessions were conducted in

Table 5: Village campaigns conducted up to August'03

Project Sites	Sessions Conducted (no)	Villages Covered (No)	People Attended (No)
HH Site	218	21	5,990
TB Site	90	36	5,548
KM Site	162	36	5,602
Total	**470**	**103**	**17,140**

103 villages in three MACH sites with over 17,000 villagers were covered (Table 5). These programs are usually conducted during the non-work periods (viz. after planting rice or harvesting) when the villager communities are free to attend.

Some village level events were conducted on time-specific issues, e.g. immediately before the fish spawning period awareness campaigns were conducted with a message related to allowing brood fish to spawn, stopping the use of certain fishing gears 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 the hill slopes causes sediment problems in the haor basin. The purpose was to inform the people of the issues and let them know the 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 Sreemongal and reached 715 farmers/farm laborers.

International Environment Day Observance. MACH uses the occasion of international environmental days to support its messages of sustainable resource use. Days observed included World Environment Day (5 June), Earth Day (22 April), World Wetland Day (2 February), World Biodiversity Day (22 May). Activities on international environment days included mass rallies, discussion meetings, school children awareness meetings, field (wetland) visits, video show, art competition (wetlands and biodiversity), environmental quiz competition, essay competition and so forth. Tree planting at various institutions, primarily schools was also a part of the day observation programs.

The USDA funded BREAD Project provided a grant to CNRS to develop environmental awareness materials and implement 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 of posters, designing 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" of the day observance in the Hail Haor created mass awareness among the wider community and stakeholders. The number and types of day observance at three MACH sites can be seen in Table 6. Data shows that a total of 40 events related to day observance were organized in three MACH sites where over 25,000 local people attended

Table 6: Observance of various environmental days up to August'03

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 site	5	3,069	6	3,780	4	2,671	1	130
TB site	4	2,505	3	1,550	4	2,050	-	-
KM Site	3	2,250	6	4,250	4	2,900	-	-
All Sites	12	7,824	15	9,580	12	7,621	1	130

Baul Songs. Baul 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. While not a religion they follow customs which combine 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. In order to sensitize the local communities at village level baul (folk) 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 in creating mass awareness among the communities in project sites.

MACH Video. MACH commissioned a 24 minute video to document program purpose, approach and achievements. This was finalized in August 2002. This video has been and continues to be used in many functions and activities; these include presentations to all RUGs, RMOs and in various day and baul functions. It is also used to introduce MACH to local and national government personnel at Fish Week Activities and MACH America Week activities in Chittagong and Syhlet.

To date a total of 171 video shows and events were organized in different villages with approximately 67,000 people attending. (Table 7). Some of the video show programs have been organized in local schools where students, teachers and UP Chairmen and members attended. The respective RMO are involved in organizing these programs in their areas.

Table 7: Baul songs and video shows organized up to August'03

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

Dramas. As reported in the Community Development section of this report, drama programs with environmental themes were conducted by MACH in all sites. Separate dramas were conducted in 2001, 2002 and 2003. These traditional village events, generally seen at local festivals, were designed to introduce and support specific MACH concepts through a drama format- namely the importance of wetlands, the need to conserve fish, wildlife & bird, communities working with local government to achieve success. These were very successful in reaching thousands of people with a message that tended to remain in their memory.

iv. RMO Formation and Activities

RMOs in MACH were formed in a multi-step process that included awareness raising as discussed above. A general outline of the steps involved in the process are shown below:

- 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 RMO/Cs
- Implementation of wetland activities
- Capacity building and other strengthening and other s

RMOs are composed of representatives from villages around a particular wetland, wetland cluster or river section. As part of the formation of the RMO, a series of initial sensitization meetings are held., At these meetings villagers are requested to select representatives in an open village-wide forum where each and every household of the concerned village were invited. The selected members vote on the make up of the GB (general body). Later in open meetings, the GB office bearers then elect an Executive Committee from the General Body members. In these meetings, concerned UP Chairmen and members along with project staff attend to 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). At the initial stage of the project based on open elections the percentage of RUG[3] (Resource User Groups) and other poor members came to about 50% of all GB 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 Chairman and a MACH staff member act as advisors to the RMO throughout the process. .

The MACH aim is 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

[3] RUGs (resource user groups) comprising of fishers and poor people in project sites who largely subsist on wetland resources and are organized by MACH-Caritas for alternative income generation

systems is prerequisite to implement the concept. The idea of forming resource users into managers of resources was the driving force in implementing the MACH project. Motivation, knowledge sharing, interaction with the communities and related stakeholders at all steps of the project activities developed a platform to start the resource management practices by the user communities.

The MACH introductory meetings with the community at different levels and the working relations developed between the project and the local communities and other actors opened up opportunities for developing a common understanding of the local problems, solutions and approaches. During the planning (PAPD: Participatory Action Plan Development) workshops at local levels with the communities of different social and occupational hierarchies, a draft guideline on the community organizations and participation in Natural Resource Management interventions were suggested.

On the basis of the draft outline on community participation and local management of natural resources, RMOs are formed and management areas for each of the RMOs have been delineated based on specific water-bodies, riparian areas and community development activities. The improved management is defined as the area where any MACH intervention or a combination of interventions has been made, whether it is swamp plantation, wetland sanctuary, habitat rehabilitation, riparian vegetation development, pineapple cultivation on a combination of all. It should be noted that all interventions are made within the jurisdiction RMOs. The RUGs villages are also included in the improved management area of MACH.

Table 8 shows the improved management area, which has been brought under management by RMOs 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 the improved management against the planned target of 15,000 ha in three sites.

Table 8: Area under improved management by RMOs

Sites	Resource area (ha)	
	Project target	Achieve d up to June'03
Hail Haor	6,700	8,311
Turag-Bangshi	4,200	6,275
Kangsha-Malijhee	4,100	4,280
Total	15,000	18,866

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

Resources Conservation measures. Resource conservation measures include interventions leading to the wise use and protection of resources at a level that can support maintenance of natural productivity of biological resources as a function of ecosystem at pristine condition.

To this end RMOs have undertaken various conservation measures in their respective wetland areas under their management as appropriate to the local situations. Major conservation measures have included those shown and described below.

Ban on use of harmful gears. Some gears are recognized as harmful for 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 jals and fine mesh nets. In all the RMO managed water-bodies there has been notable reduction in use of current jals and kafri jals due to the motivational and surveillance efforts of the RMOs. The UP Chairmen and members and local DoF staff have also taken a proactive role in 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 very start of the monsoon in the month of March/April/May. This time is very crucial as water is low are most vulnerable to fishers and predators. In Hail Haor, all RMOs established a fishing closure in the early monsoon (March-May) to allow the adult fish to spawn. While in Turag-Bangshi and Kangsha-Malijhee areas, the closure is applied from April-June each year. However, during seasonal closure some small subsistence gears (thela jal, small traps, jhaki jal) usually used are allowed.

Stop 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 Chairmen and members took part in awareness campaigns so save the fishery through saving the fish fry. Partial success has been achieved in this effort.

Stop 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 this issue very seriously and with RMO and LGC support continuously motivates fishers, government personnel and more importantly 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 the 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. In order 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 the deeper parts of the khals or beels either naturally or through re-excavation. Four Sanctuaries are also established in the river kums (scour holes) in TB and KM sites. Thus far, 66 sanctuaries have been established covering an area of over 75 acres (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-Malijhee	21	12.11	4,898
All sites	66	75.74	21,021

Besides these small sanctuaries, MACH has advocated the establishment of large and permanent government sanctioned sanctuaries in its sites. MACH staff explored suitable large water-bodies based on suggestions made by the RMOs, local fishers and leaseholders as to 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. LGC reviewed and approved the proposal. MACH then prepared with the community groups the technical proposals and submitted them to the MOFL for review and approval. The MOFL raised the issue to the Steering Committee (SC) for approval.

The MOL approved the proposal and issued an order for handing over 8 water-bodies to RMOs for the establishment of permanent sanctuaries in 2003 (Table 9). Of the 8 permanent sanctuaries, 2 are located in Hail Haor, 5 in Turag-Bangshi and 1 in Kangsha-Malijhee site. Two large sanctuaries in Hail Haor are beels (whole beel), 2 out of 5 in the TB site are daha in the beel and 3 in the river kums while in KM site the sanctuary site is river kur (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)	200m up and down stream	Existing
6. Turag River (Lalkhar Kum)	200m up and down stream	Existing
7. Turag River (Gabtali-Syedpur Kum)	200m up and down stream	Existing
Kangsha-Malijhe	200m up and down stream	Existing
8. Malijhe River (Part in Malijhikanda)	200m 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 re-introduce 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), etc. Of these species, meni is available in Hail Haor but not in Turag-Bangshi and Kangsha-Malijhe sites. Table 11 shows the list of threatened species reintroduced in MACH sites.

Table 11: Re-introduction of species since inception (2000-2003) in MACH sites

Species Reintroduced	Hail Haor	Turag-Bangshi	Kangsha-Malijhe	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. As discussed in the ISMP section MACH is beginning to undertake large scale habitat restoration activities in its sites. Details of excavation, riparian and other activities is to be found in that section. 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.

v. RMO Strengthening and Sustainability

The existing RMOs are now managing their allocated wetlands and associated areas with technical and management support form MACH project. Making them sustainable is a complex and bng-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 to natural resource management" 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 and thereby demonstrates sustained management of natural resources by the concerned communities. The workshop output provides a guideline towards sustainable wetland resource management.

RMOs, as community organizations ensuring conservation-oriented approaches to the management renewable resources, should be seen as supporters of government policy. MACH will continue to support efforts to have the GOB supply incentives that encourage their formation and ensure their sustainability. Other incentives to be considerably government should include longer leases and reduced costs for leasing, the provisions of training and capacity building supports from concerned agencies, and so forth. The government should consider providing RMOs or similar organizations priority in the allocation of wetlands and other water-bodies for the conservation and enhancement of natural resources. In order to build the capacity, various steps have been taken by the project. All RMOs formed in the three MACH sites have been provided with support in various technical and managerial areas. This included formal classroom training, interactive lectures with field works as well as on-the- job training where RMO members work with the project staff in accomplishing various natural resource management activities.

In 2002, all the RMOs were provided training and guidance on NRM planning that included detailed planning for their areas. . A total of 321 RMO members participated in the training sessions on NRM planning conducted at the respective sites. In addition to NRM planning RMOs were provided training on plantations with a total of 217 RMO members (taking 2-3 members from each RMO) being trained 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
T-B	66	48	19	313	73	30	21	0	0
K-M	146	56	16	303	74	21	23	0	0
Total	**321**	**217**	**60**	**865**	**278**	**77**	**102**	**72**	**80**

With the understanding of the importance of financial management to community RMOs 2-3 members from each RMO have been provided with training on accounts management. It is noted that after the formal accounts training, MACH accounts staff continuously assist each of the RMOs in maintaining their account books properly.

vi. Institutional Arrangements

MACH from its inception has been committed to the inclusion of local government at the Union, Upazilla and District levels in MACH. The involvement of local government directly 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 staffs at the various Districts, then with concerned UNOs, Union Parishad Chairpersons and Members. Based on those discussions the project held formal introductory meetings at all sites for all concerned Upazilla Officers and Union Parishad Members. A major recommendation from the meetings was that a local government committee (LGC) be formed. The recommendations included a statement of work identifying the members (UNO, UP Chairs, concerned Upazilla Officers and MACH partners). LGCs were therefore formed at all sites with the UNO as chair and initially the MACH Site Coordinator as member-secretary. 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 Upazilla Fisheries Officer (UFO) the Member-Secretary of all committee and to allow RMO chairs and members to attend these meetings. UP chairperson were included both as member of the LGC and as 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 insured smooth relations with local government at all levels. This again showed that local government and local communities are capable of management local natural resources.

vii. 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-Malijhee 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, unplanned and unsustainable upland cultivation in the hill slopes in Bangladesh and India are the main reason for increased soil erosion. The wetlands in Hail Haor and Kangsha-Malijhee sites are under serious threat of increased silt deposition causing acute shortage of dry season water and thus affecting the natural productivity of capture fisheries.

