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Culture-based fisheries in Bangladesh

A socio-economic perspective

Cover photo:
Community organization stocking fingerlings in Hamil Beel, central Bangladesh.
Courtesy of P.M. Thompson.

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Preparation of this document

This Fisheries Technical Paper has been prepared as part of FAO's regular programme activities in cooperation between the Fisheries and Aquaculture Department's Fisheries Management and Conservation Service (FIMF) and Dr Paul Thompson from the Flood Hazard Research Centre at Middlesex University, United Kingdom of Great Britain and Northern Ireland. The layout was done by Ms Nadia Pellicciotta.

The document reviews and discusses the outcomes of culture-based fisheries enhancements in Bangladesh in a social context. The conclusions reached are based on the authors' own experiences working with fisheries projects in Bangladesh and discussions with a range of actors in the fisheries sector in the country. The document is intended for fisheries managers, non-governmental organizations, donor agencies and policy-makers in Bangladesh and other countries where stocking is used as the most important tool in enhancing inland fisheries. The document is also intended to complement the guidelines on stocking requested by the 2005 twenty-sixth session of the Committee on Fisheries currently under development. The paper was presented by Dr Paul Thompson at the International Association for Society and Natural Resources Conference on "Social Science in Resource Management: Global Challenges and Local Responses" in Vancouver, Canada, 4–7 June 2006.

Abstract

Fisheries policy in Bangladesh is still trying to get to grips with the major (universal) dilemmas of maximizing benefits from natural resources while, at the same time, ensuring an acceptable degree of equity in distribution of benefits and protecting the ecosystems that support the resources. During the twentieth century Bangladesh adopted one-sided production-oriented policies in the agricultural sector to feed the rapidly growing population. This strategy included increasing fish production, which was in decline mainly as a result of environmental degradation brought about by the expansion of agriculture. The solution was aquaculture development and later the promotion of culture-based fisheries and large scale stocking in the floodplains and beels (lakes) that previously sustained the capture fisheries. Although fish production *per se* in many cases may have increased as a result of this type of intervention, benefits are not socially and environmentally sustainable.

Traditional leasing of waterbodies is effective but not equitable because the powerful leaseholders control the access; and because the leasing arrangements are of short duration the leaseholders will try to maximize benefits, often at the expense of environment and biodiversity. These strategies have consequently caused serious negative environmental impacts and have further reinforced inequalities between local elites and poorer fishers. Although several attempts have been made to transfer fishing rights to poor fishers through community-based management arrangements, influential people tend to dominate these attempts when there are financial attractions such as subsidies for stocking and the opportunity for easily controlled profits.

While stocking of fingerlings, gear bans and seasonal bans on all or some fishing gears were successful technically to conserve and enhance resources it led to exclusion and suffering of poor fishers. Culture-based fisheries have relatively high production, but need strictly enforced closed seasons to allow fish to grow, an activity which excludes poor subsistence fishers. However, in some places people who participated with the expectations of considerable personal gains ceded when more resilient lower-cost practices such as sanctuaries were adopted.

Local equity issues are partly mitigated when poor people are allowed to catch small (non-stocked species) for food. In the floodplains, public stocking has not been sustained as access to these larger open systems is

difficult to control and participants are unable to capture enough benefits or raise funds from the wider community, while landowners tend to take advantage of the situation and catch more of the stocked fish. In smaller, more closed waterbodies, groups of fishers are able to control access and can profit, but the risks and need for capital are high.

This document reviews the development of culture-based fisheries enhancements in Bangladesh and discusses the outcomes in the context of the social and economic impacts. The various management arrangements and the risks and benefits they entail for the stakeholder groups are examined as well as the roles of donors, Non governmental Organizations and the government and its agencies. Culture-based enhancements have been encouraged as a panacea solution to increase benefits from fisheries, however, here it is concluded that the entry point for fisheries management should not be stocking. Interventions such as sanctuaries and limits on fishing effort are less risky and cause less social conflict. Habitat rehabilitation has a higher initial capital cost but does not require recurring annual investments in stocking. However, this type of intervention is not very attractive due to the government's lease policies that discourage long-term investments in fisheries management. A series of recommendations for organizations involved with community-based fisheries management are provided.

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Contents

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Abbreviations and acronyms

BRAC	Bangladesh Rural Advancement Committee
BWDB	Bangladesh Water Development Board
CBFM	Community-based Fisheries Management project
CBO	Community-based organizations
CPUE	Catch per unit effort
Danida	Danish International Development Agency
DFiD	Department for International Development (United Kingdom of Great Britain and Northern Ireland)
DoF	Department of Fisheries (of Bangladesh)
EUS	Epizootic Ulcerative Syndrome
FAO	Food and Agriculture Organization of the United Nations
FFP	Fourth Fisheries Project
GDP	Gross domestic product
GoB	Government of Bangladesh
HYV	High-yielding varieties (of rice)
IFAD	International Fund for Agricultural Development
MACH	Management of Aquatic ecosystems through Community Husbandry
MoL	Ministry of Land (of Bangladesh)
NGO	Non-governmental organization
OLP-II	Oxbowlake Project Phase 2
PBAEC	Patuakhali Barguna Aquaculture Extension Component
USAID	United States Agency for International Development

