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**Community-based Wetland Habitat Restoration and Management: Experiences and Insights from Bangladesh**

Rahman, M. [1], Halder, S. [1] and Capistrano, D. [2]

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[1] Center for Natural Resource Studies, Dhaka, Bangladesh
[2] The Ford Foundation, Dhaka, Bangladesh

Community-based Wetland Habitat Restoration and Management: Experiences and Insights from Bangladesh

**Authors:** Rahman, M. (CNRS), Halder, S. (CNRS) and Capistrano, D. (Ford Foundation)

***Abstract:*** With over 300 fish species and a diversity of flora and fauna, Bangladesh's more than 2.8 million hectares of wetlands represent one of the richest and, from the stand-point of human dependence, most important aquatic commons in the world. For centuries, a delicate cycle of flooding, fish migration between rivers and floodplains, spawning and growth has maintained the wetlands and the rural economy it supports. The country's complex networks of canals have been important conduits for this natural cycle of fish migration and wetlands regeneration. In recent decades, unfortunately, siltation, land conversion and haphazardly planned infrastructure construction have increasingly blocked fish migratory pathways, seriously threatening the fragile wetlands ecosystem.

The paper discusses an experimental participatory action-research in community-based fisheries habitat restoration. It presents preliminary findings on the impact of a community-organized excavation and maintenance of a silted up canal to reestablish fish migration links between a floodplain and the river system in central Bangladesh. Approaches to conflict resolution and mechanisms for participation of stakeholders with varying interests in the wetland's rehabilitation are also discussed. Data from the first two years of research indicate that, following the community's intervention, fish species diversity, production, catch per unit effort and household fish consumption all increased despite an accompanying increase in fishing intensity. Preliminary results suggest that, where feasible, community-based fisheries habitat restoration might be a possible alternative to costly floodplain fish restocking programs favored by the Bangladesh government as a means of increasing floodplain fisheries productivity.

## 1.INTRODUCTION

Covering over a third of the country's total area, Bangladesh's freshwater marshes, lakes, rivers, estuaries and floodplains make up a complex ecosystem that supports a diversity of aquatic species and 120 million of the world's poorest people. An estimated 300 species of fish, more than 20 species of prawn, and a variety of plant and animal species are found in these wetlands. Two million people rely on the wetlands for employment in fishing and another ten million in fish-related trading and processing. Bounty from these waters contribute over 6 percent to national output and 12 percent to export earnings.

Even more important is the wetlands' largely undervalued direct contribution to household nutrition and well-being. About 75 percent of all rural households engage in seasonal subsistence fishing (DOF, 1989). For these households, their subsistence catch are an ecological subsidy provided by the country's extensive aquatic common property resource.

As food, fish is second only to rice in importance and represents 80 percent of animal protein consumption. Over the course of a year, households typically consume more than 50 fish species, taking advantage of patterns of seasonal abundance to smooth out nutritional intake (Minkin et al, 1993). More than 70 percent of inland fish catch comes from inundated floodlands and perennial water bodies in floodplains, which from the standpoint of human nutrition alone, are arguably the country's most important aquatic resource base.

Recurrent monsoon flooding which inundates more than half of Bangladesh is key to the maintenance of the wetlands, their productivity and, ultimately, the sustenance of the human communities they support. A majority of the country's inland fish species are migratory (FAP 17, 1992). With the onset of the rains, many species start their spawning migration from the rivers to the floodplains which serve as nursery and feeding ground for their young. Through canals (*khals*) and estuaries, the fish move back to the rivers with the receding waters. Some get trapped in low lying areas and deeper pockets of the floodplain (*chawk*), in the deepest perennially inundated portions (*beel*), and in man-made ponds (*pagar*) within the floodplain. There they become more vulnerable to fishing pressure. Those able to make it back to the rivers have far greater chances of reaching maturity, returning to the floodplains to spawn and, thus, repopulating the fisheries.