The local communities in both the sites identified increased rate of siltation and raising 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 amount of silts coming into the Haor through a number of charas (hill streams) originated from surrounding Satgoan and Balishira Hills within the country as well as streams from 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 aggravating the dry season water shortage problem. To address the soil erosion and siltation issue, various activities have been taken up by the MACH project aiming at increasing tree cover at the watershed areas so that the rate of soil erosion can be reduced and thus the wetland habitats can be protected. The activities included:

- Riparian and Institutional vegetation cover along the streams and roads approaching wetlands
- Environmentally sustainable pineapple cultivation demonstration along hill slopes, and

Riparian and Institutional Vegetation Development. During the project period about 333,000 saplings of various species of plants have been planted in three sites in the low-lying areas, riparian areas and in various local institutions. The basic standpoint of plantation program was to increase the vegetation cover to arrest soil erosion and thereby protect 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: Number of trees planted in Riparian areas and local institutions including homesteads

MACH Sites	Riparian	Institutional	Total
Hail Haor	48,638	11,851	60,489
Turag-Bangshi	23,092	23,522	46,614
Kangsha-Malijhee	96,724	23,172	119,896
All Sites	168,454	58,545	226,999

Table 13 shows the number of trees planted in riparian and institutional areas in three MACH sites. A total of 60,489 saplings have been planted in Hail Haor site of which 48,638 saplings have been planted in the riparian areas (along the charas) and 11,851 in various institutions. In Turag-Bangshi site 46,614 plants have been planted of which 23,092 in the riparian areas and 23,522 in various institutions. Maximum trees have been planted in Kangsha-Malijhee site where a total of 119,896 saplings have been planted. Of the trees planted in the site, 96,724 in the riparian areas and the rest in different institutions.

The institutional plantation covered all suitable institutions in the project area viz. schools, madrasas, mosques, cluster villages, etc where potential for plantation exist and the authorities are willing to take care of the plants and agreeable to project related conditions.

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

To stabilize the river and stream banks, apart from developing tree cover (upper canopy), under story vegetation cover was also initiated. The idea was to make a green cover of the bank surface so that soil erosion due to run off could be protected. To this end, vetiver

grasses (super soil binding grass) have been planted along the chhara banks, riverbanks and roadside slopes. The roots of vetiver grass are long and penetrated deeply in the soil thus form a mat on soil surface and stabilize surface soil during surface run off of rain water.

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

In the Kangsha-Malijheee site, a total of 464,000 tillers of vetiver grasses have been planted along the Malijheee River from Paglar mukh to Tinani bazaar, Hasligaon Chairmanbari to Darger khal and along the Kewta Beel complex (5 km, two rows). Over 200,000 tiller of vetiver grass were also planted in Hail Haor along the charas. The result of vetiver plantation was not very encouraging and thus emphasized on massive tree cover, which has both environmental and socioeconomic values and the communities also very supportive as they see the tangible benefit.

c. Community Development and Supplemental Income Generation

i. Introduction

The main objective of the component has been to ensure equitable access and participation by the poor in the management of floodplain resources. In addition, recognizing that the reduction of fishing pressure and imposition of closed fishing season is a critical part of reviving the floodplain fisheries, MACH has included supplemental alternative income-generating activities (AIGA) as means to ensure that poor fishers and other RUG members are not unduly disadvantage.

MACH, through its NGO partner CARITAS, has organized groups of economically or socially disadvantaged men and women, including fisher. A total of 225 groups with 4,598 members have been enrolled in MACH Resource User Groups (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, 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 with recovery to-date amounting to Tk 25.588 million. The average per cent 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 six per cent.

ii. Awareness Raising Campaign

The MACH field program started with an extensive awareness raising campaign targeting resource users, local elites, Union Parishad members; Upazila and District level government

officials. The awareness topics covered project goals, objectives and activities aimed at developing sustainable wetland resources management and their enhancement with direct participation of the RUGs and the neighboring populace. A total of 141,701 RUG members and community people attended 683 awareness raising related 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 where held in small gatherings at the farmers' court yard, called Uthan Boithok (courtyard meeting). 483 Uthan Baithoks were held at the three project sites during the project period attended by 14,237 participants. Topics discussed at these baithoks focused on RUG issues and included RUGs organization building and their range of activities; the importance of closed fishing seasons, establishment of fish sanctuaries, tree planting in wetland for habitat restoration and fish conservation. Participants also talked about their socio-economic condition, 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 to the above the goals and objectives of MACH project were presented and efforts were made to convince the participants to extend their cooperation to achieve the project goals.

Village level. At the village level, 170 awareness sessions were organized and attended by 107,352 RUG members and other community members. Village awareness programs included the staging of live drama shows highlighted problems of resource conservation, over-exploitation of resource and degradation of resource base, the MACH approach to local resource management, holding of farmer field days on different agriculture and aquaculture demonstrations, awareness for plantation activities besides exposure to MACH goals and objectives, project implementation modes and methods.

Union Parishad Level. At the Union Parishad (UP), introductory and awareness raising programs were conducted. MACH held UP level 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 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 the set objectives mentioned below:

- Making RUG members and the wider community aware of the need for resource conservation and management
- Working with RUG members on the need for alternative income generating activities to s reduce fishing pressure.
- Encouraging successful RUG group members by providing awards during the program
- Arranging get togethers of all project participants (RUG, RMO, development allies, local elites, local govt. officers and project staff) for sharing the experiences of 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 a part the awareness campaign MACH has conducted a total of 109 live drama shows at the three sites attended by over 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, etc.. The programs were performed in 2001, 2002 and 2003 by an NGO specializing in village drama. This program has been found to be effective and popular at the village level. MACH as a result, plans to conduct additional dramas at different levels (school, community, etc.) in the phase MACH-II.

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

- Importance of wetlands to communities.
- Issues of wetland resource degradation
- Population pressure and effect on wetland ecosystem
- Cause of fish and other resource decline
- MACH approach to involve community people
- Community actions that can conserve the wetlands
- Involvement of local government and local administration in successful conservation of wetlands.

Table – 14 : Status of site-wise cumulative of awareness raising program

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

** para; small part of a village*

Cross Visit. 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. Table -15 shows the particulars of cross visit programs organized by the project.

Table – 15 : The status of cross visits.

Particulars	HH			KM			TB			Project	
	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Target	Achievement
Nos.	2	1	2	2	2	4	2	-	2	Need based	8
Participants	28	16	44	100	30	130	37	-	37		211

iii. Resource Users Groups (RUGs)

The main focus of MACH Community Development activities has been the formation and support of Resource User Groups 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 groups had been formed during the project period with a total current membership of 4,598 Out of 225 groups, 155 are male and 73 are female, formed with 3,127 male and 1,471 female members respectively. Table–16 shows the site-wise status of organized resource user groups.

Table – 16 : Status of site-wise organized Resource User Groups (RUGs)

Particulars		HH			KM			TB			Project	
		Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Target	Achievement
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 2000 to 4400.

iv. Alternative Income Generation Activities, Credit and Savings

Alternative income generating activities (AIGA). MACH through its partner NGO Caritas has implemented alternative income generating programs in all the 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 with the most popular AIG activities being: 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), rickshaw purchase & pulling (435), and others.

Table – 17: Status of AIGA implemented by the RUG members.

Kind of AIGAs	HH			KM			TB			Project achievement
	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	
Total 35 types	2,401	806	32,07	1,893	849	2,742	830	229	1,059	7008

Baseline Income Survey. A simple short opinion poll survey was conducted in December 1999 to arrive at some baseline data. The survey was aimed at ascertaining the income data of 416 individual RUG members at the starting point 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, working areas primarily devolved on paddy fields and fishing wetlands) with little or no notable supplementary income. A per capita annual income of $180 was considered as the base line income with which to measure the alternative supplementary income.

Increase in alternative supplementary income. The increase in supplementary income has been tracked from December 2000. At Hail Haor and Turag-Bangshi sites, in the first year, there was a notable increase of 19.44% in the income of individual loan users. 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 Dec. 1999) to $56/capita/year (i.e. 31.11%). The data came from a survey of 183 individual users out of 1,279 loanee by December 2001. In the 3rd year, CARITAS has conducted survey of the same users that were surveyed on previous occasions in Dec. 2000 & 2001. It was found that the supplementary income increased to 40.29% (37 samples were studied out of a population of 2000). At the Kongsho-Malijhee site, survey was however conducted from the first day of the project implementation (2001) and it revealed an increase of 30.13% in RUG member's income. In the fifth year of project implementation (i.e., final year of the project period), supplemental income increased by an average of 46.55 %. The site wise increase had been 52.02% at Hail Haor, 50.94% at Turag-Bongshi and 40.34% at Kongsho-Malijhee site.

Enterprise Loan. MACH recognized that micro-credit supplied through the project, while achieving the results expected, does not generate life changing amounts of income. After discussion and agreement with CARITAS the project agreed to initiate SME loans of Tk 20,000-30,000 on an experimental basis. Selected RUG members were encouraged to expand their activities as a larger business enterprise. To implement such programs, MACH-Caritas imparted micro-enterprise development training to potential RUG members at all project sites. Eleven skilled and interested RUG members took enterprise loans and implemented micro-enterprise activities successfully. The type of enterprises they embarked on were: poultry rearing, plant nursery establishment, carpentry, land tilling by purchasing power tiller, cattle fattening etc.. As a result earnings, as reported by MACH-CARITAS are in the range of Tk. 4,000- 8,000 per month. Some loanees have literally come out of poverty. In addition some have also left the fishing profession altogether. Moreover some of these entrepreneurs created job opportunities with a total of 30 new jobs created for their 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 in addition encourages resource users to look for income outside of the wetlands- in a bid to reduce pressure on wetland resources. With this supplementary income, some fishers are now able to refrain from fishing for at least part of the year.
Operating through MACH-Caritas, MACH utilized a fund amounting to Tk. 10 million. This seed money had been utilized as a revolving loan fund. From the original Tk. 10 million, a total of Tk. 36.005 million has been disbursed and recovered money amounts to Tk. 28.588 million through August 2003. A total of 4,058 individual RUG members received credit services through 7,008 loan schemes during the project period. The recovery rate stood at 96%. Table –18 shows the site-wise status of ordinary loan, enterprise loan, credit disbursement and recovery status for the project period

Table – 18 : The site-wise status of loans, credit disbursement and recovery Status .

Particulars	HH			KM			TB			Project Progress	
	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Target	Achievement
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 received loans	1448	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 1st ceiling	1095	304	1,399	445	619	1,064	295	125	420	Need based	2,883

Particulars	HH			KM			TB			Project Progress	
	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Target	Achievement
Loanee repaid the 2nd ceiling	246	383	629	-	28	28	32	86	118	-	775
Loanee repaid the 3rd ceiling	-	26	26	-	-	-	-	-	-	-	26
Enterprise loan	4	4	9	-	-	-	-	2	2	need based	11
Credit amount disbursed (taka – in million)	13.114	5.420	18.536	7.032	3.88	10.912	4.895	1.662	6.557	05 (10)**	36.005
Recovered amount (taka – in million)	10.948	5.685	16.635	3.680	3.639	7.320	3.209	1.424	4.633	05 (10)**	28.588
Recovery rate (%)	98.44	99.62	99.35	94	89	89	99.02	99.42	99.26	100	96

* Existing loanee indicates the RUG members who are under loan during the month of August 2003.
** The credit disbursement target reset from Taka 5 million to 10 million as the number of RUG members increased.