Glossary

Baor:	Oxbow lakes, i.e. old river channels that now have limited connections to their parent rivers through channels in the monsoon season.
Beel:	Deeper depressions in the floodplain, some are open and linked through canals to other waterbodies, while others are closed or separate from other waterbodies. Oxbow lakes outside the southwest region are sometimes referred to as *beels*.
Boal:	*Wallago attu*, a large predatory silurid catfish.
Catla:	*Catla catla*, an indigenous major carp species which is frequently used in aquaculture and culture-based fisheries.
Gher:	Rice fields around which earth bunds have been constructed with the purpose of stocking of prawn larvae, or fish.
Haor:	A large bowl-shaped depression between two or more rivers (Khan, 1997).
Jalmohal:	Fishing estates, permanent waterbodies which can be leased out by the Government.
Koral:	*Lates calcarifer*, barramundi, a large-sized marine predatory fish species that often penetrates far up rivers, and are especially common in the estuarine zone.
Kua:	Dug-out ditch used as trap pond for fish.
Mrigel:	*Cirrhinus cirrhosus*, an indigenous major carp species which is frequently used in aquaculture and culture-based fisheries.
Rui:	*Labeo rohita*, an indigenous major carp species which is frequently used in aquaculture and culture-based fisheries.
Thai Sharputi:	*Barbonymus gonionotus*, Thai silver carp, an introduced species which is widely used in aquaculture and culture-based fisheries.
Upazila:	Subdistrict.

Foreword

Wetlands have been destroyed at an alarming speed in Bangladesh resulting in a decline of capture fisheries. The construction of polders and roads, drainage, agricultural, industrial and urban developments, and reduced dry season flow of water, are the main reasons. The declining fisheries have affected the livelihoods of millions of poor people. While overall production of fish has increased steadily through the rapid development of pond fish culture, the demand for fish is constantly rising and new means to enhance production are eagerly sought. Thus, both government and the private sector are looking for ways forward and stocking of different types of water bodies has been one obvious option; consequently, donor agencies have been supporting attempts to stock water bodies through development projects over the last twenty years.

However, efforts to enhance the production in inland water bodies through stocking have not benefited the poor and landless to the extent that was expected. For these groups, open access capture fisheries provide an economic buffer and are extremely important for their food security. Therefore, in order to reconcile production needs with the needs of poor people to have access, attempts have been made to introduce different forms of community management, with less dependence on costly stocking programmes that are out of reach for the poor.

This paper raises the important questions of production by whom and for whom. It reviews the development of culture-based fisheries and community-based fisheries management in Bangladesh. It discusses experiences from different development interventions over the years with regard to socio-economic impact, as well as environmental effects and biodiversity loss. The shifting policy framework is also examined. Bangladesh has concluded the process of formulating its poverty reduction strategy and a National Fisheries Strategy has been adopted. The resulting experiences, reflected in this paper, have been the basis for these strategy processes. However, will the strategies be implemented with the poor in mind or will the need for rapidly-increased production today override the poverty focus?

This paper will be of great importance in guiding future policy and strategy discussions, by underlining both the potential benefits from different stocking regimes based on community participation and the negative impacts of uncontrolled and unregulated stocking on the natural fish habitat. The latter include increased loss of connectivity between dry season water bodies and the floodplains which serve as nursery areas for indigenous species and loss

of both species and genetic diversity. It should be recommended reading not only for fisheries administrators and managers, but also for non-governmental organizations and donor agencies, who contemplate supporting interventions and wish to enable poor people to benefit from actions in the fisheries sector.

The authors' review is based on an in-depth knowledge and understanding of socio-economic, hydrological, biological and biodiversity issues around wetlands management. Although the main question raised in the paper – who are the winners and who are the losers – is not given a direct answer, balancing the considerations on poverty focus versus production is clearly shown with an emphasis on the need to protect access rights of poor groups of mainly seasonal fishers and to adopt management of the resources with cost-effective measures, which can go a long way to enhance production while protecting livelihoods.

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Introduction

SCOPE

Bangladesh is one of the countries which, partly as a result of significant international donor support, have adopted stocking and culture-based fisheries as national strategies to feed a rapidly growing population. That these policies have had significant influence on the inland fisheries sector of the country is incontestable. However, what is missing from the debate is a proper account of the outcomes of this development in terms of poverty alleviation and socio-economic sustainability.

Based on our experiences and a number of case studies from various parts of Bangladesh, we examine the natural, institutional and socio-economic conditions that are decisive for the outcomes of culture-based fisheries, and should be taken into consideration in the development of future national policies and strategies. We feel that this discussion is relevant for policymakers, fisheries managers, donors and non-governmental organizations (NGOs) working with or supporting the fisheries sector in Bangladesh, and in many other developing countries where stocking and culture-based fisheries are promoted as panacea solutions to compensate for losses in capture fisheries and contributing to meet the need for fish protein.