Unfortunately, an expanding network of massive flood control and irrigation structures, roads and highways built over the last two decades is seriously interfering with the delicate cycle of fisheries regeneration. Typically haphazardly planned, these structures block fish migration pathways and degrade natural spawning and feeding grounds. They exacerbate siltation, facilitate wetland conversion and lead to widespread loss of aquatic habitats. As a consequence, some migratory fish species have disappeared from the floodplains and many resident species are at risk of extinction. Yet, the Bangladesh government plans to build more such structures. The implications of continuing large-scale wetland habitat destruction would be devastating. Per capita rural daily fish consumption could drop even lower than the current average of 22 grams, already considered low by international standards, as wetland productivity and fish diversity further deteriorate.

Indeed, over the past decades, the productivity of Bangladesh's floodplain fisheries has dropped significantly. Apart from the disruption of the natural cycle of fish migration, reproduction and growth, agricultural expansion and agro-industrial pollution have contributed to this decline estimated to be between 3 and 10 percent per year. To counter this trend, the Bangladesh government has adopted a two-pronged strategy of aquaculture promotion in private ponds and, for the floodplains, restocking 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).

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 moratorium on fishing imposed by the government to allow stocked fish to grow to harvestable size effectively denies the poor access to the fisheries during the monsoon season. By the time they are ready for harvest, the fish would have aggregated in private ponds or deeper water bodies controlled by powerful local elite, beyond the reach of the poor and the landless. Widespread introduction of commercially valuable exotic fish species and attempts to give them survival edge over indigenous small fish species so important to the diet of rural households has troubling implications for both fish diversity and human nutrition.

This paper presents preliminary results of an action-research project on fisheries habitat rehabilitation in a wetland in central Bangladesh which may suggest an alternative approach to arresting the declining productivity of the country's floodplain fisheries. 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 preliminary 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 adopted by the project is working.

## 2. THE PROJECT

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

The project, which started in mid-1994, 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 possible cost-effective strategies for floodplain fisheries productivity and species diversity enhancement in ways that would minimize the potential for adverse social and biological impacts. By working collaboratively with the community of fishers and resource users starting all the way from project design and site selection to implementation and monitoring, the project hopes to further develop local capacity for community-based fisheries management.

## Project Site

The Singharagi *beel*, a crescent-shaped wetland of about ten hectares, was selected as a pilot site. Settlements within the site are arranged in cluster and linear formations on the north, west and south borders. Located in the Elasin union (village cluster) of Delduar thana (sub-district) in central Bangladesh, the Singharagi wetland used to be linked to the Dhaleswari River to the west through canals (khal) most important of which is a 1.5 kilometer long Hajibari Khal (**Figure 1**).

On the east, a vast area of low lying lands locally called *chawk* remains under water during the monsoon season for about 6 months starting mid-June. In its deepest, perennially flooded portion (middle of the *beel*), water depth varies from a monsoon peak of 25 feet to a dry season low of 12 feet.

With the onset of monsoon rains in May, the Singharagi *beel* inundates adjacent paddy lands and starts to expand. It gets connected through surface flow over the low lying *chawk* to the Abadpur Beel, another wetland about 3 kilometers to the south. In late June, flood water from Dhaleswari River enters the *chawk* and, about a week later, flows to the *beel* through a small canal. The meeting of the expanding beel and the river flood creates a vast continuous wetland.

Most of the canals linking the wetland to the river system are now dead due to siltation, subsequent human encroachment and land conversion. In the Hajibari Khal, heavy silt deposition was obstructing and delaying the flow of water from the Dhelaswari River to the wetland and causing rain water logging in the *chawk*.

A total of 990 households reside in the project area. Average household size is 5.6 members. As in the rest of rural Bangladesh, agriculture is the predominant occupation although households typically have multiple income sources including fishing, petty trading, wage labor and services.

