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Stream: Fisheries

# Benefits of Community Managed Wetland Habitat Restoration: Experimental Results from Bangladesh

## Abstract

Bangladesh, a floodplain deltaic country, has a rich and diverse aquatic resource base with over 300 species of fish and shrimps and numerous other flora and fauna which provide sustenance and livelihood for millions of rural households. Fish alone provides essential nutrients and 80% of the animal protein consumed by the country's 111 million people. Over the centuries, the fish community in Bangladesh's floodplain ecosystem has adjusted to the plasticity of the aquatic environment. The seasonal expansion and contraction of floodplain waters through rain and flood water ingress and egress via numerous natural channels, form the basis for reproduction, growth and stability of riverine - floodplain fish populations. Unfortunately, ill - conceived human interventions which have overlooked the importance of common property open capture fisheries, have jeopardised the complex fisheries, altered and degraded fish habitats, and impeded natural recruitment of fish!!, resulting in loss of fish yield and biodiversity. In turn this has negatively affected the nutrition and livelihood of millions of floodplain dwellers. Past fisheries development projects in the country have either emphasized the socio-economic development of fisher communities with little regard to fisheries management, or promoted fisheries enhancement through the introduction of fast - growing exotic fish species. No serious attempt was made to improve fish habitats, or encourage ecologically - sound fisheries management involving affected communities.

To test the viability of an ecologically - based method of floodplain fisheries management, a grassroots level intervention aimed at community - based fish habitat restoration and management was initiated in late 1994 in a wetland in north - central Bangladesh. The project activities included participatory planning with villages around the wetland to identify problems and work out possible solutions, particularly conservation measures with the least potential for adverse impacts on the existing social relations and on the local environment. Possible management interventions were identified through a series of open community consultation meetings and participatory

appraisals supplemented by preliminary surveys. The interventions, as decided and agreed by the community along with the project team, included desilting a channel to re-establish a link between the wetland and the nearby river to facilitate migration of fish between river and floodplain, restrictions on harmful !!fishing gears for a limited period, and establishing small fish sanctuaries which the community volunteered to protect.

All the project activities have been planned and executed with community participation through a local Project Implementation Committee (PIC) formed during an inter - village meeting at the start of the project. The PIC consists of 31 members representing traditional fishers, landless laborers, farmers, local leaders and professionals, and project staff. The elected local government administrator serves as adviser to the PIC.

The paper presents the findings of the project based on data gathered through participatory social and biological monitoring during the year preceding (year 1) and the two consecutive years (years 1 and 3) following intervention. The data show an increase in fish species diversity, yield and household fish consumption. Comparison of pre-and post-intervention data shows an increase in the yield (total fish catch) from 3,932 kg to 17,404 kg in seasonal and perennial and wetlands including ditches and ponds, from year 1 to year 2. In the third year, the yield was 11,140 kg, which was about three times higher than the yield during the pre-intervention period. There was a dramatic increase in the catch of major carps from 33 kg to 1,597 kg in the second year and 1,603 kg in the third year; and that of large catfish form 1 kg to 776 kg in the second year and 357 kg in the third year. The number of fish species recorded increased form 46 to 64.

The results indicate that the channel rehabilitation facilitated migration into the floodplains or riverine floodplain spawners including Indian major carps, large catfish and other species. Project benefits were found to be widely distributed among different types of households (professional and subsistence fisher, pond owners, farmers and boat operators) within the participating community. Average per capita fish consumption for all types of households living around the wetland increased from 24 g to 30 g in the second year but fell back to 25 g in the third year compared with the second was due to low river flooding leading to lower ingress of river water and a shorter inundation period than in the second year.

Efforts are being made to strengthen and institutionalize the PIC to facilitate community management of the wetland after the project team phases out. In the third year, with project support, the PIC succeeded in obtaining a one-year lease on the wetland from the government. The PIC hopes to be able to renew the lease beyond the current contract period. On - going planning meetings between the PIC and local traditional fishers, who had been excluded from fishing by the previous leaseholder, are trying to re-establish these fishers traditional rights in the wetland within the context of more of more sustainable fisheries management.

The findings from the project have encouraged the Bangladesh Department of Fisheries and other agencies to adopt similar approaches to wetland management and to use

participatory social and biological monitoring for environmental data generation. The project has had a significant impact on national level policy planning. The international donor funded Bangladesh Fourth Fisheries Project presently under preparation is considering community - based management, fish habitat restoration, and rehabilitation of fish migration routes, which were the basic components of this experimental project, for wider scale introduction, The project has demonstrated that habitat restoration could be an ecologically sound and cost - effective way of managing some of Bangladesh's floodplain resources. Benefits have included the prevention of greater inequity in access to wetland resources, protection of biodiversity and the more sustainable production of fish, rice and other products fr!!om the floodplains. The project team is now testing similar approaches in different locations in the country under different social and ecological conditions.

## 1. INTRODUCTION

Bangladesh, a floodplain delta of the Ganges, Brahmaputra, and Meghna rivers, have one of the world's richest and most diverse inland aquatic environments, which support a diverse ichthyofauna. More than 300 species of fish and prawns reportedly inhabit the wetlands of the country (IUCN, 1993). The fisheries sector contributes substantially to the economy of Bangladesh. About two million people are engaged in commercial fishing and associated activities. Around 75% of rural families are engaged in seasonal consumption fishing in floodlands, *khals* (canals), and *beels* ((DOF, 1989). Fish constitutes nearly 6 percent of the gross domestic product and more than 12 percent of the country's export earnings (Fourth Five Year Plan, 1970). In Bangladesh, fish is second only to rice as a source of food and each rural family eat fish 3.5 days per week (Minkin et. al, 1993). The Nutritional Survey in Banglad!!esh (1990) revealed that more than 80 percent animal protein in the diet comes from fish. The rural families consume more than 50 species of fish during the course of a year hence they rely on a wide variety of fish species to get their nutrition (Minkin et. al. 1993).