BACKGROUND

Bangladesh is situated in a gigantic delta consisting of the distributaries of the Ganges, Brahmaputra and Meghna Rivers, and the country is consequently blessed with access to enormous aquatic resources. The country is cross cut with an impressive network of rivers totalling 24 000 km (Muir, 2003) and about a quarter of the country is inundated each year (Brammer, 2004). Fishing and farming are the two main economic activities throughout rural Bangladesh and the two activities are intimately integrated, they supplement each other and are both closely linked to, and adapted to the annual cycle of flood and drought allowing people to benefit from the riches of nature.

The old Bengali proverb "*Rice and fish make a Bengali*" underlines the importance of these two resources in the lives of the people of Bangladesh (see Box 1). In the past there were no conflicting interests between the production of these two staple diet items infact, they complemented each other. The rice required flooding and flooded fields gave fish habitat to thrive in. If a flood

BOX 1

Fish consumption and its nutritional significance in Bangladesh

Per capita fish consumption in Bangladesh was 11 kg fish per year in 2000 (Muir, 2003). Over 80 percent of animal protein in the diet in the early 1980s came from fish (Ahmad and Hassan, 1983). However, the key contribution is additional nutrients – minerals and especially vitamin A – provided by different types of fish. Several species of small wild fish have been found to have very high contents of vitamin A, while all small fish (which are consumed whole) are a key source of calcium in the diet where consumption of milk is low. Fish in general also are important sources of iron and zinc in the rural diet. The key finding is that small wild-caught fishes are more important sources of micronutrients than the larger carps favoured by culture based systems.

Source: Thompson *et al.* (2002).

damaged the crops there would be more fish, and if there were less water, the rice grew better.

Bangladeshi farmers have developed about 7 000 rice varieties well-suited to the climate and hydrology of the country (Thrupp, 2000); and hundreds of fishing gears have been designed to secure a share of the multitude of fish available in rivers, *beels* (floodplain depressions) and *khals* (channels) all over the country. The shallow flooding of the rice fields does not disqualify them as fish habitats. For instance, Rahman *et al*. (1999b) demonstrated that the fish biomass (kg/m^3) is actually higher in the shallowest water (1–15 cm) compared with other depths. What is important is the duration of the flood and that the fish can access permanent water during the dry season.

Rapid population growth in the twentieth century, particularly between 1961 and 1981 when birth rates remained high and death rates declined with improved health care, led to an increase in settlements in flood-prone areas, resulting a need to augment rice production in order to feed the people. This was addressed through the adoption of high-yielding varieties (HYV) of rice developed as part of the "Green Revolution" (Thrupp, 2000). The new varieties are not tolerant to flooding and are mainly grown with irrigation during the dry season or in the monsoon with flood control and drainage and require more intensive use of fertilizer and pesticides than was used for the traditional rice varieties.

Preoccupation with agricultural development led to the closure of more than 1 000 smaller rivers and canals and the construction of 8 881 kilometres of embankments and 7 907 hydraulic structures affecting 35 percent of the country (Muir, 2003). The benefit of this policy is that the country now is almost

self-sufficient in terms of rice. However, the price is severe degradation of aquatic habitats. Natural dry season wetlands were drained for rice paddies, ignoring that these water bodies are extremely important fish habitats during the dry season when they act as refuges for the individuals that will repopulate the floodplains during the next rainy season. Thus, the chosen development path has been rice instead of fish.

Courtesy of J. Valbo-Jørgensen

Rice cultivation and fishing provide the two food staples in Bangladesh; the two activities are well-suited to complement each other. Here a boy is setting a gillnet in a rice-field in southern Bangladesh.

The role of living aquatic resources in rural Bangladesh

However, from an economic point of view the focus on rice may not necessarily be the best course. An economic analysis from Cambodia showed that the value of wild fish and other living aquatic resources in the rice fields was significantly higher than the value of the rice (Shams *et al.*, undated). This was echoed in a study of Hail Haor, a large wetland in northeast Bangladesh, where the total annual use value for the wetland, including seasonal rice fields, was about US$650 per ha in 2000 of which rice contributed only 14 percent while fish and other aquatic resources were the main products by value (Colavito, 2002). Moreover, it is widely recognized that the poor have a high dependence on aquatic resources – including fish – from wetlands and floodplains. Aquatic resources are used as a safety net when labouring and other work is unavailable. About 70 percent of the country's population is rural, 50 percent of which live in poverty and more than one in five live in extreme poverty (FAO Fisheries Country Profiles, http://www.fao.org/fi/fcp/en(BGD/body.htm). Yet an estimated 82 percent of households who fish for an income and 65 percent of those fishing for food are poor (WorldFish Center, 2003).

Various types of temporary or permanent wetlands play important roles in rural livelihoods and economies (Boxes 2 and 3). Apart from fishing, the water is used for all sorts of household purposes including bathing, washing, cooking, cattle bathing, duck rearing, navigating, irrigating and collecting various aquatic animals and vegetation for food, medicine and other purposes.