A household census conducted at the start of the project revealed a pattern of land ownership distribution not unlike the rest of the country. Households can be classified into landless, small, medium and large farmer groups depending on the size of their homestead and cultivable crop landholding. Average landholding size is .12 hectares for landless households, .50 hectares for small farmers, 1.3 hectares for medium farmers and 3.7 hectares for large farmers. Majority (57%) of households in the project site are landless and a quarter (25%) are small farmers. Medium and large farmers make up only 16% and 2%, respectively. Since croplands turn into fishing grounds during the monsoon season, household access to fishing areas is closely linked to landownership.

## Site Selection

The site was selected from among several possible sites identified through maps, satellite imagery and field verification visits. The main criteria for selection were: the presence of manageable-sized wetlands with fish migratory pathways obstructed by siltation and other infrastructure; possibility of minimizing adverse impacts of project intervention on the local ecology and socio-economy; and local community interest in undertaking the project.

The following features made the Singharagi wetland especially suitable:

- There are both perennial and seasonal water bodies in the area and fishing is a major economic activity for many during a significant part of the year. The wetlands are being used by local communities as a common property resource to which all, especially poor households, have access.

- Proshika has operated in the area for about five years and provided a vital entry point for developing local contacts. There already existed self-help development groups organized and assisted by Proshika in the villages in and around Singharagi. Having the organizational structure in place facilitated consultations with various stakeholder communities in the site and simplified project planning and implementation.

- There was a consensus forged in a series of community meetings attended by a broad spectrum of people in the locality that intervention was needed to rehabilitate the wetland. In these meetings attended by local government officials, village leaders and CNRS and Proshika staff, they agreed on the need to reopen the Hajibari Khal and believed that such intervention will be beneficial for both agriculture and fishery. In the meetings, sometimes attended by over 100 people, project objectives were clarified and alternative courses of action discussed in detail. The consensus developed in these discussions has lessened the potential for conflict and increases the chances of project success.

- The local government (Union Council) was supportive of the project and the proposed canal reexcavation. The chairman and council members as well as the Thana Nirbani Officer, the chief government administrative officer at the subdistrict, and the Thana Fisheries Officer were all consulted from the very early stages of project planning and played an important advisory role in implementing the agreed intervention. Their cooperation and active support remain crucial to the smooth implementation of the project. The Union Council even provided counterpart funding for the canal reexcavation costs.

## Project Intervention and Implementation Mechanism

Adopting the role of outside facilitator, project staff made every effort to ensure active broad-based local participation at each step of project planning and implementation. When differences of opinion arose among various stakeholders, project staff helped clarify positions, mediate conflicts and find common ground thus, helping consensus or compromise solutions to emerge. While most concerned about the project's likely impacts on the poorest households, the project also remained cognizant of the reality of local power politics and the need to be inclusive rather than exclusive in its approach.

To facilitate community participation and ensure smooth project planning and implementation, CNRS and Proshika facilitated the formation of a **project implementation committee (PIC)** made up of the wetland's users and stakeholders. The PIC consists of 30 members representing farmers, fishermen, local leaders and professionals from four villages in and around the floodplain. The PIC also includes Proshika and CNRS field staff. Currently, the PIC is headed by a Chairman popularly elected during an inter-village meeting. The mechanism for future PIC Chairman selection will be developed and formalized as the project evolves. The chairman of the Elasin Union Council, the local government administrator in the project site, serves as adviser to the PIC (**Figure 2**). Each of the four villages selected their representatives to the PIC.

The first main task of the PIC was to plan and implement the reexcavation of the Hajibari Khal. PIC members were to be involved in executing the canal rehabilitation and other project-related tasks strictly on a voluntary basis. On the suggestion of the Union Council Chairman, two local supervisors were engaged on a temporary basis to supervise the work on behalf of the PIC.

The Hajibari Khal reexcavation brought immediate economic benefits to the communities in the site through the employment it created. A total of 62 people, 44 men and 18 women drawn from among the poor, were hired as laborers to remove 162,400 cubic feet of silt from the canal. The portion of the canal reexcavated measured 2,580 feet in length with width varying from 10 to 27 feet in certain places. The work was undertaken in 1995 during the dry season months of February to April. The activity created a total of 1500 person-days of employment. It also allowed water from the Delashwari River to flow more freely into the Singharagi wetland when the monsoon rains started in June.