The inland fishery of Bangladesh is largely dependent on and strongly influenced by seasonal variations in its rivers and floodplain systems. Sustainable population balance, species diversity, and fish production in the reverine floodplain ecosystem are thus heavily dependent on successful migration of fish to their critical habitats and recruitment potential (Wellcome, 1985). The floodplain fisheries production and social equity issues are closely linked to species diversity. Unfortunately, the social benefits of species diversity and its contribution to the fish yield have been overlooked in open water fisheries development plans. In Bangladesh, open water fisheries management policies, so far, concentrated on the production of a limited number of species through large scale stocking of carp fingerlings. To counter this trend, the Bangladesh government has adopted a two-pronged strategy of aquaculture promotion in private ponds and, for the floodplains, rest!!ocking with fast-growing, usually exotic, fish

species. Funded by the World Bank and the Asian Development Bank, floodplain-stocking programs have been credited by the government for helping increase production and fishing income (Ali and Fisher, 1995). Major benefit of the stocking program goes in favor of the lease holders and large farmers and therefore run contrary to the interests of the poor people to whom easy access to fishing of a variety of species is of utmost importance. However, serious concerns have been raised about the ecological and social equity implications as well as cost-effectiveness and sustainability of stocking programs (Kremer, 1994; Minkin and Boyce, 1994; Naqui et al, 1994).

The stocking program may produce benefits for the disadvantaged community if the stocking is done by them (fisher community) in wetlands having property rights through leasing or licensing. The CBFM (Community-based Fisheries Management) project being implemented by the Department of Fisheries (DOF), ICLARM and NGOs in selected wetlands where the fishers community is given the management and harvesting rights backed up by technical and credit support. The fishers organized under CBFM project stocked some of the semi-closed wetlands and made good profit with equal distribution of benefits among the fishers families.

This paper presents the results of an action-research project on fish habitat rehabilitation: an ecological approach, in a wetland in central Bangladesh, which may suggest an alternative approach to sustainable management of the country's floodplain fish production and biodiversity. The paper is divided into five sections. The second section describes the project, the pilot site and implementation mechanisms. Data collection methods are described in the third section and the results are presented in the fourth section. Section five concludes with a summary of the results so far and notes encouraging signs that the community-based approach to fisheries management habitat restoration adopted by the project is a success and can be replicated in other areas in the country.

## 2. THE PROJECT .4 Project Objectives

The **Community-based Fisheries Management and Habitat Restoration** is a collaborative project of the Center for Natural Resource Studies (CNRS), Proshika Manobik Unnayan Kendra (Proshika) and the Ford Foundation started in mid-1994. CNRS is a Bangladeshi resource management research organization, Proshika is the country's largest environmental-developmental private voluntary organization, and the Ford Foundation is an international funding and development agency.

The project aims to promote sustainable floodplain fisheries use through community-based management arrangements that would encourage resource conservation and at the same time promote equity in resource access. Since the maintenance of floodplain fisheries greatly depends on the cycle of flooding and fish migration between floodplains and river systems, the project encourages use of management interventions that are consistent with this natural ecological process. The project seeks to test doable participatory low-cost strategies for floodplain fisheries productivity and species diversity

enhancement in ways that would minimize the potential for adverse social and biological impacts.

**a) Project Location**

In this site the project concept was tested in the first year and therefore, termed as the pilot site. The Sigharagi Beel is a crescent shaped wetland covers an area of about 7 ha (dry season water area) and the deepest floodplain wetland in the union. This *beel* was formed by a cut off river loop: hence an ox-bow lake by its origin and locally called *rakh* (deep perennial water-body). During monsoon, the water depth rises up to 25 feet in the middle of the *rakh* and it goes down to about 10 feet in the dry season. On the east to the beel, there is a vast area of low lying lands locally called *chawk* (seasonally inundated low lying floodlands) which remain under water in the monsoon for about 6 months starting from mid June.

The wetland has direct connection with the Dhalesawri River through Haji Bari Khal on the Northwest. The length of the *khal* is about 1.5 kilometers. A major portion of the *khal* in Sanbari mouza was heavily silted up and for which entry of river water was obstructed and delayed. During monsoon, the *beel* gets connected with another wetland at the south named Abadpur Beel situated about 3 kilometers on the south. At the on set of monsoon rains in May, the *beel* started to expand spatially and inundate the adjacent paddy lands. During late June, floodwater from Dhalesawri River enters into the *chawk* and then, about a week later, to the *rakh* through a small *khal* which connect the *rakh* with the !!*chawk*. In the past, there were three other *khals*, which linked the beel with rivers. These khals are fragmented and converted in to ponds and croplands.