BOX 2

Economic contribution of fish

The fisheries sector accounts for some four percent of GDP and more than 11 percent of annual export earnings (FAO Fisheries Country Profile). Estimates of livelihood dependence are scattered: Mazumder, Samina and Islam (2000) reported 1.4 million full time fishers and 11 million part-time fishers. However, case studies and surveys in different regions indicate that some 70 percent of all households in the floodplains catch fish either for income or food (Minkin, Rahman and Halder, 1997; Thompson *et al.*, 1999).

Adopting a purely sectoral approach to fisheries analysis denies the fact that many households and communities integrate fishing into a diverse livelihood strategy based on different activities and resources, and that wetlands are multipurpose resources within that strategy. The problems of fisheries development and management must consequently be viewed from a broad perspective and the issue of poverty in fisheries must be addressed through a multidisciplinary and multisectoral approach.

In spite of decreasing yields from the inland capture fishery which supplied an estimated 39 percent of fish production in 2002 (Muir, 2003) compared with 63 percent in 1983–1984 (DoF, 1996), fish continues to be the most important source of animal protein in the diets of the Bangladeshi population thanks to significant advances in the aquaculture sector (Muir, 2003). Growth in aquaculture has mirrored that in agriculture, thus, according to the Bangladesh Department of Fisheries (DoF, 2000; Muir, 2003) production from ponds more than trebled to about 650 thousand tonnes – or 40 percent of total fish

BOX 3
Who fishes?

Professional fishers: fishers who rely entirely on fishing for their income. They mainly fish in open waters, especially in rivers, and tend to belong to communities that have fished for generations.

Part-time or seasonal fishers: when there are few other employment opportunities and fish are moving and easy to catch in larger quantities (i.e. at the beginning of the flood and during the drawdown period), people take up fishing and tend to focus on areas that are drying and on migration corridors such as canals connecting rice fields with permanent waterbodies.

Subsistence or ocassional fishers: members of most rural households own a net or rod or even fish by hand, fishing in floodplains and beels where they can gain access. They fish mainly for food, however all fishers will sell surplus catch, especially large fish which fetch a higher price.

Investors: wealthier people who do not normally fish themselves. Some investors lease the fishing rights to a particular waterbody and collect tolls from fishers or hire them as labourers. Other investors procure expensive types of fishing gear (e.g. seine nets) which they rent to groups of fishers against a share of the catch.

Women: do not normally fish in Bangladesh, it is almost exclusively men who are engaged in fishing, even at the subsistence level. Fish are generally also only traded by men. However, women (especially elderly widows) can sometimes be seen using hook and line near their home; in coastal areas poor women are involved in the collection of shrimp fry, which is sold.

production – over the period 1988/89 to 1999/2000. However, the increases in aquaculture production have only brought marginal benefits for destitutes and the landless, sustaining inland fisheries is of immense importance to ensure the food security of this poorest part of the population.

Human population growth has put extreme pressure on common pool natural resources, including fish. Bangladesh is consequently often mentioned as a classical example of a fishery that is collapsing because of overfishing. Although some stocks, particularly carps and predators, have been overfished, and fishing pressure is intense, the problems the fisheries are facing are, to a large extent, rooted in administrative and development policies outside the fisheries sector.

Embankments, roads and drainage have fragmented or compartmentalized the aquatic ecosystem, separating major parts of the floodplain from the river system with severe consequences for the diversity of fish species. Migratory fishes have obviously been most affected and catches of these species have declined dramatically some have completely disappeared from many parts of the country with seriously negative consequences for the fishers who traditionally exploited them – including the spawn collectors who previously provided fry for the aquaculture sector.

The Department of Fisheries (DoF) is charged with increasing fish production. Yet administrative and institutional constraints have discouraged cooperation and a holistic approach to maintaining capture fisheries and the wetlands they depend on. Moreover, government policy has made the majority of waterbodies a source of government revenue and short-term profits for those who lease them from the land administration. The advent of carp hatchery technologies and donor supported training and funding for aquaculture, which set in motion rapid growth in fish production from ponds, spilled over into programmes for culture-based fisheries and large-scale stocking in what were capture fisheries. The production emphasis in government has led to a widespread misperception that wetlands could be treated as if they were large aquaculture ponds. Within this overall picture, four trends in stocking in fisheries (as opposed to ponds) can be discerned:

i) measures by individual leaseholders or groups of fishers (through project support) to control movement of fish from "closed" waterbodies, such as oxbow lakes and dead rivers, which they then profitably stock annually with carp fingerlings;

ii) stocking of carps in open floodplains either as part of donor-funded projects or as part of annual government programmes designed to raise overall fish production;

iii) private initiatives to close floodplain areas where landowners and investors then stock fingerlings annually; and

iv) attempts to restore fish stocks of species that are scarce or absent from an area where they once occurred by releasing them into wetland systems that have come under some form of restoration or improved management in the hope that they will form self-sustaining populations.