In its 2002 meetings the MACH National Steering Committee recommended re-examination of the project loan disbursement and recovery procedures. Based on that recommendation, a committee composed of MOFL, DOF and MACH partners developed a detailed credit management procedure that was approved by the Steering Committee and is to be implemented in Phase II of MACH.

Savings by RUG Members. MACH RUG groups as part of the standard CARITAS and general micro-credit group culture have a forced savings program. This requires RUG 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 if they leave the group. During the project period, RUG members accumulated savings of Tk. 3.963 millions. Out of the total savings, Tk 2.676 million were accumulated by male groups and Tk.1.289 million by female groups. To acquire higher interest rates, Caritas keeps the money in scheduled commercial banks in fixed deposit receipt (FDR) Accounts. Table-19 shows the status of site-wise accumulated RUG savings.

Table – 19: Status of site-wise accumulated savings (in million Taka) by the RUG members

Particulars	HH			KM			TB			Project	
	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Target	Achievement
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	3.963

v. Training

Staff Training. Caritas staff were exposed to a variety of training courses both generic job and project related on a number of different subjects to support effective project interventions. Training was imparted in 45 sessions on various subjects. A detailed list of Caritas staff trainings has been incorporated in the appendices of Volume 2.

RUG Training. To develop group and individual skills for RUG members MACH-Caritas organized training as shown below. A total of 814 training sessions were held and attended by 15,057 RUG members and community people. In the training process group members received training on more than one occasion. Over a period of 2-3 years the average group members attended 3-6 training sessions. Details of RUG trainings have been incorporated in appendices of Volume 2.

Group Development Training. This is part of the standard group training program to develop better understanding and cohesion among group members. A total 6,580 RUG members were trained in 337 sessions during the project period. The group development training included group management, leadership and accounts keeping matters. In the training process, it is likely that one individual might have received training in more than one subject.

Resource Awareness Training. Every RUG member attended training courses on resource awareness and learnt 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 both MACH, Caritas and government personnel on their chosen AIGAs. 2,689 RUG members received training on a variety of subjects in 170 training sessions. The skill training included poultry/duck rearing, tailoring, embroidery, cattle rearing, vehicle driving, vocational training in mechanical & electrical repairing welding, cane and bamboo handicraft making, micro-enterprise development in fish culture/nursery, pen culture, cage culture, vegetable cultivation, plant nursery establishment and others.

Primary Healthcare and Education Training. This is another standard training program directed at RUG members. 1,539 RUG members, primarily women, received this training in 76 training sessions during the project period. The primary purpose was to impart training in a number of health care areas that included primary health care, sanitation and nutrition, and teachers' training for conducting adult education.

Development Allies Training. An innovative CARTIAS activity conducted for MACH is to provide training for elites and influential people from the community to encourage their support... The courses helped participants to understand the project concepts, development objectives, activities envisaged and the implementation process of MACH.. 162 development allies (local elites, village doctor, teachers, UC chairpersons, members and other influential people) received this training. Table -20. shows by type and site, the training imparted to the RUG members and community people.

Table–20: Type and site-wise status of imparted trainings to the RUG members and community people.

Type of training and batch participants		HH			KM			TB			Project	
		Up to Dec. 02	Achie. Jan.-Aug. 03	Cumul ative	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumul ative	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumul ative	Target	Achievement
Group Dev.	Batch	116	12	128	136	8	144	60	5	65	Need based	337
	Parti.	2,141	250	2,391	2,787	146	2,933	1,165	91	1,256		6,580
Resource awareness	Batch	56	22	78	96	5	101	39	2	41	Do	220
	Parti.	1,061	414	1,475	1,776	92	1,868	714	30	744		4,087
Skill dev.	Batch	47	12	59	52	14	66	35	10	45	Do	170
	Parti.	715	193	908	906	200	1,106	549	126	675		2,689
Health & education	Batch	41	-	41	17	-	17	18	-	18	Do	76
	Parti.	822	-	822	397	-	397	320	-	320		1,539
Developm ent Allies	Batch	4	-	4	3	-	3	4	-	4	Do	11
	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

Adult Literacy Courses. MACH, among others, has identified literacy as a major factor in the empowerment of economically disadvantaged wetland users. Adult education was highlighted at the inception phase and reemphasized by the MTR. Assessing the field needs and MTR recommendations, MACH increased the target of adult literacy program and conducted increased numbers of courses at the three project sites.

Eighty-one (81) adult literacy courses were conducted and attended by 1,620 RUG members. On completion of the courses successful participants are to a limited extent able to read and write Bangla, browse newspapers and maintain their day-to-day accounts. Table 21 shows the site-wise achievement of adult literacy program and related information.

Table – 21: Site-wise status of adult literacy courses

Particulars	HH			KM			TB			Project	
	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulati ve	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumul ative	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumul ative	Target	Achievem ent
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

vi. Demonstration activities

The purpose of MACH demonstrations was to encourage profitable agriculture activities which 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' or granular urea reduces the amount of nitrogen that is released into the atmosphere or nearby water bodies.

MACH demonstration activities had been innovative in nature and conducted to help poor wetland users better understand various aspects of sustainable wetland management's. Some demonstrations were held year-round while others were seasonal. After completion of each demonstration activity, an awareness-raising program (Farmer Field Days) were organized to

disseminate the useful aspects of the demonstrated items among interested farmers and others. On these Field Days, the assistance of the concerned Upazilla government officials (subject matter specialists) were sought and obtained. A total of 6,368 RUG members and community people have taken part in 11 types of demonstration activities covering 154.60 acres of land.

Demonstrations were also conducted in a variety of locations with the assistance of CIMYT, BARI, BADC, CARE and other organizations connected with USAID sponsored program implementation. These demonstration activities included fish culture (poly-culture of carp, cage fish culture, pen culture, fingerlings nursery); year round vegetable cultivation; wheat, maize, potato and elephant's foot taro cultivation; beneficial aspect of granular urea fertilizer application. Details of these activities have been incorporated in appendices of Volume 2.

Table 22: Site-wise demonstrations activities:

Items, Farmers & Area (decimal)		HH			KM			TB			Project	
		Up to Dec. 02	Achie. Jan.-Aug. 03	Cumul ative	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumula tive	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumul ative	Target	Achieve ment
Pond fish culture	Farmers	11	-	11	37	13	50	9	4	13	64	74
	Area	200	-	200	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
Granul ar 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 culti.	Farmers	54	-	54	43	-	43	72	-	72	143	169
	Area	1,302	-	1,302	700	-	700	901	-	901	2,900	2,903
Vegeta bles	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
Elepha nt foot	Farmers	-	-	-	-	-	-	1	4	5	-	5
	Area	-	-	-	-	-	-	4	7	11	-	11
Potato culti.	Farmers	13	-	13	57	-	57	20	-	20	50	90
	Area	120	-	120	250	-	250	72	-	72	270	442
Homes tead veg.	Farmers	1,382	70	1,452	2508	200	2708	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 culti.	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

vii. Tree Planting Programs

RUG Tree Nurseries. MACH project envisaged an extensive tree planting program covering roadsides, swamp lands, riparian zones, homesteads and institutional premises. The primary focus is the 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 the project's sapling requirements and also to enable the poor RUG members to earn extra income, MACH encourage and assisted interested RUG members to establish 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 learnt the nursery trade well would continue nursery activities and saplings production. This is in keeping with project goal of reducing fishing pressure by diverting subsistence fishers to other avocations of life.

Forty-seven RUG members who undertook nursery trade have produced 399,225 saplings belonging to 15 different tree species of timber and fruit categories. 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-1 (August 2003), 273,023 saplings remained in the RUG nurseries and would be available for 2004 plantation programs or sale. The site-wise status of sapling production, sale and income has been shown in Table 23.

Table –23: Site-wise status of sapling produced in RUG nurseries

Particulars	HH			KM			TB			Project	
	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Target	Achievement
Farmers engaged	16	3*	19	18	*	18	10	*	10	35	47
Saplings produced	134000	35,755	169,755	54932	27,395	82,327	98361	48,782	147,143	192,000	399,225
Species	15	6	15	15	7	15	15	5	10	-	18
Saplings sold	39445	25,680	65,125	17110	19,518	36,628	27947	13,612	41,554	-	143,307
Income (taka)	209860	156,300	366,160	96884	103,455	200,339	182992	151,302	334,294	-	900,793
Expensed (taka)	68002	25,148	93,150	44951	59,386	104,337	53190	34,602	87,792	-	285,279
Profit (taka)	141858	131,152	273,010	51933	44,069	96,002	129802	116,700	246,502	-	615,514
Remaining saplings in nursery (nos.)	94555	104,630	-	80336	62,809	-	70414	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 include shares for; (i) the RUG, (ii) local UP who own the road and (ii). landowners adjoining the road who will be impacted by the trees. The benefit sharing percentages for RUG : UP : Landowners being: 40% : 20% : 40% respectively. During the project period, 48.2 km roadside plantations were established by planting 45,087 saplings belonging to 13 tree species. 56 RUGs groups were involved in this participatory tree plantation program. Table-24 shows the statistics of roadside plantations.

Table –24 : Roadside trees planted

Site	Yearwise plantation kilometer and number of saplings planted									
	2000		2001		2002		2003		Grandtotal	
	Km	# plants	Km	# plants	Km	# plants	Km	# plants	Km	# plants
H H	6.5	6,020	7.5	6,620	4	,000	2	1,950	20	18,590
T-B	4	4,200	6	4,725	3	2,287	0	0	13	11,212
K-M	0	0	5.5	5,500	8.2	8,260	1.5	1,525	15.2	15,285
Total	10.5	10220	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 income, supply of fruits for better food and nutrition, supply of fuel-wood and timber, and also for contributing to the overall increase of tree covered surface area and bio-diversity of the 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) who planted those in their homesteads. The average survival rate was estimated at 75%. Table-25 shows the site-wise homestead plantation status.

Table –25: Site-wise Homestead Plantation Status

Particulars	HH			KM			TB			Project	
	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Target	Achievement
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

viii. Health Care and Sanitation Improvements

MACH project identified several supporting activities for improving the life style of poor RUG member. These are:

- Installation of pit latrines
- Sinking of tube wells
- Distribution of Worm Clothes

Table–26: Site-wise status of installation of pit latrines, sinking of tube wells and distribution of warm clothes

Particulars	HH			KM			TB			Project	
	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Up to Dec. 02	Achie. Jan.-Aug. 03	Cumulative	Target	Achievement
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. RUG members profile survey was deemed essential to understand the pattern of changes in the economic status of the RUG members on account of operation of various project assistance programs and loan schemes. To accomplish the profile survey, Resource Management Consultants (RMC) was hired. Caritas closely collaborated with the RMC throughout the whole survey operation. In the process, data collection from 1,201 RUG members was done by Caritas field staff and 2,520 were completed by RMC. The data was collected by interviewing RUG members through structured questionnaires that sought to get overall picture of their socio-economic condition, base income and impact of credit operations. RMC survey revealed an average supplemental income increase of Tk.1933, 2482 and 5019 respectively through utilization of MACH assisted 1st , 2nd and 3rd ceiling loan money . Table –27 shows the site-wise status of RUG members profile survey.