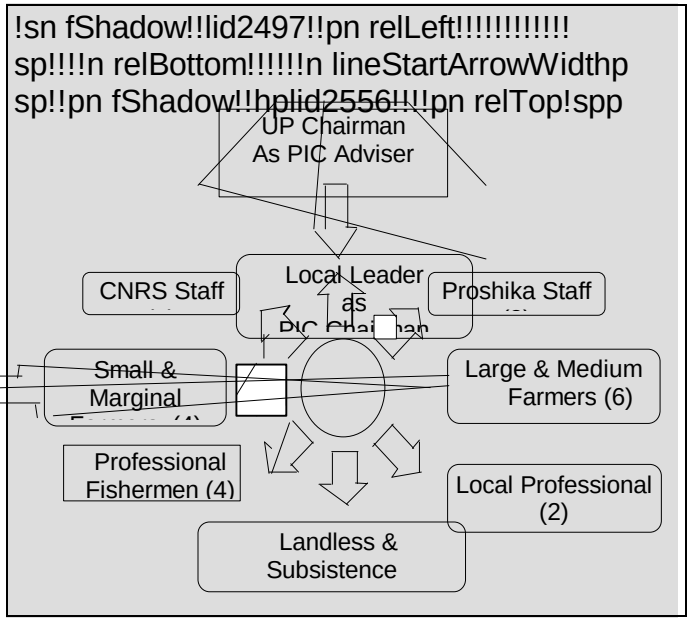
The beel was selected due to the following basic features:

- local people believe that the opening of the canal will be beneficial for fish and crops.
- the bed of the major link *khal* (Hajibari Khal) was raised due to siltation causing delay in entry of water and limiting fish migration.
- there are perennial and seasonal wetlands in the area and fishing is a major economic activity for large part of the year. And the poor people enjoy open access rights for fishing in the wetlands as a common property resource.
- the local government (union council) was in favor of desiltation of *khal*.
- there are numbers of Proshika groups in the villages around the wetland.

**2.1.2 Participatory Planning Process<u>b) Project Execution and Management:</u>**

For proper management and organization of project activities as well as to ensure local participation, a **project implementation committee (PIC)** was formed. The PIC was formed at the inter-village meeting at the out set of the project in late 1994. The PIC consisting of 31 members taking representative from four villages of various social strata

Proshika and CNRS field staffs are also included in the PIC. A Chairman headed the PIC from the locality. The chairman of Elasin Union was associated with the PIC as adviser. The services of PIC members in supervising *khal* rehabilitation and other related works were kept voluntary. In early 1997, the PIC was reshuffled as per the proposal of the committee. Some PIC members, due to their personal affairs could not attend the meetings. In place of them new members were included taking 3 more traditional fishermen in the PIC. The new PIC consisting of 30 members of which 25 are male and 5 are female (Figure 1). The chairman of the PIC remains the same.




In the first year, the Hajibari khal was desilted at different stretches in April 1995. A total of 162,400 cubic feet earth was removed from the *khal*. Local people including Proshika group members were engaged in earthwork. A total of 62 laborers were engaged, of which 44 were male and 18 were female laborers. In total, the *khal* rehabilitation work created 1,500-person days job for the local poors.

Some portion this khal at the off take of Dhaleswari River was partially silted up during flood in 1995. To keep the khal operative, this portion of the khal was again desilted in the second year (1996) under the project.

## 3. MONITORING OF SOCIAL AND BIOLOGICAL PARAMETERS

To assess the impacts of the project intervention, selected social and biological parameters are being monitored to allow for a comparison of pre- and post-intervention values. Data collection on biological parameters started mid-December 1994 while data collection on socio-economic parameters started in February 1995. The preliminary biological monitoring results reported in this paper cover only the six months from 16 December to 15 June for 1994/95 (baseline, pre-intervention), 1995/96 (post-intervention, year-1) and 1996/97 (post-intervention, year-2). The social monitoring results cover the five-month period from February to June 1995 (baseline), and the same period in 1996 and 1997 represent post-intervention year-1 and year-2 respectively. So far, these are the only months for which comparable data are available.

### Social Monitoring

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Fifty-six households were randomly selected for monitoring. The sample households were classified based on their landholding into three groups: (i) landless; (ii) small farmers; and (iii) medium and large farmers. Information on fish consumption, diversity of species consumed, fishing rights and access to fishing grounds, and household member participation in fishing are regularly collected from these households. Five village women with basic literacy and numeracy skills were selected as the project's Resident Monitors (RM) and trained in the use of structured monitoring formats and simple weighing instruments. The Resident Monitors, with the assistance of a project staff, visit the sample households for five consecutive days each month and collect data through interview and direct observation and measurement.

**Biological Monitoring**

For purposes of biological monitoring, three distinct fish habitats were defined: (i) *beel*; (ii) *chawk*; and (iii) *pagar*. *Beels* are deeper, perennially inundated areas while *chawks* are shallower seasonally inundated lands which are usually cultivated during the dry season. *Pagars* are ponds and ditches within the *chawks* dug by landowners in order to trap fish. The timing of peak fishing activity varies across the three habitats. In the *chawk*, fishing is most intense during the monsoon season lasting up to the late monsoon when floodwaters begin to recede. In the *beel*, peak fishing takes place after the monsoon when the *chawks* start to dry up and fish move to the deeper waters of the *beel*. In the *pagars*, peak fishing occurs during the dry season when it is !!easier to drain the pond and harvest all the fish that have aggregated there.