The first major test to the PIC's ability to manage was on the issue of compensation for losses arising from the project intervention. Parts of the canal had been encroached and some local farmers had been raising crops on the canal. When the PIC decided to go ahead with the canal reexcavation, the encroachers demanded compensation for their standing crops. The PIC agreed to compensate one farmer who had the largest standing crop and had suffered the greatest crop loss. Others who suffered only minimal losses did not receive any compensation. This decision by the PIC, perceived by local villagers to be both fair and practical, served to defuse tensions during the crucial early stages of the project. This issue highlights the importance of flexibility and pragmatism in mediating conflicts among stakeholders that will surely arise in projects of this kind.

## 3. MONITORING OF SOCIAL AND BIOLOGICAL PARAMETERS

To assess the impacts of the intervention, a system of monitoring social and biological parameters was designed 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. Both will continue for at least another two years. The preliminary biological monitoring results reported in this paper cover only the three and a half months from 16 December to 31 March for 1994/95 and 1995/96, representing the pre- and post-intervention periods, respectively. The social monitoring results cover the three-month period from February to April 1995 and 1996. So far, these are the only months for which comparable data are available. Recall that the intervention was undertaken from February to April 1995. As the post-intervention observation period lengthens, more of the 1994/95 baseline data can be used for comparison. It is worth noting that 1994 was a drought year. Thus the baseline data may reflect a lower than usual level of wetland productivity and fishing activity and perhaps tend to overestimate changes attributable to the intervention.

### Social Monitoring

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 flood waters 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 just before the monsoon when it is easier to drain the pond and harvest all the fish that have aggregated there.

A project staff and an assistant 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. Baseline information were collected from 27 *pagars* before intervention. However, only 19 of the *pagars* were monitored following intervention. The results reported in this paper pertain only to these 19 *pagars* for which comparable pre- and post-intervention data are available. 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. PRELIMINARY FINDINGS

### Fishing Activity

#### The Fishers

Based on survey results, fishers in the Singharagi wetland can be categorized into three types: full time professional; part-time professional; and subsistence fishers. Professional fishers sell most of their catch while subsistence fishers, who live close to the wetlands and fish with small gear, mostly consume their catch. Full-time professional fishers depend solely on fishing for their income throughout the year while part-time professional fishers derive only part of their income from fishing and are engaged in other non-fishing activities during the course of the year. Part-time fishers are also wage laborers and farmers. They turn to fishing during the monsoon season, a time when alternative employment is scarce and returns from fishing are relatively attractive, particularly when regulations on fishing activity are minimal.

Almost 40% of the fishers in the Singharagi wetland are subsistence fishers. About 36% are part-time professional fishers and 24% 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%) engaged in full-time or part-time fishing for sale.

## Fishing Intensity

Before intervention, fishers altogether spent 396 person-days fishing with the greatest fishing effort expended by fishers from landless households. Fishing intensity increased following intervention, presumably, in response to greater fish availability in the wetlands (Table 1). Total fishing effort more than doubled to 810 fishing days. The greatest increase in fishing effort was observed among small farmer households which spent almost five times as many days fishing after intervention.

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

| Household Type | Fishing Person days | |
|---|---|---|
| | Pre-intervention (3 months) | Post-intervention (3 months) |
| Landless | 275 | 390 |
| Small Farmer | 52 | 252 |
| Large Farmer | 69 | 168 |
| Total | 396 | 810 |

## 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 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, leasees or their designated users. Customarily, poor households have been allowed to catch residual fish after the *pagars* have been fished by their owners and leasees. They have also been allowed to fish in fallow, low productivity *pagars* (eg. *pagars* not getting sufficient flood water 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 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. 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.