Table – 27 : Site-wise status of RUG profile survey

Particulars	HH			KM			TB			Project	
	Up to Dec. 01	Achie. Jan.-Aug. 03	Cumul ative	Up to Dec. 01	Achie. Jan.-Aug. 03	Cumul ative	Up to Dec. 01	Achie. Jan.-Aug. 03	Cumul ative	Target	Achiev ement
No. of RUG members surveyed	1,750	-	1,750	1,158	-	1,158	825	-	825	2,500	3,733

d. Monitoring

MACH carried out a baseline survey and has followed this up with impact and monitoring of fish catch and household level fish consumption in the three sites. Fish catch was measured at selected locations every 7 days during the baseline period and on a 10-day interval in the impact period. Fish consumption observers visited households every 7-8 days per month and physically measured 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 CPUA (Catch Per Unit of Area), CPUE (Catch Per Unit of Effort), and number of fish species to express the biodiversity scenario for the three sites by each monitoring locations, by sites and by years. The household fish consumption data have been interpreted as per capita fish consumption and species consumed by land size classes, by sites and by year.

MACH feels confident that the overall data measurements were precise. But MACH is not a research project and given the large variances involved there are always questions to be answered regarding overall data accuracy. MACH feels that the catch data is more indicative of positive trends generated by MACH activities than as an absolute measure of production.

i. 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 the fresh water capture fishery beyond MACH sites to the country as a whole. MACH Impact Report (volume 3) describes the positive correlations between flood extent, maintenance of dry season water levels and fish production. In addition the project found a very 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).CPUA has been expressed in kg/ha/year for a specific monitoring area or a site. CPUA of the baseline and impact years as observed by sites are presented below:

CPUA of monitoring locations in Hail Haor was 171.08 kg/ha/y while 205.05 kg/ha/y, 190 kg/ha/y and 287.28 kg/ha/y were recorded in the impact year-1, year-2 and year-3 respectively. The higher CPUA in the impact years than that of the baseline year indicated the production of fish increased in the area compared to 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. Bi-variate (CPUA and water level) regression analysis indicates that there was positive correlation (R=.85) between CPUA and retaining of water level during dry season

(March-April). It indicates an increasing trend of CPUA during the period of four years. The value of R square explains that CPUA depends 75% on water level being retained in the dry season. Four years data are not sufficient to draw conclusive remarks on same trend, however, analysis shows a positive trend of CPUA in the Hail Haor site.

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

The regression analysis (R= .84) indicates a positive relationship between CPUA and the project intervention periods. The linear bi-variate regression determines that (R square = .67) 67% variation in CPUA could be explained by the project interventions. The trend of the CPUA was found positive during the project intervention period.

This site was selected a year after the others. Higher CPUA of 149.16 kg/ha was observed in the impact year-1 compared to 150.16 kg/ha in the baseline year indicated slight decrease than that of baseline period. However, in Impact year-2 CPUA was observed 273.37 kg/ha which indicates 82% increase over the baseline period. It may be due to establishment of fish sanctuary in Katakhali, Darabashia, Kewta and in Bailla-Bailsha Beel complexes.

Catch per Unit of Effort (CPUE). CPUE has been expressed in kg/day/gear effort over a specific period of time (viz. day or month or year). CPUE of the baseline and impact years as observed by sites are presented below:

The higher CPUE of commonly used gears in the monitoring locations of Hail Haor was observed in impact years compared to the baseline period (Table 28). Increase of CPUE was observed double in case of thela jal in the impact years compared to baseline period while the gear operation time in both periods was almost same.

Table 28: CPUE in baseline and combined impact period of 3 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

Higher CPUE of commonly used gears in the monitoring locations of Turag-Bangshi site was observed in impact years compared to the baseline period except for the current jal (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 (kg/day/gear) in Baseline and combined impact period of 3 years in TB site

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 to that of the baseline period except the ber jal (Table 30). The CPUE of ber jal was increased by about 412% in the impact year compared to baseline period.

Table 30: CPUE (kg/day/gear) of Selected Gears in Baseline and impact year in KM site

Commonly used Gears	Baseline Period		Impact period of 2 year	
	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 vary by seasons largely due to changing water regimes over the seasons, fishing practices and fishing intensities. In general, floodplain beel catch is least in the pre-monsoon (April-June) when water level is low, major fishing from beels is done and people are busy in harvesting boro rice then the catch started to increase in monsoon (July-September) with the rising water level due to rains and floods and peaked in post-monsoon (October-December) which coincides with the recession when fish tend to migrate back to rivers/deeper pools and are caught in large quantity. The catch then again starts to decline over the dry season (January-March) and finally reached it's lowest in pre-monsoon.

The lowest catch was observed in pre-monsoon (April-June) in Hail Haor contributed only 7% of the total annual catch. Then the catch rate increased in monsoon (July-September) to 25% and further increased to 33% in post-monsoon (October-December). The highest catch (35%) in Hail Haor was recorded in the dry season (January-March), which is unusual but happened possibly due to the major catch of beels were done (katha fishing and dewatering) by the leaseholders.

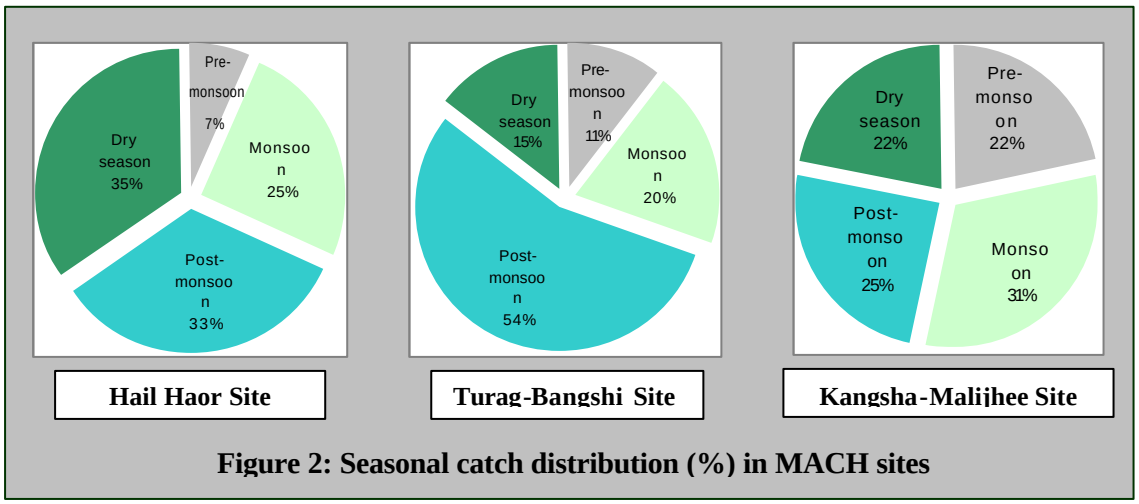

Figure 2: Seasonal catch distribution (%) in MACH sites

Like Hail Haor lowest catch of 11% was observed in pre-monsoon in Turag-Bangshi site (Figure 2). The catch then increased over the monsoon (20%) as usual, and peaked in post-monsoon contributing 54% of the total annual catch and then it sharply declined to 15% in the dry season. The lowest catch in the dry season was associated quick recession of water from floodplain beels and the absence of perennial water in the beel area.

The seasonal catch distribution in the KM site is more or less similar to that of other two sites. However, variations in catch quantity do not vary much among the seasons like in two other sites (Figure 2). The lowest catch of 22% was observed in pre-monsoon and the maximum of 31% recorded in the monsoon.

Fish Species diversity. The fish catch monitoring data have been collected by species and thus the number of fish species observed during the whole monitoring period by monitoring locations can be assessed. This data has been analyzed and expressed as the number of fish species observed in the baseline as well as in the impact period.

Diversity of fish species was recorded 71 at the baseline period while 85 species were recorded in the combined impact period of 3 year in Hail Haor site. Presence of fish species in the impact years varied from year to year (from 69 to 76). However, increased diversity indicates a positive impact of the conservation initiatives undertaken by the communities with MACH support.

Diversity of fish species in Turag-Bangshi site was found higher than that of Hail Haor. During the baseline period 82 fish species were recorded from the monitoring locations while in the combined impact period of 3 years, 95 species were recorded from the same locations indicates positive impact of project interventions on biodiversity.

Compared to the two other sites, diversity of fish species was found lower in KM site, which ranged from 64 at the baseline to 71 in the impact year-2. Lower species abundance in the location may 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 like reintroduction of locally threatened species, establishment of wetland sanctuaries and restriction on the use of harmful gears.

ii.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 classes, species consumed and sources of consumed fish.

Per capita fish consumption for all social classes combined significantly increased from 46.90g at the baseline to 53.05g, 54.98g and 60.89g over the impact year-1, year-2 and year-3 respectively. 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 though higher (50g and above per head/day), but a bit reduction in the impact year-3 (50.00 g) observed compared to that of the baseline (52.47g) and impact year-1 (57.32) and year-2 (57.31g).

Per capita fish consumption for all social classes increased from 27.32g at the baseline to 29.18g, 30.61g and 37.14g at the impact year-1, year-2 and year-3 respectively. 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 to the baseline period.

Like two other sites, per capita fish consumption was observed increased from the baseline figure of 22g/head/day to 26.58 g/head/day at impact year-1. Higher rate of increase in fish consumption was observed among the marginal farmers (29%), medium farmers (22%) and landless classes (20%) while only 7% increase was recorded for the large farmers. Significant differences were observed between the impact and baseline situations (P-value <. 05).

iii.Vegetation and Wildlife Monitoring

Vegetation Diversity. In MACH project sites a gross vegetation survey was conducted to know the present/absence status of the flora in terms of number of species found in the area. Survey was conducted twice a year (dry season and wet season). The MACH project started activities in the Kangsha-Malijhee site one year later than other two sites. The vegetation survey of KM site was therefore done for the baseline and impact year-1 only. Comparative data of vegetation survey in three sites is given in Table 31.

Total number of hydrophytes species was recorded as 107 at the baseline period combining the dry and wet seasons in the Hail Haor. The number of species was reduced to 98 in the impact year and again observed increased to 117 at the impact year-2.

The abundance of aquatic vegetation was found low in Turag-Bangshi site compared to that of the Hail Haor. A total of 51 species 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 to the Turag-Bangshi site, diversity of habitats and surface area in larger in Hail Haor site.

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

Table 31: Abundance of Hydrophytes in Baseline, Imapct-1 and Impact-2 in three sites

Project Sites	Baseline			Impact-1			Impact-2		
	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-Malijhee	47	43	55	58	64	72	0	0	0

Variations in the number of aquatic vegetation species from year to year were possibly due to annual changing of water level and flooding pattern. It was observed that in a year when early flood contribute to sudden rise of water, vegetation cover and diversity observed less compared to the year when water level rises gradually.

Wildlife Diversity. In all the three MACH sites wildlife survey was carried out to document the gross abundance of wildlife population in the area. The monitoring was done twice a year once in the dry season and the other 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 interviewing local knowledgeable persons. The project started one year later in Kangsha-Malijhee site, therefore, results incorporated for two years only while three years findings are presented for Hail Hail and Turag-Bangshi sites. Summary of wildlife monitoring data for three sites is presented in Table 32.

In the Hail Haor site, 6 species of Amphibians have been recorded over the three years monitoring period. During baseline and impact year-2, 5 species were observed while in the impact year-1, 6 species was recorded in the same locations. Reasons for the absence of one species in baseline and impact year-2 was not clear. No seasonal variation in the abundance of Amphibian species was observed.

Abundance of Reptile fauna ranged from a minimum of 19 in the 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 observed in the area.