A project staff and an resident monitors hired from the community regularly collect data on catch, fish migration and species diversity, fishing intensity, methods employed by different categories of fishers and institutionalized sharing arrangements in each of the three habitat types. Out of 46 *pagars* within the floodplain (*chawk*) monitoring area, fish catch and biodiversity was monitored in 19 *pagars* in each of the three years. These data are presented in this paper to measure the changes in fish production and biodiversity at pre and post intervention periods. Total fish harvest from the monitoring sites is calculated as the sum of the catches from each fishing habitat.

To facilitate analysis, fish species were grouped into 10 large categories based on their biological characteristics, size and commercial importance. The groups are: prawns (all species of freshwater prawns); snakeheads (four species of Channidae); major carps (four species of large sized cyprinds); minor carps (Labeo bata, L. gonius, Cyrhinus reba); eels (freshwater spiny eels including one species of mud eel); exotic species (common carp, grass carp, mirror carp, silver carp and tilapia); knifefishes (Notopterus spp.); large catfishes; small catfishes; and small fishes (all species of small-sized fish).

## 4. PROJECT RESULTS

**Fishermen and Fishing Participation**

Based on survey results, 40% of the fishers in the Singharagi wetland are subsistence fishers. About 34% are part-time professional fishers and 25% are full-time professional fishers. Fishing is an activity that involves both male and female members of the

community although participation in fishing and end use of the catch varied by age group and gender. The data show that females make up 7.4% of the fishers but most of them are children below 15 years of age and are fishing for home consumption. Over all, 28% of all fishers are children below 15 years old half of whom fish mainly for subsistence. In contrast, the adults mostly (66-76%) engage in full-time or part-time fishing for sale. The participation of villagers in fishing observed higher during monsoon and post monsoon months (July-December) compared to pre-monsoon (January-June).

Participation of villagers in fishing varies from year to year and season to season. Data shows that, fishers altogether spent 690 person-days fishing with the greatest fishing effort expended by fishers from landless households before project intervention (Table 1). Participation in fishing observed increased following intervention, presumably, in response to greater fish availability in the wetlands due to extended spatial and temporal extent of wetland area. Total fishing effort almost doubled to 1302 fishing days in the following year (1996). The greatest increase in fishing effort was observed among small farmer households, which spent four times as many days fishing after intervention. In the third year of the project (1997), total fisher-person days observed 858, which is higher than the baseline situation but less than that of the second of the project. Involvement in fishing by the subsistence fishers observed decreased from 624 days in the second year and 434 !!days in the baseline situation to 402 days in the third year. This was due to some conflicts arisen in connection with the leasing of the beel. The beel was leased to a third party residing outside the project area and used to control fishing in the beel through a local agent. This year, under the project support, the PIC got the lease of the beel. But the local agent illegally controlled fishing in the beel. He fished in the beel even after expiry of his leasing period and did not allow the people to fish there. As a result, fishing participation in beel by the villagers was less. However, after the final fishing done by the former leaseholder, the villagers again started fishing in the beel.

**Table 1: Fishing Days by Household Type**

| Household Type !!cf8 | Fisher Person Days | | |
|---|---|---|---|
| | Pre-intervention (Feb.-Jun'95) | Post-intervention (Feb-Jun'96) | Post-intervention (Feb-June'97) |
| Landless | 434 | 624 | 402 |
| Small Farmer | 118 | 450 | 300 |
| Med. & Large Farmer | 138 | 228 | 156 |
| Total | !!33 690 | 1302 | 858 |

## Fishing Grounds

The *beel*, *chawk* and *pagars* represent three distinct fishing grounds where different institutional arrangements apply. While the *beel* and the *chawk* are essentially open

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access fishing areas for members of the surrounding villages for at least part of the year, only the owners, leaseholders or their designated users fish the pagars. Customarily, poor households have been allowed to catch residual fish after the *pagars* have been fished by their owners and lease holders. They have also been allowed to fish in fallow, low productivity *pagars* (e.g. *pagars* not getting sufficient floodwater during the monsoon) whose owners do not even bother to fish. Through these practices, landless households !!(often also the poorest households) have had some access to privately held fishing grounds.

Data from household monitoring show that the major portion of household catch during the observation period came from the *beel* rather than from the *chawk* and *pagars*. Landless and poor families fished mostly in the *beel* while the medium and large farmers got their fish mostly from *pagars*, which they either own, lease or share. Following the intervention, which has helped raise the productivity of the *pagars,* there are indications that landless households may lose their limited access to these private fisheries as the resources become even more productive. However, a portion of benefit of *pagars* production goes to the poor fishermen who are engaged by the owners to fish and sell the catch. The local fishermen often buy most of!! the pagars in advance from the owners at comparatively lower rate. And after protecting the pagars for 2-3 months they sale the fiah and make a profit. So the benefit of *pagars* is not solely going to the owners rather divided between the owners and fishermen of the area. Post-intervention data show a decreased proportion of landless households' catch coming from *pagars* with the *beel* as the source of a major part of their catch.

**b) Yield, Diversity and Distribution of Catch**

**Yield and Species Diversity of *Chawk* and *Beel* Catch**

Comparison of pre- and post-intervention data shows about five-fold increase in the catch from the *chawk* and the *beel* (Table 2). This dramatic increase in catch from 2,481 kg to 12,222 kg indicates an underlying increase in wetland productivity following the intervention. In the year three, production of fish *beel* and *chawk* fall from 12,222 kg to 8,693 kg, which is about 30% lower than the second year's production but more than three times higher than the baseline figure. The fall in fish production in the third year compared with the second was due to Low River flooding leading to lower ingress of river water and a shorter inundation period in the beel/floodplain than in the second year.