## Yield, Diversity and Distribution of Catch

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

Comparison of pre- and post-intervention data shows a six-fold increase in the catch from the *chawk* and the *beel* (Table 2). This dramatic increase in catch from 1863 kg to 11204 kg indicates an underlying increase in wetland productivity following the intervention. The data also indicate an enhancement of fish species diversity with the number of species represented in the catch increasing by 25%.

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 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 (16 Dec'94-31 Mar'95) | | | Post-Intervention (16 Dec'95-31 Mar'96) | | |
|---|---|---|---|---|---|---|
| | Wt.(kg) | % | No.of species | Wt.(kg) | % | No. of species |
| Small fish | 605 | 32.5 | 23 | 4235 | 37.8 | 31 |
| Prawns | 518 | 27.8 | 1 | 3906 | 34.9 | 2 |
| Snake heads | 250 | 13.4 | 3 | 1606 | 14.3 | 2 |
| Eels | 335 | 17.9 | 4 | 434 | 3.9 | 4 |
| Small cat fish | 103 | 5.5 | 7 | 280 | 2.5 | 7 |
| Major carps | 4 | 0.2 | 1 | 362 | 3.2 | 2 |
| Large cat fish | 1 | 0.1 | 2 | 207 | 1.9 | 3 |
| Exotic species | 42 | 2.3 | 2 | 127 | 1.1 | 2 |
| Knife fish | 5 | 0.3 | 1 | 33 | 0.3 | 1 |
| Minor carps | - | - | - | 13 | 0.1 | 1 |
| Total | 1863 | 100 | 44 | 11204 | 100 | 55 |

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 reexcavation of the Rajabari Khal. The intervention provided fish a wider area and made possible a longer duration for nursing, feeding and growth in the fertile floodplain.

## Distribution of *Chawk* and *Beel* Catch

The catch was divided almost equally between part-time (47%) and subsistence (49%) fishers with only 4% going to full-time fishers. This was due to the low fishing effort expended by full-time fishers in the Singharagi wetland which during the base period had received little flooding. The full-time fishers are likely to have fished instead in rivers and other water bodies. Subsistence and part-time fishers evidently continued to fish in the nearby waters of the wetland.

**Table 3: Fish Catch (kg) from Chawk and Beel by Type of Fisher**

| Period | Fish Catch by Type of Fisher | | | Total |
|---|---|---|---|---|
| | Full time | Part time | Subsistence | |
| Pre-Intervention | 77 (4%) | 883 (47%) | 903 (49%) | 1863 (100%) |
| Post-Intervention | 333 (30%) | 6292 (56%) | 1582 (14%) | 11205 (100%) |

After intervention, catch significantly increased in absolute terms for all types of fishers (Table 3). Catches increased by 612% for part-time fishers, 332% for full-time fishers and 75% for subsistence fishers. In relative terms, professional fishers both full-time and part-time got the larger share of the increased catch with 56% and 30%, respectively.

## Yield and Species Diversity of *Pagar* Catch

Total yield from the 19 *pagars* monitored increased from 2963 to 11456 kg after intervention and average yield per *pagar* increased from 156 kg to 603 kg (Table 4). Major changes were observed in both the catch 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 and ranked only seventh in terms of contribution to yield. After intervention, major carps made up almost 24% of catch and ranked first in contribution to yield.

Similarly, large catfishes which were previously absent from the *pagars* made up about 8% of catch following intervention. 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*.

**Table 4: Species Composition of Pagar Catch**

| Species Group | Pre Intervention | | Post Intervention | |
|---|---|---|---|---|
| | wt. (kg) | % | wt. (kg) | % |
| Snake heads | 596.60 | 41.11 | 568.86 | 10.98 |
| Small cat fish | 393.34 | 27.10 | 508.87 | 9.81 |
| Small fish | 177.36 | 12.22 | 1119.70 | 21.61 |
| Knife fish | 113.34 | 7.81 | 76.62 | 1.48 |
| Eels | 85.94 | 5.92 | 256.40 | 4.95 |
| Exotic species | 31.00 | 2.14 | 744.45 | 14.36 |
| Major carps | 28.72 | 1.98 | 1221.60 | 23.57 |
| Prawns | 24.95 | 1.72 | 254.33 | 4.91 |
| Large cat fish | - | - | 431.36 | 8.32 |
| Minor carps | - | - | 0.35 | 0.01 |
| Total | 2963.33 | 100.00 | 11456.04 | 100.00 |

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 58.