Abundance of birds was found higher in the Hail Haor ranged from a minimum of 110 in the impact year-1 to a maximum of 133 in the impact year-2. Record of impact year-1 revealed abundance of 110 bird species. Seasonal variation was observed in abundance of birds, higher numbers of birds was observed in dry season except in the baseline year. This was may be due to sampling error.

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

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

Six amphibian species were recorded in the Turag-Bangshi site over the monitoring period of three years. Six species were recorded in the baseline year while 5 species were observed in the impact years. No seasonal variation was observed in amphibian diversity except that 6 species were observed during wet season in TB site.

Table 32: Wildlife species recorded in Baseline, Impact -1, Impact -2 in MACH sites

Organism	Baseline			Impact-1			Impact-2		
	Dry	Wet	Both	Dry	Wet	Both	Dry	Wet	Both
Hail Haor Site									
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 Site									
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-Malijhee Site									
Amphibians	5	5	5	5	5	5	0	0	0

Organism	Baseline			Impact-1			Impact-2		
	Dry	Wet	Both	Dry	Wet	Both	Dry	Wet	Both
Hail Haor Site									
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

Reptile population was also rich in the baseline year compared to impact years. A total of 19 species of reptiles were recorded in the baseline year while 16 species were observed in impact year-1 and year-2. Like amphibians no seasonal variation in the abundance of reptiles observed in the area.

Population of birds in the area ranged from a minimum of 96 observed in the impact year-1 to a maximum of 107 in the impact year-2. Abundance of bird species in the baseline period (101 species) was a bit higher than that of the impact yeart-1 but lower than impact year-2 (Table 32). 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 and impact year-1 to a maximum of 21 in the impact year-2. Higher abundance of mammalian faun was observed in the impact year-2 compared to the baseline and impact year-1. No seasonal variation in the abundance of species observed.

In the Turag-Bangshi site 145 wildlife species were recoded at the baseline period while 149 species were observed in the impact years. Combining all classes of species higher abundance of wildlife fauna was recorded in the impact years.

Five species of amphibians were recoded both in the baseline and impact year. No seasonal variation was observed in the abundance of amphibians over dry and wet seasons.

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.

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

Mammalian diversity was found less in the area compared to two other sites. Presence of 17 species was recorded in the baseline year while 16 was observed in the impact year. No seasonal variation was observed in case of mammalian fauna.

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

iv. Hydrology Monitoring

Hydrology study is essential for the proper management of wetlands. Wetland ecosystems depend on the 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. Also, the high sediment load eroded from the degraded watershed is carried into the stream system and wetlands causing rapid filling of stream beds and Haor basin consequently impacting the biodiversity and eco-system of the Haor Habitat. For this reason, from the beginning of the project, MACH has been 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 corrupted form of the Sanskrit word Shagar (sea) or the Arabic word Bahar (sea). There are 35 large Haors 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 Sreemongal under 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. miles). The basin water originates from the surrounding mostly hilly watersheds of which approximately 85% lies in Bangladesh and 15% in India. The wet season area of Hail Haor is approximately 13,000 ha while the dry season area varies from as low as 500 ha to 4,000 ha.

Due to a variety of manmade 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 flash floods 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, locally called "Chara", that flow into the Haor. A large number of smaller seasonal streams also feed into the haor. Among the charas, Bilashi Chara 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, while the Udna-Lungla-Bilashi system has a length of around 15-20km.

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 has identified a number of hydrological parameters for systematically measuring those parameters. These included 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.
The water levels of Hail Haor were analyzed and it was 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 till the end of April 2001. However, in 2002, water level receded slowly till the end of March, and began to increase from early April. Usually water level begins to increase at the end of April or beginning of May. Also, this year (2002), the water retention period was above 5.5m PWD (about 10 ft depth of water) was longer than the previous 2 years. Year 2003 was also a moderate year; water in the dry period (2003) was relatively lower than the last year (2002). Early monsoon flood onset in 2003 was earlier than the last four years.

Possible Relation of fish yield with hydrology. From the 5 years hydrology data, it is observed that water level of Hail Haor begins to rise in April-May. The date of pre-monsoon flood commencement is one of the major factors which impacts on yearly fish production. The earlier the flood-water level rises in April, the potential for more breeding is there if other conditions remain un-changed. Analysis shows that in the base year (1999), pre-monsoon flood onset was on 6 May,99 which is comparatively late and fish production was only 171.08 kg/ha. Impact-3 showed highest yield of 287.28 kg/ha because of the earlier flood onset. Therefore for Hail Haor, April to May might be termed as the critical period for total fish yield, i.e. the earlier the flood comes, the higher would be the fish production.

Chhara 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) with little if any surface water reaching the haor (largely because of water used in the 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, i.e. 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 highest sediment and have water flow throughout the year) and water samples were collected once a week during the wet season.

Besides the 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 appreciating the impact of various land use types on watersheds and help defining 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 sub-watershed with respect to soil degradation. Analyses of the two Charas, Joita and Jag, showed high siltation rate. The eroded sediments are carried by the streams and ultimately reach the haor, filling the wetland basin beds. If increased siltation rate continues for a decade, centimeter by centimeters sediment will settle at the basin bottom and many beels will lose their perennial nature. Consequential effects will be: loss of the expanse of dry season aquatic habitat and loss of brood fish. Remedial measures lie in undertaking activities that would slow down/reduce sediment transport.

Remedial measures would be like bank protection, watershed restoration and regulation of watershed land use, riparian plantation, proper use of stream water, etc.

Hydrology and Water Resources of Turag-Bangshi Project Area. The Turag-Bangshi river basin is located in the North Central Region of Bangladesh. This region is bounded by the Jamuna, Padma, Old Brahmaputra and the Sitalakha river system; Jamuna on the west, Old Brahmaputra on the north and northeast, and Sitolakha on the east. Other important waterways are 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 etc. The MACH project area consists of a portion of the Turag-Bangshi River and their adjacent wetlands within Kaliakoir Upozila of Gazipur District and a small portion within Mirzapur Upozila 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 river pools (called 'kum's) and in the deepest portions of the beels (called 'doha'). Annual fish production is dependent 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 that have a water surface area of approximately 10,000 ha at full flood, which is reduced 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 28km of khals exist within the area. The hydrology of the Turag-Bangsi Flood Plain, like that in all other similar areas of Bangladesh, is determined principally by the monsoon occurring from May-October followed by a dry period from November-April. The availability of water determines fish production, the agriculture cycle and the live style of the people of the area. 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 is obtained from the BWDB rain gauge station at Mirzapur. The records show that on average less than 3% of the rainfall occurs in the period December-March, less than 20% in the pre-monsoon period March-May and the remainder in the period June-October. Water level and tidal variation has been obtained from BWDB records at Kaliakoir town and from water gauges set and inflow and outflow monitored by the project in Mokesh and Alua Beels and the Turag River. Historical data has shown that, while rainy season flows have maintained the same levels over the last 50 years, dry season water levels have declined. The primary cause is 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 the month of 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 the installation. Since 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 the years 2000, 2001, 2002 and 2003. In four years, similar trend is observed from January to May. Water level begins to rise in May of 2002 but in the previous year, water levels were far below during this same period. At the end of June 2002, water level exceeded 2001's level due to the heavy downpour during this month. This year (2003) water levels followed the same trend of last year.

Malijhi-Upper Kongshaw Basin (Sherpur) Hydrology. The Sherpur project site is a flash flood prone area. The farmers of the site suffer repeated heavy damage of their crops by the flooding from Shomeswari, Malijhi and Chellakhali Rivers. In each year, flash flooding occurs in these rivers for more than once and water spills over river bank flooding a large portion of the project area. These flash floods discourage intensive pond aquaculture in the area. Continued flood damage to the monsoon crop force 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 are in operation in Sherpur site from June 2000. These are: Malijhi river at Tinani bazaar, Chellakhali river, near Kapashia bridge, Baitkamari bridge and Dholi beel of Jhenaigati union. Another two gauges are in operation at Kewta beel and Tenachura Bridge from May 2001. It was the common belief that rivers of Kangshow–Malijhi basin drained only into Malijhi River. After the field investigation, it was observed that a large portion of the basin water drained into Mrigi river of Sherpur town and ultimately to the Old Brahmaputra. This new phenomenon started about 7/8 years ago. The change of this course is due to the siltation at the Shomeswari –Malijhi confluence and the 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 the water levels as well as the flow direction of the khal (MACH Hydrology Report 2002).

The water levels of Dholi beel of Kangsha-Maijhee site were analyzed for the year 2001, 2002, and 2003. The site received higher intensity rainfall in the year 2002; rainfall was 3416 mm (Jan-Dec 2002), almost double of the previous year's (2001) rainfall, 1835mm. Occurrences of flash floods were also observed in our analyses. Usually 5 to 7 floods occur in a year due to local rainfalls as well as rainfalls from outside Bangladesh. Field data shows that the water levels began to rise in the first week of April this year (2002) whereas it was about two weeks later in 2001. Pre-monsoon flood onset was earlier in 2003.

e. Special Programs

i. Investment Support to MACH

From its inception MACH has recognized the need for specific physical interventions in order to restore function to wetlands and surrounding riparian habitats. These activities have included re-opening canals and other fish migration pathways, re-excavating lost beels, re-vegetating or re-establishing riparian and wetland forests, re-introductions 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 committees. 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 has slowed MACH physical intervention progress since 2001. The interventions over the period through June 2003 have focused on minor habitat restoration through excavation to re-establish permanent water bodies, excavation to re-connect habitats so as 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 as follows:: i) have a biological impact, ii) be socially acceptable and iii) be technically feasible. The interventions must offer quantifiably positive impacts for the concerned wetlands and the communities that live around them. The potential impacts must be of sufficient size to justify the interventions cost. Interventions must be acceptable to the community as a whole and benefit the entire community. MACH engineers determine the technical feasibility of re-excavation 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 the specific requests from RMOs, community groups and other CBOs including local government. Interventions require the support of the concerned Union Parishad and the MACH Local Government Committees (LGC). At all sites the 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 working with MACH engineers to establish excavation rates for each scheme.

Earthwork & Construction Related. Details of specific earthwork interventions are to be found in the appendices of volume 2 but some of the projects completed schemes areas shown in table 33.

Table:33 Beel and Khal Excavation 2003

	Beel Re-Excavation				Canal Re-Excavation			
Site	**Achieved through 2002**	**Achieved 2003**	**Total Excavation**	**Total Influence Area**	**Though 2002**	**Achieved 2003**	**Total**	**Total Influence Area**
	Ha	**Ha**		**Ha**	**Meter**	**Meter**		**Ha**
HH	9.6	2.0	11.6	2,151	3,576	3,220	6,796	557
(HH#)	(9)			(11)	(4)			(7)
KM	3.4	1.2	4.6	119	1,419	2,578	3,997	390
(KM #)	(3)			(4)	(3)			(6)
TB	5.4	3.8	9.2	390	500	-	500	191
(TB #)	(6)			(8)	(1)			(1)
Total	18.4	7.0	25.4	2,660	5,495	5,798		1,138
# Schemes	(18)			23	(8)		11,293	(14)

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: the establishment of permanent boundaries, the addition of fish aggregating devices (FADs) and structures that prevent illegal fishing. Details are shown in the table 33 below.

Tetra-Pod/Pipe Construction. A major community concern with sanctuaries, even those with brush pile fish aggregating devices (FADs), is illegal fishing, particularly fishing with seine nets or similar gears. In an effort to ensure the permanent nature of the sanctuaries and reduce the annual recurring costs of FAD temporary fish aggregating devices 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, a tetra-pod, a hexapod concrete pipe. The tetra-pod/hexapod has been used successfully in the US and Africa as a FAD while the pipe is a standard fishing device used in Bangladesh and abroad. Both of these were purposely heavy (over 100 kgs) to prevent movement and theft. As shown below the project has introduced this technology in sanctuaries to permanently secure with the community these critical areas for future fishing.