The data also indicate an enhancement of fish species diversity in the project wetlands. Number of species increased from 46 to 59 in the second year and to 63 in the third year (Table 2). The increase in number of species is an indication of the positive impact of habitat improvement interventions and other conservation measures adopted. These are establishment of fish sanctuaries, fishing regulation in canal, and restriction on use of harmful gears for short period in the floodplain.

The species group composition of total catch remained more or less unchanged with

small fish, small prawns, snakeheads and eels making up the bulk of the catch in both periods. However, the relative abundance of major carps, large and small catfish and minor carps following the canal rehabilitation indicates successful recruitment of these riverine species into the floodplain.

**Table 2: Yield and Species Composition of Beel & Floodplain Catch**

| Species Group | Pre-Intervention (Dec'94-June'95) | | | Post-Intervention (Dec'95-June'96) | | | Post-Intervention (Dec'96-June'97) | | |
|---|---|---|---|---|---|---|---|---|---|
| !!t1lcbpat8 !!ltxlrtb lt | Wt. (kg) | % | Species (No) | Wt. (kg) | % | Species (No) | Wt. (kg) | % | Species (No) |
| Small fish | 830 | 33.5 | 25 | 4548 | 37.2 | 33 | 2160 | 24.8 | 29 |
| Prawns | 709 | 28.5 | 1 | 4052 | 33.1 | 2 | 1495 | 17.2 | 3 |
| Snake heads | 305 | 12.3 | 3 | 1626 | 13.3 | 2 | 2588 | 29.8 | 3 |
| Eels | 417 | 16.8 | 4 | 657 | 5.4 | 4 | 181 | 2.0 | 3 |
| Small cat fish | 143 | 5.8 | 7 | 434 | 3.6 | 7 | 198 | 2.3 | 10 |
| Major carps | 4 | 0.2 | 1 | 375 | 3.1 | 3 | 1239 | 14.3 | 4 |
| Large cat fish | 1 | 0.0 | 2 | 345 | 2.8 | 3 | 191 | 2.2 | 4 |
| Exotic species | 42 | 1.7 | 2 | 135 | 1.1 | 2 | 422 | 4.9 | 3 |
| Knife fish | 29 | 1.2 | 1 | 34 | 0.3 | 1 | 59 | 0.7 | 2 |
| Minor carps | - | - | - | 16 | 0.1 | 2 | 160 | 1.8 | 2 |
| !clvertalt | 2,481 | 100 | 46 | 12,222 | 100 | 59 | 8,693 | 100 | 63 |

Evidently, the rehabilitated canal provided these migrating species a favorable habitat during the early monsoon. The reopened canal not only facilitated fish migration but also allowed more river water into the floodplain than would have been available without the intervention. Thus, habitat for fish in the Singharagi wetland was expanded both spatially and temporally with the desiltation of the Hajibari Khal. The intervention provided fish a wider area and made possible a longer duration for nursing, feeding and growth in the fertile floodplain.

In addition, other conservation measures were adopted for sustainable fish production. The measures were establishment dry season small fish sanctuaries in the floodplain, ban on using fine mesh nets for two months during fish breeding season and ban on using set bag net in canal during peak migration of fish from river to beel. These measures are planned and adopted at the community level meetings and in the PIC and found positively contributed to increased fish production and biodiversity.

**Yield and Species Diversity of *Pagar* Catch**

Total yield from the 19 *pagars* monitored (before and after intervention) increased by 257% from 1,451 to 5,182 kg after intervention in the second year. Average yield per

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*pagar* also increased from 76 kg to 272 kg in the second year (Table 3). In the third year, the production of fish from 19 *pagars* fall to 2,440 kg with 128 kg/*pagar* which is about 50% less than the second year's figure but 70% higher than the baseline production. The lower production in the third year was due to low flooding in the second year of the project.

Major changes were observed in both the catches, species composition and the relative contribution of species to total yield. Prior to intervention, commercially valuable major carp species represented less than 2% of catch (29 kg) and ranked only seventh in terms of contribution to yield. After intervention, in the second year, major carps made up almost 24% of catch (1,221 kg) and **ranked first** in contribution to yield. In the third year, major carps constituted 15% of the catch (363-kg) and ranked 4th. The small fish group ranked first in the third year contributing over 24% of the catch (593-kg). The snakeheads and small catfish contributed 20% and 19% of the catch respectively and ranked 2nd and 3rd.

**Table 3: Species Composition of Pagar Catch**

| Species Group !!ertalt | Pre Intervention (1995) | | | Post Intervention (1996) | | | Post Intervention (1997) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Rank | wt. (kg) | % | Rank | wt. (kg) | % | Rank | wt. (kg) | % |
| !!00**rdrw15** | | | | | | | | | |
| **Snake** | **1** | **596.60** | **41.1** | **4** | | **10.98** | **2** | **497.46** | **20.39** |
| **heads** | **2** | **393.34** | **1** | **5** | | **9.82** | **3** | **462.84** | **18.97** |
| **Small cat** | **3** | **177.36** | **27.1** | **2** | | **21.60** | **1** | **593.46** | **24.32** |
| **fish** | **4** | **113.34** | **0** | **9** | | **1.48** | **9** | **16.08** | **0.66** |
| **Small fish** | **5** | **85.94** | **12.2** | **7** | | **4.95** | **7** | **75.60** | **3.10** |
| **Knife fish** | **6** | **31.00** | **2** | **3** | | **14.36** | **5** | **231.25** | **9.48** |
| **Eels** | **7** | **28.72** | **7.81** | **1** | | **23.57** | **4** | **362.91** | **14.87** |
| **Exotic** | **8** | **24.95** | **5.92** | **8** | | **4.91** | **8** | **32.87** | **1.35** |
| **species** | **9** | **-** | **2.14** | **6** | | **8.32** | **6** | **167.27** | **6.85** |
| **Major carps** | **10** | **-** | **1.98** | **10** | | **0.01** | **10** | **0.03** | **0.01** |
| **Prawns** | | | **1.72** | | | | | | |
| **Large cat** | | | **-** | | | | | | |
| **fish** | | | **-** | | | | | | |
| **Minor carps** | | | | | | | | | |
| **!!0 lbrdrl** | | | | | | | | | |
| **Total** | | **1451.25** | **100** | | **5182.54** | **100** | | **2439.90** | **100** |