The first three approaches have been criticized for their negative environmental impacts and for reinforcing the seizure of fisheries by local elites at the expense of poorer fishers. On the other hand, several donor-funded projects working with fishing communities through NGOs have tried to address some of these problems through community-based approaches, with varying results. This paper focuses on culture-based fisheries in the first category above, but also examines open water stocking and compares it with some of the alternative paths of fishery development that Bangladesh has tried.

Policy and administrative context

In Bangladesh, permanent waterbodies are government property and have traditionally been considered a land resource under the jurisdiction of the Ministry of Land (MoL) which leased out fishing rights in these *jalmohals* (fishing estates) to the highest bidder with the sole objective of generating government revenue. Leaseholders have long been among the local rich and influential people who have the political and social power to enforce their control over the resource (Toufique, 1999). Although since the early 1970s leases have gone by preference to registered fisher cooperatives, very often behind them are the same leaseholders as before managing funds and political power. The leases are short-term arrangements (three years) and the leaseholders therefore try to exploit the resources to the maximum without any regard for the future potential of the wetland.

Policy-making has been predominantly top-down, originating with the central government. Policy processes are complex and have been analysed for the fisheries sector by Huda (2003). Although several policy innovations have been made, and to some extent policy shifts appear sensitive to domestic pressures to address poverty and access rights for the poor and international trends for greater participation, in practice changes have often been subverted to maintain the interests of powerful, elite groups in Bangladeshi society, at the expense of rural people.

For example, the experimental "New Fisheries Management Policy" of 1986 introduced an annual licensing system for "genuine fishers" in some 270 waterbodies on condition that they collectively pay the previous lease rate plus an extra 10 percent per year. This became a vehicle for the national fishers association to gain control over access. However, lacking the funds to pay the lease/licences, control reverted often to the same investor class as before (Ahmed, Capistrano and Hossain, 1997).

The policy shift in 1995 to make all rivers, or "open *jalmohals*", zero-rated for revenue collection (not leased) effectively ended the previous pilot policy and made rivers open access. However, while freeing fishers of tolls and fee collection, this change also opened the way for the wealthiest to invest in gears and brushpiles as ways of capturing more of the resource.

Other policy shifts have included the reservation of smaller waterbodies (under 8 ha) for leasing to youth cooperatives in 1998, ostensibly to enable the

unemployed to earn an income from aquaculture. However, many of these waterbodies are the vital smaller depressions which hold water and fish in the dry season converting them to aquaculture has a tremendous adverse impact on biodiversity and on the capture fishery that goes far beyond the waterbody in concern. Moreover, where such cooperatives control capture fisheries, they act as another layer of intermediaries subleasing fishing rights and thus earning rent from the labour of the fishers.

It is reported that nationwide there are 3 773 open *jalmohals* (MoL quoted in Islam, 1999a) consisting mainly of rivers and estuaries that cover more than 1 million ha, while beels and haors cover 110 000 ha (Ahmed, 1999), and there are 8 549 closed *jalmohals* totalling 14 000 ha (MoL quoted in Islam, 1999a); although more recently the Bangladesh Poverty Reduction Strategy Paper refers to over 30 000 waterbodies (GoB, 2005). Over time the contribution to national government revenue collected from *jalmohals* has fallen sharply as the economy and tax base has dramatically changed in recent decades. Now only some 0.07 percent of government income comes from *jalmohals*, and many generate no revenue owing to legal cases (Huda, 2003), creating a space for changes in future policy.

However, although revenue is no longer the national concern, it is still a prime mover in local policy application because it is a source of local resources and of unofficial resource rents. There have been recent attempts to shift fisheries policy to using leases to limit fisheries access towards fishers in the expectation that this will benefit the poor and ensure sustainable harvests (DoF, 2006). But are these aims contradictory and are they best met by giving preference to full-time fishers? While some full-time fishers effectively work as labourers in fishing teams and are clearly poor, living day-to-day on their wage or share of the catch, many full-time fishers are not necessarily poor, some own higher value gears or lead fishing teams and may also have fish trading interests. Also the type of fishers who depend on the resource differs between waterbody types (Box 4). In reality, most full-time fishers fish mainly in the rivers, while the people fishing in relatively smaller closed *beels* and *baors*, which are the focus of this paper, are mostly part-time fishers who fish seasonally when there is work to be had harvesting a waterbody, and those who catch fish for their own food fish mostly in the seasonal *beel*-floodplain systems.

BOX 4

Waterbody complexity – access and use

Waterbodies are very diverse which has implications for fisheries management.[1]

Open waterbodies

These are common pool resources. Fishing tends to be dominated by professional full-time fishers. Many of the more valuable fish migrate between rivers and floodplains and, in the case of Hilsa *Tenualosa ilisha* (the dominant species), between coast and rivers. In some open waterbodies there have been government-supported stocking programmes.