In the coming year planning is underway to include Hexapods/Tetrapods and or pipes in all permanent sanctuaries.

Table 34 : Sanctuary Activities

			Achieved thru August 2003			
Sl. No.	**Particulars**	**Unit**	**HH**	**TB**	**KM**	**Total**
01	Mould Construction (for Tetra pod and Pipe)	No.	90	50	35	175
02	Hexa Pod mould	No.	01	0	9	10
03	Tetra Pod (RCC-No.)	No.	1305	902	950	3157
04	Ring Pipe (RCC- No.)	No.	218	550	401	1169
05	Hexa pod construction	No.	1	0	200	201
06	Demarcation pillars (RCC-Sanctuaries)	No.	138	450	70	658
07	Permanent signboard	No.	17	26	4	47
08	Brush Piling					

Watershed/Riparian Plantations Activities. Degradation of the vital aquatic and terrestrial habitats of the project command areas has left those resource bases in critical conditions. Habitat restoration, bio-diversity enhancement, soils and water conservation of these critical wetland and watershed habitats through reforestation and afforestation are also prime goals of MACH.

In the recent years, participatory tree farming on marginal public lands has proven to be successful in generating income for the rural poor, In keeping with MACH quest for securing project sustainability from environmental, biological, social and economic view points, MACH worked on participatory tree plantation scheme .

With experience and expertise gained in the initial years of MACH, a truly participatory approach has been undertaken in all the subsequent phases of the reforestation program starting with the identification of the schemes, planting plan preparation, choice of species, community's involvement in field program execution. RMOs and RUG committees in close coordination with project staff selected the restoration/reforestation sites. The local UP chairmen and ward members reviewed recommend the scheme sites while the Local Government Committee (LGCs) accord the policy approval. The local people (especially the adjacent private landowners) who are to some extent adversely affected by shade to their rice crop and at the same time also directly benefiting from a percentage of harvesting, were informed of the program and motivated through regular dialogue. Local community primarily decided what to plant. The project staff assisted them with technical information and group of trees from which to select from what were suitable biologically. High valued timber and fruit bearing trees and medicinal plants mostly dominated species selection. Guaranteeing distribution of ultimate benefits to various partners at final harvest was ensured through the execution of formal written agreements on 150 Taka Non-Judicial 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 (details in Appendices, Volume 2) were planted in the 3 project sites on wetlands, riparian zones, watersheds, rural road slopes, homesteads and institution premises with a promising 80-90% success. MACH has made a significant contribution to the country's bio-diversity enhancement. In terms of resource building, considering 40% of the planted saplings to finally develop as mature trees at times of harvest in 15th year, timber production from these plantations is likely to attain a volume of 10.5 million cft. whose value at current prices amounts to 261.6 million Taka (US $ 4.5 million). Apart from being significant biological resources, these reforested areas will influence changing local habitats for increased production of fish and wildlife. They will also generate substantial income for sustainability of RMOs and RUG organizations. The site wise reforestation by type is given in Table 35 below.

Table 35: Reforestation by type

Site	Riparian	Swamp	Roadside	Institution	Total
HH	48,638	26,307	18,590	19,986	113,521
T-B	23,092	1,828	11,212	27,329	63,461
K-M	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. In the traditional method of cultivation, the farmers grow this crop by planting it in rows that descend vertically down the hillsides. Such 'across the contour' line planting or the steep hill slopes is one of the causes of increased soil erosion from the watersheds. To improve the retention of soil on the hill sides, MACH began demonstrating to farmer contour cultivation in 2001.Observing the very encouraging positive results of MACH established demonstrations in 2001, eight more farmers adopted the new system in 11 demo plots in 2002 and nine more farmers expanded the program on 17 demo plots in 2003. This has been a significant break through in the farmers' attitudinal change.

Meanwhile, the first year's demonstration plot started bearing fruit. Monitoring by the project staff in respect of fruiting incidence, size and quality of fruits, and the overall income to the owner brought to light significant positive and attractive results. Adopting contour planting method, farmers could plant about 4,000 more plants per acre (30% more) compared

to that of the traditional vertical line planting system. In contour-planted gardens, fruiting percentage was 30-35% at the close of first year and 70% in the second year, while the same figures for traditional vertical line planting system is respectively 20-25% and 60-65%. The fruit size registered an increased weight of 0.5 kg/fruit (3 kg for contour plantation while 2.5 kg for traditional method). At the close of 2nd year, the net increased income from contour plantation system amounted to Tk. 54,000/- per acre compared to that of the traditional system. The soil conditions are improving.

MACH through future MACH II and ISM efforts plans to advocate policy changes by convincing policy makers to formulate government pineapple cultivation regulations. At the program level, motivational work will continued in the subsequent years to expand contour pineapple gardens with more vigorous persuasions through MACH extension support.

Table-36 : Showing 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 Chhara	24.68
Total			30.62

Reintroduction of Tropical Forest Indigenous Fruit Trees. Indigenous tropical forest fruiting species are themselves important for supporting wildlife bio-diversity particularly the bird populations. Because of the GOB's past policy for high yielding timber stand production through the creation of man-made plantations (mostly mono-culture or limited number of species culture) the tropical forest fruit species (normally less valued as quality timber and volume production) have been sacrificed. This has led to a significant reduction of many species.
For restoration of both plant and wildlife bio-diversity MACH identified 11 of the most important forest-based fruit species and produced saplings of these species in the nurseries. Seedling production in nurseries produced 7,340 saplings of the species shown in table 37.

Table 37: Showing List of Forest-based Fruit Tree Saplings Produced for MACH Plantation

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 the wetland and riparian areas where the project is reestablishing native forest species.

Miscellaneous Activities. MACH is attempting a number of innovative activities utilizing Investment Support to MACH (ISMP) funds. One that is taking 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 Ministry of Land, MACH has this year produced and fixed a total of 80 pillars. It is an on-going process for both demarcation of beels, as well as sanctuaries. Another bird friendly pillar cum signboard has been designed and constructed for conveying 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 road side plantations, project engineers after discussion with the community and a feasibility study, have successfully constructed small spars. It has been reported that concerned communities claim success that this rainy season it functioned as they expected and as a result, it saved the road from further erosion and protected its plantation.

Table38 : 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	Cft	0	0	10,000
04	Kalagosha Jhora repair	Cft	0	0	38,000
05	Earth-work at Abashan Prokalpa	Cft	0	0	25,000

ii. Pollution

The Turag-Bongshi MACH site in Khaliakhair Upazilla, Gazipur District lies on the periphery of the Dhaka-Savar-Tongi industrial triangle. The Turag-Bungshi/Khaliakhair Community identified industrial pollution as one of the major factors affecting their wetlands. In response to community requests MACH began in 1999 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. MACH completed the first phase of the special pollution project in March 2001 and held a final workshop in June of that year. MACH was awaiting the arrival of ISMP funds before undertaking additional activities. Leveraging ISMP funds MACH and BCAS in 2002 encouraged the Stockholm Environment Institute-York to undertake the DFID funded "Managing Water Pollution from Small-Scale Industries in Bangladesh" in this MACH areas. That program begun in early 2003 will continue through 2005.

Pollution problems. The Khalikhair project area, on the northern edge of the Dhaka-Tongi-Savar industrial belt is home to 11 industrial plants. These include a major tannery, several textile and textile dying plants, metal anodizing, and over 300 poultry farms. Further industrial expansion is expected. Most of the effluents from these flow into Ratanpur canal which then discharges into Mokeshh Beel and then into the Turag River which in turn connects with the Buriganga and Shitiylaka Rivers.

The polluting industries identified were the Apex Tannery, Aymon Textile, Rahim Textile, Gumti Textile, Bangladesh Thai Aluminium, Devine Textile, Newtex Mill Ltd., Uttra Textile, Apex Weaving, Purbani Fabrics, and some 300 poultry farms.

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 are correct, in concentrations that far exceed national and international standards and include: Cadmium, Chromium, Lead, Arsenic and Zinc. There are also high levels of petroleum distillates, high levels of dyes, sulfites as well as high chemical oxygen and biological oxygen demands, and pH, (see MACH 2000 Annual Report). In all cases, the concentration of heavy metals, sulfides, the BOD and COD were found to be higher than allowed by national standards. Significant seasonal variation was also observed, the pollution level being 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 is a result of poor industrial processes particularly dyeing. Plants are being run inefficiently and manufacturers are practicing 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 there is 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. MACH in the period 1999-2001 undertook activities to; identify the problems, begin a dialogue with industry and undertook 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 the provision of draft suggestions to clean up operations. In addition workshops were held first with community members, with industrialists and then at the end of first phase with 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 hyacinth 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 of April 2002.

Two other pollutants in the study area poultry farm wastes and kerosene, were taken up by MACH. There are several poultry farms in the area, which 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 bio-gas for their internal use. MACH through FTF worked with a poultry waste specialist to meet with smaller farmers to identify means of safely disposing of wastes. These mainly involved composting. MACH also convinced the farm owners to use a degradable kind of chemical to curb the fly problem as opposed to DDT. The use of kerosene in the operation of 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 resultant quality.

Findings From MACH 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 non-confrontational approach, attempting to establish a rapport that would encourage their cooperation. Industrialists work with MACH on a voluntary basis. In addition these industrialists 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 prosecutions under the environmental legislation and regulation. However, enforcement of the existing laws and regulations does not exist primarily due to lack of capacity of the DOE in terms of political will, qualified manpower and physical resources.

MACH has found that industries pay lip service to environmental issues; some industries going so far as to include effluent treatment plants and in some cases even meet the Bangladesh ECA 95' and ECR 97'. However, these treatment plants neither operate nor are the environmental management plans implemented. As in many environmental issues, a lack of accountable local and national government agencies, a lack of effective local planning and zoning ensures that change does not occur. Pollution has many technical aspects but is at heart, like other environmental problems, a governance issue. Given the 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 so required by buyers, their host nations or encouraged by international bodies such as the WTO.
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 are a fundamental requirement.

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

This project, funded by the UK Department for International Development (DFID) under the Knowledge and Research (KaR) Programme is being conducted by a multi-disciplinary research team from the Stockholm Environment Institute, the University of Leeds and the Bangladesh Centre for Advanced Studies (BCAS). The project is being undertaken in collaboration with the Management of Aquatic-Ecosystems through Community Husbandry (MACH) Project, a Government of Bangladesh (GoB) project supported by USAID, which aims to enhance community-based wetlands and water resource management.

Many of these factories and owned by powerful and influencial people who can deter investigation of their factories. If the situation is to be improved a participatory approach is required, which works with industry to aims to reduce future pollution levels and mitigate for 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 the livelihoods that draw on water resources will be enhanced. Major MACH interventions using ISMP funds will include but is not limited to:
Consolidation of earlier activates ,
Provision of technical support for pilot treatment that will economically reduce BOD, color and heavy metal concentrations plant
Explore the possibility of establishing an 'artificial wetland' to reduce pollutants

iii. Wetlands Valuation Study

A study was undertaken to develop a methodological framework and 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 on 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 the 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 other benefits. Direct benefits such as fisheries production, production of aquatic vegetation 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, water table impacts, have real and very 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 towards conversion of wetlands to agricultural use and to neglect of wetland areas.