**Similarly, large catfishes, which were previously absent from the pagars in the baseline year, made up about 8% and 6% of the catch in the second (430 kg) and third (167 kg) year respectively. Exotic species, which include common carp, grass carp and tilapia also increased their contribution to catch both in absolute and relative terms. Among the exotic species, the common carp was most abundant, representing 68% of the exotic catch. This species seems to have adjusted well to conditions in Bangladesh's open waters and appears to be gradually becoming a native species in *beels*.**

**Before intervention, no species of minor carp and large catfish were found in the *pagars*. Following intervention, the pagar catch included additional species: one minor carp, 2 major carp, one small catfish, and four large catfish. However, while the species composition changed, the total number of species represented in the *pagar* catch remained at 57.**

The production of fish and species diversity found increased after the project intervention both in the year-2 and year-3. In January-June 1997, the production shows declining situation. This was due to the fact that there was less flood in the years 1996 which resulted less recruitment of fish from the river. Moreover, there was spawn fishing in the project-rehabilitated canal, which had negative impact on the overall productivity of the beel and floodplain. It indicated that the spawn fishing in canals has negative impact on production and biodiversity in the beel and floodplain. Based on this experience, it is planned that in future, spawn fishing in canal during ingress of river water will be discouraged. Awareness campaign and social motivation is the key to stop spawn fishing in canals.

The *beel*, *chawk* and *pagars* represent three distinct fishing grounds where different institutional arrangements apply. While the *beel* and the *chawk* are essentially open access fishing areas for members of the surrounding villages for at least part of the year, the *pagars* can be fished only by the owners, lease holders or their designated users. Customarily, poor households have been allowed to catch residual fish after the *pagars* have been fished by their owners and lease holders. They have also been allowed to fish in fallow, low productivity *pagars* (e.g. *pagars* not getting sufficient floodwater during the monsoon) whose owners do not !!even bother to fish. Data from household monitoring show that the major portion of household catch came from the *beel* rather than from the *chawk* and *pagars*. Landless and poor families fished mostly in the *beel* while large farmers got their fish mostly from *pagars*, which they own, lease or share.

### c) Fish Consumption

**<u>Per Capita Consumption</u>**

The data show an increase in daily per capita fish consumption for all types of household in the following year after project intervention. Average per capita daily fish consumption increased from 24 to 30 grams in the second year (Table 4). These figures compare favorably with the national average which was estimated in 1991 at 22 grams per capita per day (BBS, 1992).

In the third year, the per capita fish consumption declined to 25 grams (Table 5) which was probably due to lower fish production in the beel and floodplain which resulted from low river flooding in the year 1996. In addition, there was fishing regulation in the beel due to dispute in leasing arrangements. The local agent of former leasee harassed the villagers and for a considerable time the villagers could not fish in the beel freely.

**Table 4: Fish Consumption (g) by Household Type**

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| Household Type !!x2880 | Per Capita Fish Consumption (g/head/day) | | |
|---|---|---|---|
| | Pre intervention (Feb-Jun'95) | Post-intervention (Feb-Jun'96) | Post-intervention (Feb-Jun'97) |
| Landless | 18 | 22 | 19 |
| Small farmers | 26 | 42 | 26 |
| Medium & Large farmers | 40 | 43 | 36 |
| All Types | 24 | 30 | 25 |

The increased consumption suggests an underlying increase in fish catch. The modest change in fish consumption by landless households may be due to the fact that they fish relatively less intensively during the dry months under observation. Landless households tend to fish most intensively during the monsoon season when access to the floodplain becomes a little more open.

## Species Consumed

During the monitoring period, the sample households consumed more than 60 species of fish. As a group, small fish species are eaten more than any other species group. They represent 23% and 35% respectively of all species consumed before and after intervention (Table 5). The small fish also contributed the highest in the diet of the villagers in the third year (49%). A change in the composition of consumed species was reflected in the observed change in catch composition. Major carps are riverine species, were the second most consumed species following intervention. They accounted for 12% of all species consumed. Major carps and prawns ranked only fifth and sixth in terms of share of consumption prior to intervention when sample households more often ate snakeheads and exotic species. Like second year, the major carps and prawn also ranked 2nd and 3rd in the third year of the project.