- *Beels* are usually deeper depressions in the floodplain. Some are open and thus linked through canals to other waterbodies, others are closed or separate from other waterbodies (oxbow lakes outside the southwest region are usually called *beels*). Most hold water year-round, some have silted and are now largely seasonal. Man-made ditches or catch-ponds in the seasonally-flooded areas of *beels* are called *kuas.*
- *Haors* are extensive deeply flooded areas bounded by natural river levees often now raised by "submersible embankments". They may contain several beels, some of which are perennial. They cover a significant part of northeast Bangladesh (Agüero *et al*., 1989).
- Natural canals (*khals)* link beels to rivers and provide a channel for fish and water movements.
- Rivers constitute an important component of the fishery, not only the Jamuna-Bramaputra, Ganges-Padma, and Meghna, but also many smaller rivers, tributaries and distributaries that cover the countryside.

Floodplains and seasonal waterbodies

- Many *seasonal ditches* and *road side borrow pits* have been converted into perennial fish ponds through deepening and area expansion.
- Seasonally flooded land, mostly rice fields, although privately-owned forms a common pool during the monsoon with open access to fishing. Rice-fish culture is spreading in Bangladesh where the risk of overtopping of bunds around an area of rice fields is limited. When rice fields are stocked with either fish or shrimp, access is limited to the owner.

Closed waterbodies

These are permanent waterbodies that normally lack or have very few outlets into the wider wetland system in the monsoon.

- *Baors* are oxbow lakes – old river channels that now at best have limited connections to their parent rivers through channels in the monsoon season. Many are partly closed as fisheries by fences or netting so that they can be stocked. They are mainly concentrated in the southwest of the country (Haque *et al.*, 1999). Traditionally a land resource and, as such, subject to lease under the Ministry of Land (MoL). Unleased waterbodies are considered a common pool resource and are used for subsistence fishing.
- *Private ponds* have been increasing in number in recent years, dug either for house-raising or as fish ponds, but are not considered further here.

[1] See Khan (1997) for a description of these waterbodies.

Culture-based fishery management issues

Much of the permanent water that is the basis for inland fisheries in Bangladesh comprises government owned waterbodies but these connect to larger floodplains where much of the land is privately-owned and seasonally flooded. The waterbodies and wetlands of Bangladesh have been divided into many smaller units by the government for the administrative purpose of leasing out fishing rights. Improving the management of the fisheries in these waterbodies has focused on two aspects: institutional and technical. On the institutional side, and in response to the weaknesses of competitive leasing, there has been a focus on "community-based management" in recent years – through the formation of local organizations of people who are awarded use rights on the condition that they adopt improved management practices. On the technical side, and considering the declining capture fisheries and experience gained in aquaculture, the emphasis of the Department of Fisheries has been on stocking carps in these fisheries to boost production. However, other options to conserve and restore fish productivity without stocking have also been demonstrated and are gaining recognition.

COMMUNITY-BASED FISHERIES MANAGEMENT

In this section community-based fisheries management is understood to describe a set of institutional arrangements for management of waterbodies and fisheries based on the organization of local people who depend on that resource. These organizations that are typically formed with facilitation by NGOs mainly consist of people who depend on fishing for their livelihoods in a certain waterbody. Typically, the government, through a project, reserves fishing rights in an area for one such organization. These community-based organizations vary – some have a strict membership of fishers who hold exclusive fishing rights, others comprise representatives of the wider community of people who use a waterbody and associated floodplains (for example, including some farmers and wealthier people as well as professional fishers and landless subsistence fishers). Because stocking involves annual investments in fingerlings, it is usual for the community organizations involved to either be membership-based and raise funds from the members who have rights to fish, or to charge fishing fees to cover the costs of stocking.

Participatory planning

Participatory management is not just a way of giving local people influence over decisions. If fishers of whatever type are to take a leading role in management, they must be in agreement so that they will comply with plans and rules, be able to enforce them and stand up to local elites. All management initiatives and regulations (sanctuaries, closed seasons, screening/non-screening, gear bans, etc.) should only be implemented in small steps and always be subject to change whenever new information becomes available (adaptive management).

Who should and can participate is a critical design issue. In a culture-based system there are considerable levels of organization capacity required to manage funds for stocking fish each year, contracting suppliers and paying the Government leases (that are often relatively high for these waterbodies which are usually but not always rightly seen as being profitable enterprises).

The arrangements developed through, for example, the Oxbow Lakes Project (OLP II) (Apu *et al*., 1999, Box 5) and similar waterbodies of the Community-Based Fisheries Management project (CBFM) (Thompson, Sultana and Islam, 2003, Box 5) that promoted culture-based fisheries in *baors* and some *beels* have been based on community organizations with a defined closed membership. In these organizations, the members through their elected leaders prepare a stocking plan each year together with plans for raising funds, guarding, closed seasons, harvesting and sharing of costs and benefits.

Planning of culture-based systems involves a mixture of aquaculture based technical knowledge, which traditional capture fishers may not have, and local knowledge of the waterbody and its fishery which the users have in abundance. Consequently the role of NGO and DoF staff in advising and planning management has been significant at least in the early years in these various sites.