To facilitate application of the approaches developed for this study a bioeconomic model was developed. The bioeconomic model is an Excel based application that will be a tool for researchers and practitioners to understand, refine and extend the economic analysis performed for this study relating economic and biological parameters.[4]
Results. The annual economic output value estimated for Hail Haor is Tk 454 million (USD 8 million). The net present value of this benefit stream over 15 years is Tk 4.7 billion (USD 83 million).[5] 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%
Non fish 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 (Tk)	454,924,591	36,986	1
Total USD	$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 non-fish 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 also very significant at 9% of total value. The share of value for

[4] An electronic copy of the bioeconomic model can be obtained by emailing Dr. Luke Colavito at Lcolavito@winrock.org or Darrell Deppert at ddeppert@winrockbd.org.
[5] NPV was calculated for the 15-year period based on a real inflation adjusted interest rate of 5%. See Chapter 2.0 for a discussion of NPV.

recreation and flood control are 2% and 5% respectively. 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 (IUCN, ICLARM, DFID, and Danida) include a strong emphasis on investment for biodiversity preservation.

The estimated annual values for the wetland economic outputs are very conservative. They are conservative because important economic outputs such as water quality improvement and aquifer charge were not included but represent very significant economic outputs. It should also be noted that the Hail Haor has already been substantially degraded from over use, 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 Ha Tk 37,986 (Table 38) and returns to wetland natural outputs Tk 31,794 (Table 39) exceeds the value of Boro rice production Tk 18,254 per Ha (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. However, the value added from Haor economic outputs will exceed boro rice value added because boro rice cultivation requires costly inputs (fertilizer, seed, own land, and other chemicals) while harvesting for the majority of hoar outputs requires very 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	391,067,09	31,794	Returns without Boro rice value
(2) Returns to wetlands (no Biodiv)	347,416,491	28,245	Returns without Project Funds and Boro
(3) Returns with no BioDiv Funds	411,273,991	33,437	Returns without Project Funds

The economic returns to the MACH project were also estimated utilizing 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% per annum and prevent a degradation of 3% per annum over 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 %*	Annual Project Caused Loss Avoided %*
Fisheries	2%	3%
Non fish products	2%	3%
Recreation	5%	0
Results		
B/C	7.4	
IRR	63%	

Note: Time horizon 15 years, MACH investment 2.2 million (USD), 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. Below the performance of the project is discussed in relation to the changed set of indicators established in November of 2001.

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

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

MACH has and continues to demonstrate to others through example and field demonstration. MACH is also the founding member of the Wetland Network where 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:

1. Co-management of natural resources
2. Sanctuary development
3. Alternate income generating activities for Natural Resources dependent populations

The unit of measure is to be the number of occasions where these are used by other organizations (i.e. Projects, NGOs, GoB, and communities).

The approaches/best practices most widely adopted elsewhere are:

1. Sanctuary establishment and shelter provision
2. Restoration of wetland beel habitat through deepening
3. Restoration of terrestrial and wetland tree habitat
4. Co-management/local government involvement in resource management
5. Alternative income generation activities
6. Establishment of River sanctuaries

Details of the extent or number of occasions where any of the above has been used elsewhere can be seen in volume 4.

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

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. Detailed results of the fish catch monitoring can be seen in volume 3 and volume 4 of this completion report. Based on the catch survey conducted it appears that fish catch has gone up during the short life of the project and in some cases quite significantly. Based on monitoring done by the project and anecdotal evidence provided by local fishermen, it is evident that the provision of sanctuaries, restricted fishing during critical periods, the securing of increased dry season water and the re-introduction of lost species have all contributed to increased fish yields and fish consumption in the areas. In all of the MACH project areas fish yield increases have been seen over the life of the project. The increases on average have been more than 70 kgs of fish per hectare per year over the three sites resulting as much as 1.8 million kilograms of new fish produced. The details of the fish catch study can be seen fully in Volume 3 and 4. 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 re-introduced into MACH areas by the project, many of which have re-established themselves adding to the production and the diversity.

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

The time frame set for the project is far too short to be able to see the diversity changes that take years to occur with habitat improvements. Realizing this, the project has created for example sanctuary areas within the wetlands and re-introduced 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 the reestablishment of some will be jump started. The project is doing this with some of those 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. Additional details can be found in Volume 4 on performance monitoring. MACH has seen species diversity increases that have come about from re-introductions. The re-introduced species have re-established themselves and exceeded the planned targets. Diversity should further increase in the future as large permanent sanctuaries become established.

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

Through the formation of Resource Management Organizations at the local level the major areas of the wetlands where MACH worked have been incorporated into management plans that have successfully established best management practices over more than the targeted 15,000 hectares of area. This indicator has been fully completed with more than 18,000 hectares under improved management. There are a total of 42 resource management organizations of different types that have been established. In phase 2 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 the fish production and

diversity. A very important indicator of success which has been fully accomplished by the project. MACH has exceeded the target set and is continued to establish additional perennial water through the recently provided local currency fund of the GoB. A total of 236 hectares of water body area has been converted from seasonal to perennial. It is anticipated that significant areas will continue to be made perennial through the future MACH 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. This was an area that MACH was not obligated to perform in 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 in addition to what was originally set out for the project in the way of outputs. This indicator was not an original project indicator.

There are benefits to both the communities managing in terms of the future value of the trees 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 the wetland). MACH exceeded the targets set despite the late arrival of local currency funds with more than 160 km of riparian area planted with some 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 (List of Sanctuaries) and volume 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 structure has been made in all sanctuaries to improve habitat quality as well as to protect fish. Signboards, slogans and red flags have been erected at sites to draw the attention of the people. MACH has also been supporting the RMO in using for the first time permanent structure (concrete hexapods) to create shelter for fish and aquatic invertebrates as well as provide permanent protection from inadvertent or planned netting. The RMO's using MACH support have established 66 sanctuaries where 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 rehabilitated*

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 between beels have been rehabilitated. Rehabilitation has also been done where making

certain portions deeper to serve as refuges for dry season fish stocks have been advantageous to production. A total of more than 11,000 meters of canal have been re-excavated.

*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, were that project credit is having a positive impact and exceeding planned targets. In MACH 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 out for up to 10 years to Resource Management Organizations by the Ministry of Land in collaboration with the Ministry of Fisheries. In addition MACH has been successful in getting the GoB through the Ministry of Land to grant MACH community groups perpetual rights over 8 areas in MACH wetlands. These 8 locations will be permanent secured as sanctuaries on a permanent basis.

MACH has also worked through its connection at the site level and within the Ministry of Land and the MoFL to promote the 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 very detrimental to the resource and has promoted the "take everything" attitude that prevailed in MACH areas at the beginning of the project. The MoL has reduced the percentages and has for the first time dropped the entire lease value of a jhalmohol for MACH groups for a permanent sanctuary status.

Currently MACH has 24 water bodies granted by the MoL to Resource Management Groups formed in MACH areas or to sanctuaries for the entire areas. Although 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 regulation in targeted areas.*

The communities have adopted time closures for fishing during the critical pre-monsoon season for varying periods of up to three months. The time closure varied among the sites as there is a variation of the inundation period. In Hail Haor the time closure is typically for a period of three months from March to May while in the Turag – Bangshi and Kangsha Malihjee 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. The communities with local government support are limiting small mesh gill nets according to the country-wide ban.

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

Within the managed water bodies the communities have stopped fishing through de-watering in the dry season. The de-watering was particularly destructive as it claimed all species and generally all fish in an area. The project has defined the number of communities to be the number of villages surrounding the critical resources adopting management regulations. A total of 103 villages have now adopted resource management regulations and the project has met it target for this indicator.

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

During the project period over 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 drama, fairs and exhibitions were also forums used for awareness building for the environment and wetlands in particular.

MACH has been conducting a continual awareness campaigns at the central government level which has resulted in some very significant policy changes particularly at the Ministry of Land. MACH has worked extremely hard at educating senior officials in government on the benefits of proper resource management through workshop and field visits for the officials. MACH has conducted awareness building field visits and made critical presentations seeking policy changes particularly with regard to land and water leasing policies. MACH through its awareness programs has achieved permanent sanctuary status for 8 water bodies in the three project sites. This is the first time ever that the Land Ministry has foregone revenue for a conservation measure.

MACH has also worked very hard and has through constant workshops, cross visits, special functions and Local Government Committee meetings been able to change the minds and convince local administrators of the need and value of community-based co-management of natural resources. This target has been fully met.

*Indicator **6.5a** Improved wetland management institutional capacity*

This intermediate result of "Improved Institutional Capacity" was not one of the original and the indicator of success for this IR was TBD. MACH has shown in Volume 4 an indicator of "Number of local Government meetings where resource management issues discussed and the process institutionalized". There were no previous targets set for this but the numbers and a brief description of the activities can be found on tab 13 of volume 4 of the completion report.

B. Impact on Project Areas

A major impact on the areas of course has been the increasing trend of fish production at all of the MACH sites. This is reflected not only in the data but in anecdotal evidence from fishermen and community members from year to year. An example of this is in the Turog-

Bhangshi site where for the first time in many years aquatic plants proliferated in certain areas of Mokes beel due to restricted netting imposed by the community on themselves. This increased habitat which likely allowed for better survival of juvenile fish and shrimp. Blooms of certain species that benefited from this were seen in both the catch data from observation of the general trend. Overall fish and plant diversity has also impacted the yields as well as the increased fish available for consumption. Fish consumption has increased in the management areas and this is heavily benefiting the poor as the very poor are reaping more than 60% of the benefits.
All of the project areas have been positively impacted by re-forestation programs, and stocking of indigenous and often beel resident stocks that have been lost.

MACH has been able to demonstrate an approach which brings the community-based resource management groups together with the local government authorities in an integrated planning and implementation framework. This co-management between government and local communities is a model whereby 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 in 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 alternative income generation programs that included training, credit, savings, literacy, health and sanitation. Project impacts have been significant from the more than 900 result demonstrations that have been conducted followed up with numerous farmer's field days. The project has been widely accepted by both the communities and local government 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 been termed by the Director General of Fisheries as one of the Departments most successful projects. MACH has worked very hard to demonstrate successful co-management of wetland resources in major floodplain areas in Bangladesh. MACH has provided guidance in the development of the strategies to be followed in the future in the open floodplain resources. MACH through its work with both the Wetland Network and the Fishery Sector Review have led to the development of pro resource management improvement strategies for the poor and those dependent on open access resources. MACH has had major impacts on the water body leasing policies and procedures of the government through it awareness and knowledge sharing campaigns. By having an impact on 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 level and at the National level, so much so that the government has allocated funds for the continuation of this work to 2005.

The other aspect is that because of MACH's success in the approach, the NGOs working within MACH are exporting the ideas to other programs of a similar nature that they are involved in. Examples of this are CNRS and CARITAS as they are involved in not only MACH but in CBFM, SEMP, and parts of fourth fisheries. The approaches and successes developed in MACH are taken by these NGOs to other programs. BCAS also retains some of the key positions in projects like the fourth fisheries project where staff have been interchanged from MACH.

The CBFM project 2nd phase has incorporated elements that were not in the 1st phase but that do exist in MACH. Their project review recommended and they have accepted the need for closer project links to local government institutions where they are working. This project is also relying on the same group of National NGO's as MACH is and the approaches used by them will be the successful elements used in MACH for example. The CBFM review referred to the MACH project approach with local government as one that they favored for adoption. For additional examples of where MACH has impacted other programs refer to Volume 4 Indicator 6a of that document.

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 Wetlands Network as mentioned in the policy section, the support to the Fisheries Sector Review and Future Development (FSRFD) 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 importantly 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 DFID funded program has and will continue to work jointly with MACH and industries in the Turag-Bangshi basin that pollute MACH project wetlands. The program has worked collaboratively with MACH and is conducted by the Stockholm Environment Institute of York University in the UK. 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 Ministry of Fisheries and Livestock. All of these have and will continue to receive full MACH field and data support in MACH 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, IUCN, DANIDA and FTF. A full list of all the visitors to MACH sites can be found in Volume 2. 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 (CEGIS) that evolved from the USAID funded ISPAN program. MACH and CEGIS shared the costs of Landsat images to be used in determining the actual decline in wetlands area over 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 (ARMP). Many of the fisheries and other relevant research produced by that project have been beneficial to MACH.