### Fish Consumption

Per Capita Consumption

The data show an increase in daily per capita fish consumption for all types of household although the increase was only marginal for landless households. Average per capita daily fish consumption increased from 27 to 33 grams (Table 5). These figures compare favorably with the national average which was estimated in 1991 at 22 grams per capita per day (BBS, 1992).

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.

Table 5: Fish Consumption (kg) by Household Type

| Household Type | Per Capita Fish Consumption (g/head/day) | |
|---|---|---|
| | Pre intervention | Post-intervention |
| Landless | 22 | 23 |
| Small farmers | 27 | 45 |
| Medium & Large farmers | 41 | 49 |
| All Types | 27 | 33 |

**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 22% and 34% respectively of all species consumed before and after intervention (Table 6). A change in the composition of consumed species was mirrored the observed change in catch composition. Major carps and prawns, both riverain species, were the second and third most consumed species following intervention. They accounted for 14% and 12%, respectively, of all species consumed. Major carps and prawns ranked only fourth and sixth in terms of share of consumption prior to intervention when snakeheads and exotic species were more often eaten by sample households.

Table 6: Relative Ranking of Fish Species Consumed

| Pre-intervention | | | Post-intervention | | |
|---|---|---|---|---|---|
| Species Group | Percentage of Consumed Species | Rank | Species Group | Percentage of Consumed Species | Rank |
| Small Fish | 21.70 | 1 | Small Fish | 34.18 | 1 |
| Snakeheads | 21.20 | 2 | Major Carp | 13.97 | 2 |
| Exotic Species | 20.86 | 3 | Prawns | 12.02 | 3 |
| Major Carp | 11.63 | 4 | Small Cat Fish | 10.93 | 4 |
| Small Cat Fish | 8.82 | 5 | Snakeheads | 9.18 | 5 |
| Prawns | 6.78 | 6 | Large Cat Fish | 7.38 | 6 |
| Hilsha | 4.42 | 7 | Exotic Species | 7.12 | 7 |
| Large CatFish | 1.45 | 8 | Eels | 2.93 | 8 |
| Dry Fish | 1.27 | 9 | Minor Carp | 1.69 | 9 |
| Eels | 0.95 | 10 | Dry Fish | 0.39 | 10 |
| Minor Carp | 0.93 | 11 | Hilsha | 0.21 | 11 |

## Sources of Fish Consumed

Before intervention, on average, about 66% of the quantity of fish consumed by households were bought; Own catch represented only 34% of consumption (Table 7). 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 50% of their fish consumption. Landless households, who are mostly subsistence fishers, seem to have benefitted the most. More than 52% of their post-intervention fish consumption came from their own catch as opposed to 26% prior to intervention.

**Table 7: Sources of Fish Consumed by Household Type.**

| Household Type | Pre-intervention | | Post-intervention | |
|---|---|---|---|---|
| | Caught (%) | Bought (%) | Caught (%) | Bought (%) |
| Landless | 25.81 | 74.19 | 52.26 | 47.74 |
| Small Farmers | 22.20 | 77.80 | 50.65 | 49.35 |
| Medium & Large Farmers | 40.21 | 59.79 | 41.19 | 58.81 |
| All types | 34.09 | 65.91 | 48.79 | 51.21 |

## 5. CONCLUSION

Based on two years of action-research in the Singharagi wetland in central Bangladesh, preliminary data 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 identify and implement a possible "win-win" strategy for managing the Singharagi wetland on which they all depend to varying degrees. Pragmatic solutions to conflicts as they arose and tangible employment benefits during the crucial stages of implementation added fuel to this interest.