Options and participation are severely constrained when the DoF has decided through project design or professional biases that stocking should be the management approach in a waterbody. The attraction

Courtesy of P.M. Thompson

Community meeting where management interventions are being planned.

of subsidized fingerlings for stocking and profits from stocking that might be controlled through a project-community base tend to result in dependence on DoF/ projects and to attract opportunists who are not fishers but see a chance to make money from a new intervention.

In the case of the Fourth Fisheries Project, the project initially took a blue print approach having pre-defined the expected type of intervention appropriate to improve each fishery, which caused problems particularly in stocking plans. Through trial and error and failures, the community organization for each of the remaining sites by the end of the project had its own annually-revised management plan, and all of them had adopted fish sanctuaries as an easier intervention. Consequently, in reviewing its experience working in open waters the project concluded: "Do not impose any pre-determined physical and technical interventions however well-intended on the local community" (Thompson, 2005).

Involvement of NGOs

Almost all projects in Bangladesh that have attempted to establish culture-based fisheries through some form of community participation have involved NGO partners working with the Department of Fisheries. Exceptions are those oxbow lakes managed directly by DoF where a limited number of fishers are licensed by them (Middendorp and Balarin, 1999), and the Third Fisheries Project in the early 1990s where floodplain stocking initially was done by the government but in the last year NGOs were involved in an attempt to overcome lack of compliance with top-down access rules (Islam, 1999b). Since then NGOs have been involved from the outset of projects. The role of NGOs has been to organize communities/groups and develop the institutional arrangements, but often they have also been a source of credit for stocking (as in OLP-II and CBFM, see Box 5). Often the NGOs have been contracted and provide a limited project-based service without a clear target of establishing self-sustaining local institutions by the end of their work.

The capacity of NGOs in community mobilisation complementing technical support from DoF has been widely acknowledged and accepted in the Government. However, there is a tendency for some of the larger NGOs to undertake this support through their fisheries sections with technical staff who lack social organizer skills, while the smaller NGOs tend to employ new staff lacking experience in either sphere because they have few regular staff. There are also reports of smaller NGOs on average having less success in establishing effective local fishery management organizations (Thompson, 2005). Overall, it is vital that the facilitators and field workers of involved NGOs are suitably skilled and trained, it should not be assumed that the NGO will manage this.

Distribution of benefits and costs

In stocked fisheries with community involvement there are two general ways in which the returns from the fishery are distributed. In closed waters, a closed group management approach is the norm, where all of the participants are active fishers and are group members. It is normal for members to be organized into fishing teams and to rotate fishing (using seine nets). When the group agrees to harvest the stocked fish, various systems to share the income typically through a central on site auction of the catch and payment of equal shares to the members are then adopted (Apu *et al*., 1999; Thompson, Sultana and Islam, 2003). Attempts to broaden membership of these management groups appear to have been short-lived, for example in the Oxbow Lakes Project the numbers of participants were increased to spread benefits to include more of the poorest households (Apu *et al*., 1999), but after the project ended these were the group members who tended to be dropped (Nathan and Apu, 2002).

In large floodplains the attempts with stocking have been based on subsidies to initiate the process and then phasing those subsidies out. Local committees were to set fee rates for fishers to pay that would cover the costs of stocking

BOX 5
Key projects

Oxbow Lakes Project II (OLP-II): duration 1991–1997, supported by IFAD and Danida. It worked in 20 oxbow lakes in the southwest to establish and demonstrate profitable culture-based management through fisher-based local organizations.

Community-based Fisheries Management (CBFM): duration 1995–2000, supported by the Ford Foundation (a separate UK DFID second phase continued until 2007). It worked in 19 diverse waterbodies to test community-based approaches.

Fourth Fisheries Project (FFP): duration 2000–2006, supported by the World Bank, UK DFID and Government of Bangladesh. One component was for openwater fisheries, initiating work in over 70 scattered water bodies through NGOs, by the end about 46 community-based organizations (CBOs) in 40 waterbodies were continuing and expected to sustain. Interventions were pre-defined before community entry.

Management of Aquatic ecosystems through Community Husbandry (MACH): duration 1998–2007, supported by USAID. It worked in three large wetland sites to demonstrate an ecosystem approach to wetland co-management. This was based on 16 CBOs managing connected areas of wetlands, particularly to conserve and restore fisheries, linked up through *upazila* level co-management committees.

and any leases for fishing rights. Whichever fishers were willing to pay these licence fees or tolls could thus fish, with benefits accruing according to the efficiency of their gears. Nabi (1999) reported on the opinions of fishers regarding the distribution of benefits from floodplain stocking under the Third Fisheries Project. The fishers believed that owners of *kuas* (ditches) and owners of larger gear (seine nets and lift nets) gained most, although catch monitoring apparently did not confirm this. However, 21–38 percent of professional fishers reported losing because of the project because landowners prevented them from fishing or because they could not fish during an imposed closed season.

Courtesy of P.M. Thompson

In waterbodies where fish has been stocked all fishing is done by teams, the catches are sold and revenues divided among the team members.