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

The review entitled "Fisheries Sector Review and Future Development Study" (FSRFD) involved a year long study that produced 17 sector papers, 5 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 has been printed and forwarded to the MOFL in June of 2003. This challenging program has been working with the Bangladesh Government and donors to review the sector and produce a series of recommendations and a roadmap for the future development of the sector.

The FSRFD documents should be considered as 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 and it is hoped that further dialogue will be shared with civil society, fishers and others in the industry over the next year. MACH through MACH II expects to continue to support the review and to support the efforts for dialogue through the Wetlands Network, the DOF and MOFL and others in the donor community. Through MACH, USAID has been a partner in this process of a review and the development of the recommendations for the sector.

B. Arranayk Foundation.

The MACH SNRA and MACH have provided the primary development and backstopping support that has allowed the formation of the Arannayk Foundation (or the Bangladesh Tropical Forest Conservation Foundation). MACH has been directly involved in all of the steps involved with the formation of the Foundation. MACH has supplied logistical support for the two BIFOR missions of Chemonics International, provided information, documents, contacts, arranged trips and meetings for those teams. MACH has been the primary source of contact with the NGO community as well as providing detailed information on the proposed sites. MACH was directly involved in the development of the Memoranda and Articles of Agreement that formed the legal basis of the Foundation. MACH identified and financed the activities of the attorney used to develop the MOA and AOA. The SNRA assisted in the development of TOR for the Board Members and was responsible for placing advertisements and then short listing potential Board Members for approval by the GOB and USAID.

Additionally the SNRA of MACH was involved in the work of the two missions one in 2000 and the other in 2001-2002 by Chemonics International to strengthen and prepare for formation of the Arranayk Foundation. Both teams used the administrative services of MACH in the implementation of their programs. Many of the recommendations found in the documents are the 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. On arrival of the commercial implementation group from IRG, MACH again provided administrative support in terms of personnel policies, arranging reservations for site visits, providing documents and otherwise supporting the start up 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 FtF, HKI, CIMMYT, the AVRDC, the ATDP I & II, the current ARD Democracy Program, CARE, the JOBs project 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 very high amounts of water required for boro rice when compared to 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, FIVDB received a grant to work with CBOs and the Union Parishad in MACH areas in Srimangal.

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

- Democracy, particularly support for capacity building of Union Parishads 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. The GOB requires support to modernize its methods of land mapping and registration MACH and Winrock have significant land use planning experience but these need institutional backing to be fully effective. Land and the existing non-transparent means of registering and transferring land is a continuing problem throughout the country.

It should be mentioned that in the five years of MACH's existence that not one USAID project approached MACH to ask for its cooperation. If USAID wants cooperation between

programs it needs to require this of partners and contractors. USAID could hopefully identify a staff member whose specific task would be to identify areas of cooperation and ensure that this cooperation actually occurs.

E. Farmer to Farmer (FTF)

MACH has greatly benefited and obtained considerable support from the Farmer to Farmer program funded by USDA and implemented by Winrock in Bangladesh.

FTF has provided a Poultry Specialist on poultry farm waste management, a very skilled volunteer in pineapple/ lemon farming, a watershed management specialist, an improved poultry management and fish production specialist, and an 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 to 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 Pineapples plantations throughout Africa and Hawaii and a noted citrus expert provided the impetus to MACH's successful contour pineapple program which is working to change the traditional vertical planting method to an improved method that uses better quality plants along the contours. This significantly reduces erosion from these steep hill sides. Because of the pineapple specialist, pineapple growers in Srimangal have been able to increase net returns by more than 50,000 taka per acre over the old methods

F. Wetlands Network

MACH has been instrumental in encouraging policy level coordination between the GOB, the wider NGO community and donors in the sector. With IUCN, BCAS and the World Bank, MACH encouraged and was instrumental in the formation of the Wetlands Network. The Wetlands Network is a loose confederation of organizations and agencies working or otherwise active in Bangladesh wetlands. The Wetlands Network has brought together 30 institutions and organizations actively involved in floodplain and wetland management projects. This combination of concerned government agencies, NGOs, projects and donors working together to share experiences and jointly pursue mutually beneficial policy changes.

MACH has been active and will continue, with other partners, to be active in Wetlands Network activities. This has taken the form of regular meetings used to present findings and new information, holding a national conference on Wetlands Issues with a range of concerned Ministries, Department and other stakeholders and most importantly using the forum to jointly pursue policy issues at the national level.

V. Financial Resources Utilized

The project funds were administered in accordance with the terms and conditions set in USAID '22 CFR 226, entitled "Administration of Assistance Awards to US Non-Governmental Organizations". The sole responsibility for fund distribution and the financial authority resided with the grantee, Winrock International.

A 'Financial Status Report' - SF269a was submitted by Winrock on an actual basis and submitted 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 I on the 28th of October and open new books the following day for MACH II. The full financial statement will be provided the beginning of 2004.

The following tables show the financial activities and man-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 10/02 – 07/03	Expenses 58/M Total to 07/2003	% of Budget spent Total Budget
SALARIES & FRINGE BENEFITS	980,634	125.319	1,105,953	90%
SHORT-TERM SPECIALISTS	39,279	0.00	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 PM Used 10/98 – 09/03	Year 5 PM Used 10/98 – 09/03	Total Person Month Utilized
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 Admin/Accounts/Supports	LT	14	396	140	536
Sub-total		34	674	251	925

Line Item	Status	No. of Persons	Year 1 – 4 PM Used 10/98 – 09/03	Year 5 PM Used 10/98 – 09/03	Total Person Month Utilized
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
Eco-toxicologist	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
Sub-total		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	1081.6
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
Sub-total		55	1068.1	338.6	1406.7
Grand Total		179	3767.41	1352.9	5120.31

VI. Lessons learned and the way forward

A. Lessons Learned

Habitat Loss. Bangladesh wetlands, producing 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 over fishing.

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

Also through MACH hydrological and sedimentation studies it became clear that dry season water in the wetlands is under threat from lowering river water flows and watershed degradation which is dumping larger sediment loads into the wetlands then would have otherwise been possible with forest cover. Because of these findings the communities and the local authorities insisted that programs address the upper watershed and re-excavation of holding areas for fish.

Wetlands valuable

Based on the early project work and MACH surveys it became obvious that wetlands were valuable and provided services to the communities that surrounded them. MACH conducted a wetland valuation survey the full details of which are found in volume 2. The results of this survey indicate a per acre value that is significant (in excess of Tk. 30,000 per year) and one that the very poor reap most of the benefits from. The study showed that the very poor are far more dependent than others because of the open access nature. This valuation did not take into account the value of the wetland as a filter or its pollution reduction function.

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

The key is "co-management" of the wetland resources by the community-based organizations with local government. This has worked and provides both a potentially sustainable system where local government provides direction and support as well as supervision and oversight. The community organizations benefit from the institutional support particularly over land issues and rights. What MACH has started is the beginnings of a local-level planning framework.

Sanctuaries plus restricted fishing works. The best management practices of sanctuary establishment plus 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 has a beneficial impact on fish catch and also works to improve the quantity of fish consumed in and around wetland areas. These two best practices have direct immediate

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

The restoration of critical dry season habitat important leading to significant impact.

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 the creation of sanctuaries within these areas have allowed fish to make it through the dry season in beels that dried earlier. These areas by retaining surface water have been able to hold fish diversity and numbers through to the wet season when reproduction and re-population can occur.

Re-introduction of lost species of fish (particularly beel resident) into their old habitat can result in successful re-establishment when coupled with sanctuaries, improved management and habitat restoration.

MACH has been successful in re-establishing populations of fish (threatened or lost) populations through a combination of re-introduction of adults and offspring into year around sanctuaries and restored deep beel areas. Successful breeding has been indicated from the adults stocked and offspring numbers have increased to a viable level in some of the MACH areas.

Land/Water body leasing policy changes (policy reform) can be achieved by local communities with clear plans, local government support for those plans, and a "Champion" for change working with all parties.

MACH has been very successful in supporting the communities managing the wetlands in developing recommendations for management and then getting their approval at the local government level, the district level and finally the central level. MACH has been instrumental in setting up linkages between communities and local government that have strengthened the ability of communities and local users to take control of the management of their resources. RMOs with the support of MACH have received long-term leases of valuable water bodies, rent increases have been reduced through MACH and other projects lobbying, and permanent sanctuary status has been granted to critical resource areas for the benefit of the resource and the community. More information on this can be found in volume 4.

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

MACH has found that it is critical to offer poor resource users other options for income and livelihoods so that reduced fishing during critical times can be put in place by the community management groups. Poor fishers have indicated that the training provided by MACH on alternatives to fishing has been most valuable. Also long-term trade training and the opportunities has been well received and helps younger members of the fishing families to see other pathways for earning a living. In some cases the alternative income activity has turned into a business and brought enough income to allow the poor fisher to leave fishing.

Stakeholders participation essential for accomplishing changed management at the wetland resource level.

MACH has found that involving all stakeholders is essential to achieve 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 re-establishment along riparian corridors can produce monetary benefits to the communities as well as physical benefits to the streams by reducing bank erosion.

This is another program pioneered by MACH and MACH groups which will bring long term gains in three ways. One the restoration of forests along the riparian corridor of rivers contributes to long term bank stability and reduced erosion and loss of valuable land. Two the forests themselves can provide a long-term income for the community groups managing, and third the riparian forests provide wildlife corridors and habitat which will lead to increased plant and animal diversity.

B. The Way Forward

The immediate way forward is to secure the sustainability of the institutions in MACH 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 Results Package Team (RPT), a MACH II has been proposed and is planned to continue as from October 29, 2003 onward. The immediate way forward is the same as the objectives of the extension of MACH I to a MACH II which are to:

- Ensure institutional sustainability of Resource Management Organizations (RMOs) and related institutions and Resource User Groups (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 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. Most authorities feel that at least five to ten years of continuous support are required to ensure sustainability, whereas MACH has been working with its RMOs for one to three years. In addition, the RUGs supported by MACH-CARITAS have been receiving alternative income credit and training support for two to four years. It has been 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. Based on its experience, the Community Based Fisheries Management (CBFM-II) program

believes that group support is required for 10 years. Sustainability continues to be an issue of concern to all community-based resource management programs in Bangladesh.

MACH during the phase II will continue to focus on community co-management involving all stakeholders but will increase its support to RMOs, RUGs and related institutions. In addition, MACH in the immediate future will actively pursue appropriate policy changes directly through the project and more importantly in cooperation with concerned government and non-government organizations through the Wetlands Network. MACH will expand its awareness and outreach programs and will pursue the use of communication tools including drama and video. MACH will utilize the 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 II will continue to pursue the following objectives:

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

The way forward beyond MACH II is for the government agencies and institutions to fully accept community-based co-management of wetland resources as the approach to be followed in the future. That sanctuaries and conservation areas are established in every major wetland across the country and that opportunities for employment become more abundant so that the pressure on existing and future resources is reduced. The other major emphasis for protection of the existing and future fishery is that dry season water be adequately retained and preserved so that native populations have adequate numbers for regeneration during the subsequent rainy season. Continued emphasis by government and non-government entities alike should be directed at wetland resource management solutions for maintaining or increasing wetland products such as fish through community-based co-management efforts and the local level.

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