**Table 5: Relative Ranking of Fish Species Consumed**

| Species Group !!405srcls! | Pre-intervention | Post-intervention | | Post-intervention | |
|---|---|---|---|---|---|
| | Percentage of Consumed Species | Percentage of Consumed Species | Rank | Percentage of consumed species | Rank |

| | | | | | | |
|---|---|---|---|---|---|---|
| llw15 | | | | | | |
| ordrcl1 | 22.6 | 1 | 34.9 | 1 | 48.9 | 1 |
| Small Fish | 17.0 | 2 | 6.9 | 8 | 18.9 | 4 |
| Snakeheads | 15.5 | 3 | 8.8 | 4 | 9.5 | 8 |
| Hilsha | 13.9 | 4 | 6.8 | 9 | 17.7 | 5 |
| Exotic Species | 9.5 | 5 | 11.9 | 2 | 21.2 | 2 |
| Major Carp | 9.2 | 6 | 11.8 | 3 | 20.0 | 3 |
| Prawns | 7.0 | 7 | 8.6 | 6 | 12.8 | 6 |
| Small Cat Fish | 1.7 | 8 | 7.4 | 7 | 1.8 | 11 |
| Dry Fish | 1.5 | 9 | 2.4 | 11 | 6.6 | 9 |
| Eels | 0.9 | 10 | 6.1 | 10 | 11.6 | 7 |
| Large catfish | 0.5 | 11 | 00 | 0 | 00 | 00 |
| Knife fish | 0.5 | 12 | 1.8 | 12 | 2.7 | 10 |
| Minor Carp/other | | | | | | |

## Sources of Fish Consumed

Before intervention, on average, about 73% of the quantity of fish consumed by households were bought; own catch represented only 27% of consumption (Table 6). Small farmer and landless households especially relied on the market for more than 70% of the fish they consumed during the months under observation. Increased fish production and catch following intervention made it possible for both small farmer and landless households to reduce the proportion of purchased fish to less than 57% of their fish consumption for second and third year of the intervention. Landless and small farm households, who are mostly subsistence fishers, seem to have benefited the most. On an average, more than 50% of their post-intervention fish consumption came from their own catch as opposed to 25% prior to intervention. In g!!eneral, following intervention, proportion of consumed fish from their own catch increased for all categories of households in the project area.

**Table 6: Sources of Fish Consumed by Household Type**

| Household Type | Pre-intervention (1995) | | Post-intervention (1996) | | Post-intervention (1997) | |
|---|---|---|---|---|---|---|
| !!pat8 | Caught (%) | Bought (%) | Caught (%) | Bought (%) | Caught (%) | Bought (%) |
| 25.2 | 74.8 | 51.6 | 48.4 | 43.5 | 56.5 | |
| 22.3 | 77.7 | 46.0 | 54.0 | 55.7 | 44.3 | |
| 34.2 | 65.8 | 37.5 | 62.5 | 51.2 | 48.8 | |
| !!slbrdrrAll Types | 27.0 | 73.0 | 46.1 | 53.9 | 49.3 | 50.7 |

## d) Fisheries Conservation

Like other parts of the country, there is a declining trend of fisheries production and loss !!-240

of species diversity in the project is fish habitats (*chawk* and *rakh*). Increased fishing activities using various types of fine mesh nets and traps identified as a factor for declining fish production. Fishing through dewatering of *beels* and *pagars* is mentioned detrimental to fish population as this type of fishing leave no parent stock in the floodplain for next year's recruitment.

While monitoring *pagar* catch it was observed that the all the *pagars* are pumped out and almost every fish are caught. This fishing method as mentioned earlier is detrimental for sustainable production of fish. Having discussed the issue in detail with the fishermen and *pagar* owners in the field, necessity of fish sanctuary in pagars was raised. With a view to generate awareness among the local people about the necessity of conservation of parent fish, a *pagar* of about 25 decimal located in the middle of Singharagi floodplain was taken on lease from the project in March 1995 and kept as mini **sanctuary** for conserving the brood stock of *beel* resident species. The villagers voluntarily took the responsibility of protecting the pagar sanctuary by themselves. Based !!on the catch monitoring data, about 80 kg of parent stock of varieties of fish species was there in the pagar sanctuary which dispersed on the floodplain at the on set of early monsoon rains and release millions of eggs even before the entry of river water through canals. During catch survey in the following year it was reported by the fishing people about the abundance of *taki* (Chana punctatus) and *koi* (Anabus testudieus) species which they belive due to conservation pagar as sanctuary.

Observing the benefit of pagar sanctuary, it was decided in the PIC meeting that another pagar should be kept as sanctuary to conserved parent stock of fish. As per the community decision, a pagar was conserved as mini fish sanctuary in the floodplain in early 1997. Based on the pagarcatch data of 1996, there would be above 270 kg of fish in the sanctuary. This stock would repopulate the habitat at the onset next monsoon in 1997.

In the first year of the project, a decision was taken at a community level meeting in the area that fishing with seine net and lines would be controlled (not totally stopped) for the first two months of flooding (late June - late August). This control measure would allow the young to grow bigger and the adult to spawn in the floodplain. The local fishermen accepted this decision. Fishing in the canal with set nag net was also stopped by the PIC and the fishermen, instead of using bag net now use lift net which less harmful for fish.