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.

Preliminary 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.

Encouraged by the positive results, fishers and *pagar* owners agreed with project staff to maintain a fish sanctuary in the middle of *beel* to help conserve a brood stock of resident floodplain species during the dry season when fishing pressure is greatest. The project agreed to lease a .10 hectare *pagar* which the community will protect and maintain. The hope is that eventually the community can take over the lease of this conservation *pagar*.

Based on data from catch monitoring, it is estimated that the conservation *pagar* would yield about 80 kg of parent stock of a variety of fish species. With the onset of early monsoon rains, this stock would disperse to the floodplain and release millions of eggs even before river waters enter the floodplain 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 gradually instutionalize participative and negotiated approaches to the management of their floodplain fisheries.

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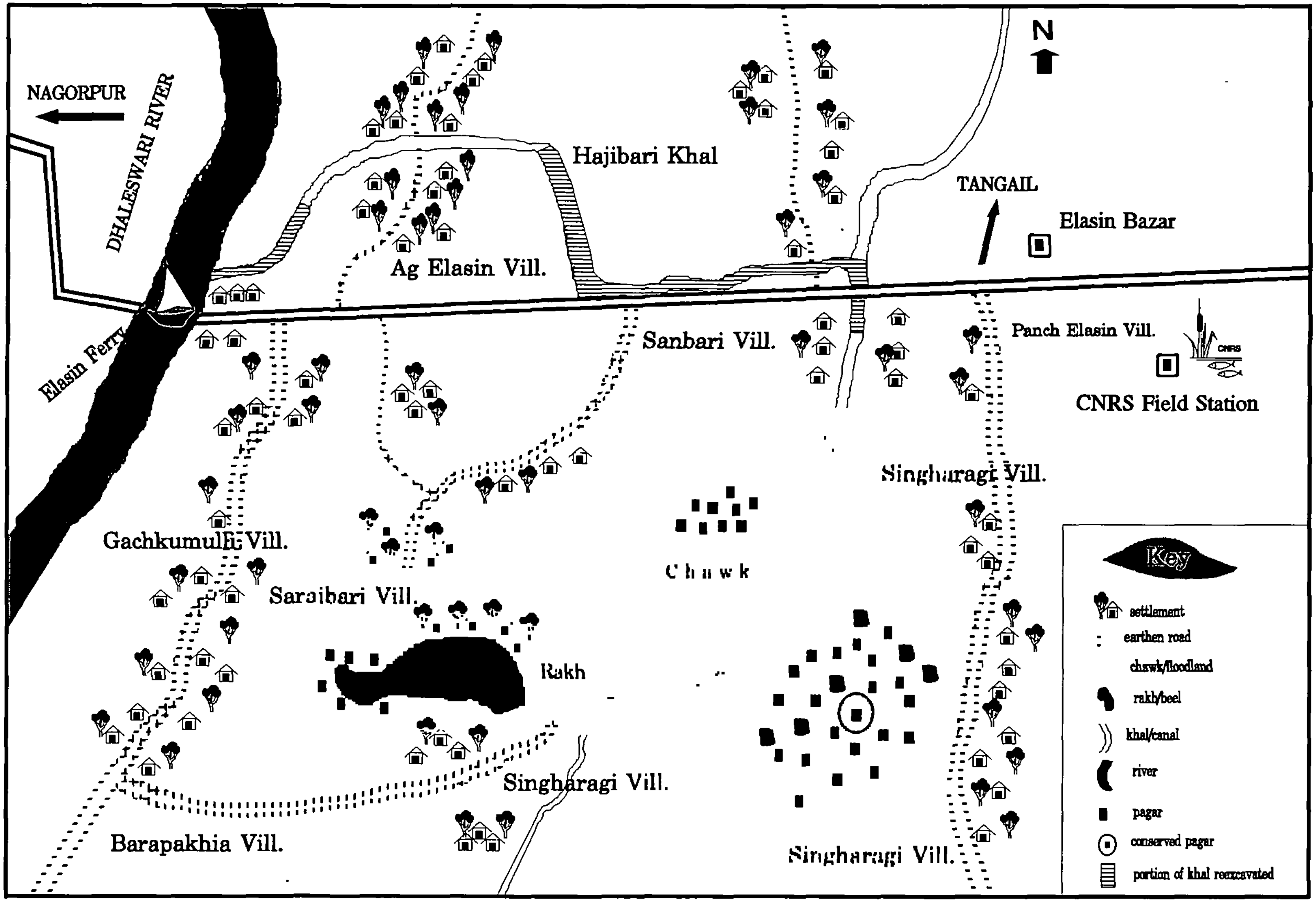


Figure 1: Schematic Map Of the Project Area

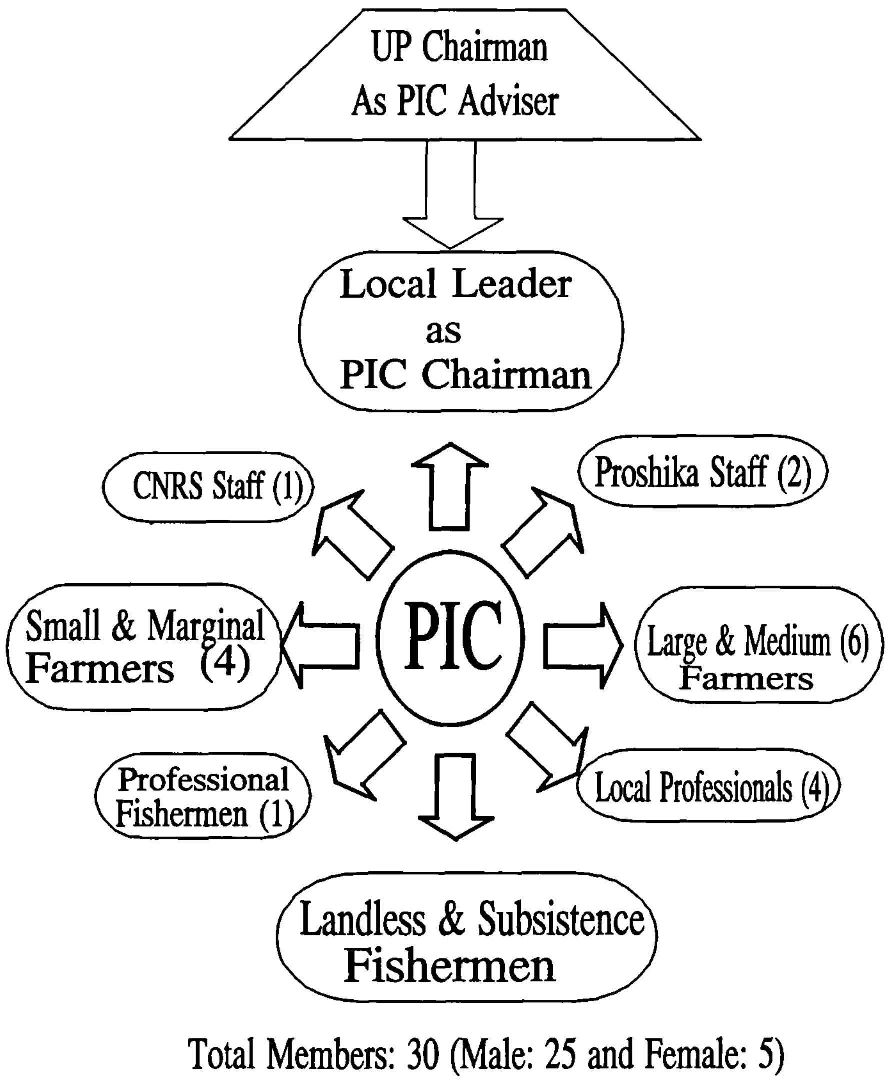


Figure 2: Structure of PIC