**Wetland Lease**

The Singharagi Beel (*rakh:* the perennial water area) is a *khas* (government owned) water-body and is leased every year to one party living in Tangail town (more than 30 km away) and managed by a local agent who live in village close to the *rakh*. The local agent often creates problems to poor fishermen while fishing in the adjacent waters of the beel. The local traditional Hindu fishermen were deprived of their traditional fishing rights who, in the past, used to get lease of the *rakh*. This year (third year of the

project), project took initiative to get the lease of the beel in favour of the local committee (PIC). The local committee got the lease from the union parishad and or!!ganized the genuine fishermen to take over the charge of the beel. The lease money was Tk. 17,400, which paid by the project to ensure the rights of the genuine fishermen in *khas* waters popularly called *jalmohal* (water estate). It is noticed that the previous leasing party is unhappy for loosing the *jalmohal* and creating problems to fishermen while fishing in the beel. However, the fishermen have several meetings under the guidance of the project and local committee (PIC) and are planning to work out sustainable fishing methods in the beel.

There are around 80 households of traditional Hindu fishermen in Agelasin, Singharagi Majhi para (Nayar Char) villages who subsists on fishing round the year. They fish in *chawk, rakh*, *khal* and rivers. Some fishermen mentioned that they are organized into groups but the groups do not function well. Like other parts of the country, the traditional Hindu fishermen are found to be exploited by the local people. Through the PIC it is being thought to reestablish the fishing rights of the local fishermen in the leased beel. The PIC is holding planing meetings with the fishermen community regarding the fishing arrangements in the leased portion of the water-body.

## 5. CONCLUSION. CONCLUSION

The results and out puts obtained over the period of three years of this action-research project in some selected wetlands at different ecoregions of Bangladesh, indicate a tremendous potential for community-based and community-managed wetland habitat rehabilitation. Broad-based consultation and consensus building on design and operating mechanisms during the very early stages encouraged greater participation and continuing community interest in the wetland habitat rehabilitation project. By recognizing the structure of local power politics and attempting to be inclusive rather than exclusive, the project helped the community to identify and implement a possible "win-win" strategy for managing the wetland resources.

The actual participation of community members as Resident Monitors and Research Assistants in monitoring the social and biological impacts of the project intervention has proven to be a cost-effective means of reliable data collection and a channel for sharing information with the community. The deliberate selection of women as Resident Monitors is a hopeful attempt to highlight the value of literacy and elevate their status in the community where, as in the rest of the country, women are largely invisible.

Data indicate increased productivity and fish species diversity in the wetland following the reestablishment of the main fish migration route between the wetland and the proximate river system. The increased productivity was matched by increased intensity of fishing by all types of fishers. However, the increase in productivity apparently exceeded the increase in fishing effort. Per capita fish consumption increased in all types of household, as did the diversity of fish species consumed. Thus far, the

intervention, which served to expand fish habitats temporally and spatially, seems to have been overwhelmingly beneficial from the biological point of view. Moreover, the benefits seem to have been broadly distributed among fisher groups and social classes.

The mini fish sanctuary in the floodplain found very effective in maintaining the biodiversity and productivity of the wetlands. Based on data from catch monitoring, it is estimated that the conservation *pagar* would yield about 80 kg and 270 kg of parent stock of a variety of fish species in the 2nd and 3rd year respectively. With the onset of early monsoon rains, this stock would disperse to the floodplain and release millions of eggs even before river waters ingress through the canals. To increase the fishes' chances of survival to maturity, the fishers, *pagar* owners and other members of the community decided to stop the use of fine mesh nets and other destructive gear for two months during the monsoon season. Hopefully, with the help of information generated by the project, the community can continue to develop and gr!!adually institutionalize participative and negotiated approaches to the management of their floodplain fisheries.

Observing the positive results of the project, it is planned to expand and extend the project activities in other parts of the country. In future, the project will be implemented in *haor* basin (vast low-lying area) in Sunamgonj district. However, the major focus of the project should be to strengthen the community management in the existing sites. It is expected that the community-based ecological management of wetland resources would contribute to sustain country's most important but fragile resources upon which a majority of our people are dependent to varying degrees.

**REFERENCES**

Ali, M.L. and Fisher, K., 1995. Potential, constraints and strategy for conservation and management of inland open water fisheries in Bangladesh. Paper presented at the National Workshop on Fisheries Resource Development and Management. MOFL, ODA and FAO, Dhaka, Bangladesh.

Department of Fisheries (DOF), Bangladesh. 1988-89. Fish Catch Statistics of Bangladesh. Dhaka 33p.

IUCN, 1993: Freshwater wetlands in Bangladesh: Issues and approaches for management, A. Nishat, Z. Hussain, M.K. Roy, and A. Karim, eds, IUCN-The World Conservation Union, Bangladesh, pp.147-161.

Kremer, A., 1994. Equity in the Fishery: a Floodplain in N.E. Bangladesh. Bath university Center for Development Studies, U.K. and Prince of Songkla university Coastal Resources Institute, Thailand.

Minkin, S.F. and Boyce, J.K., 1994. Net losses: "development" drains the fisheries of Bangladesh. Amicus Journal. 16(3): 36-40.

Minkin, S., Rahman, M.M. and Halder, S. 1997. Fish Biodiversity, Human Nutrition and Enviornmental Restoration in Bangladesh. Open water Fisheries in Bangladesh. Chu-fa Tsai and MY Ali, eds. UPL- The University Press Limited, Bangladesh, pp.75-88.

Naqui, S,A., ali, M.Y., Sadeque, S.Z. and Khan, T.A., 1994. Study on increased intervention by NGOs in the Third Fisheries Project floodplains: Final Report, Bangladesh Center for Advanced Studies, Dhaka, Bangladesh.

Wellcome, R.L. 1985. River Fishes. FAO Tech. Bull. 262, Rome.