In either case those who do not bear in some way the costs of the management practices lose access to the fishery. The arrangements in stocked floodplains have not been so different from those without stocking where there is a jalmohal leased to a cooperative or an individual, who then sets fees and aims to profit from this. The systems where committees comprising of a range of stakeholder types are involved in stocking have not continued beyond or even through phasing out of project support, for intuitively obvious reasons. Traditional leasing is effective and may be efficient but not equitable because the leaseholders have sufficient local power to control access such that they can profit (Toufique, 1999). In a larger committee there is no incentive for the non-fishing members if they cannot profit, even the powerful members have difficulty in enforcing higher fees and longer closed seasons that are needed to profit from stocking over a large floodplain. Consequently culture-based systems so far have only been sustained in well defined waterbodies of moderate to smaller area.

Credit

Culture-based systems require large investments each year to buy fingerlings and to pay lease costs for *jalmohals*. For example, Nathan and Apu (2002) reported the oxbow lake groups needed the equivalent of about US$9 000–18 000 per year as working capital. When funds were not available from an NGO or their own sources, they were forced to borrow from

fingerling suppliers and other money lenders at interest rates of 5 percent per month. Eventually these groups are likely to fall under the control of these financiers especially considering the risks associated with stocking (below), and would in effect be worse off than before becoming involved because by then they will have accumulated a considerable debt. It is therefore important for fisher groups involved in stocking to have access to credit on favourable rates, for example through NGOs, one option is to help the groups develop their own revolving funds.

Risk management

The outcomes of stocking are highly variable, and because stocking requires a high investment the risks are high even if average long-term returns are good (Lorenzen and Garaway, 1997). Even when loans are provided, the poorest people are not likely to become involved because they cannot afford to take the risk involved with the investment. It is crucial that results are positive even in the short term because the beneficiaries have accrued a debt which may be very significant compared with their individual incomes, and which needs to be paid off.

Examples from Bangladesh confirm this and highlight other related hazards, for example even if fisher communities gain access to a waterbody and have access to credit from an NGO for stocking, they may lose control owing to disputes over the lease or they may be forced to pay for the fishing rights even in situations where they lack the power to exercise these rights or they may have to pay retrospectively so that they can maintain access rights in the future (for example in Rajdhala Beel discussed in Mamun and Thompson, [2004]).

When the waterbody has a high lease cost it is impossible for fishers to raise enough money to pay for both the lease and the stocking (on the other hand it is only possible to raise sufficient money to pay for the lease if fish are stocked and only if the attempt is successful). Fishers then have to rely on wealthy investors or money lenders who will demand repayment at high interest rates. Before any stocking the resulting cash flow for the fisher community should be worked out realistically after considering all the costs, likely returns and risks. This should be discussed widely with all stakeholders to see if costs and risks are acceptable.

ACCESS LIMITATIONS

People living around unleased waterbodies catch fish, both for their own consumption and to sell when there is a surplus during peak fishing months. In addition rural people are also able to freely access seasonally inundated land including rice fields – although outsiders from distant villages may be

denied access. Because effective stocking is synonymous with private or group ownership it will automatically lead to fewer and fewer households having access to what previously were common pool fisheries that had elements of seasonal open access or localized common property resources. The consequences are a loss of direct access to animal protein for their household diet and loss of supplementary employment and income (Ahmed, 1997; Thompson *et al*., 2002).

Ahmed (1997) emphasizes: "Catches from common property land are one form of ecological subsidies to the poor people, that keeps the balance between rural poverty and distribution of benefits. The loss of access to floodplain fisheries to promote the culture-based fisheries will benefit the land-rich people. This means a direct transfer of benefits from the poor and needy to the rich and surplus. This is a major policy issue with negative impact on equity and income distribution".

In Bangladesh, women are by default categorised as non-fishers, and therefore not included in the fisher groups involved in culture-based fisheries. However, divorced women and widows together with their children do in some areas fish both for subsistence and for an income, and have shown some ability to conserve and restore floodplain fisheries (Sultana, Thompson and Ahmed, 2002).

In Bangladesh, there was little tradition to increase fish production in rice fields through stocking, but this has changed significantly in recent years. NGOs, Government and donor organizations are now promoting several arrangements and local people are taking up culture-based private systems.

One spreading trend in the south of Bangladesh is the stocking of prawn larvae, but also fish, in areas of rice fields around which earth bunds have been constructed (known as *ghers*), most are owned by one farmer or a handful of joint-managing farmers. The prawns are fed with meat of the snail species *Pila globosa.* This practice increases the value of the production from the fields several times, it creates jobs for people who collect the snails and it also encourages farmers to reduce the use of pesticides.

On the negative side local people are normally no longer allowed to use the fields for subsistence fishing. The availability of fodder for livestock has decreased since the rapid expansion of *gher* operations. Snail populations have been locally depleted, and the environmental consequences of this are not known.

These trends are extending to culture of finfish in rice fields on either an individual or group basis through private initiatives, most recently adopting the model of companies where the shareholders (mainly the landowners of an area but also outside investors) invest in making bunds to enclose a large area and then stock it annually with carps. This practice is spreading in the

Comilla area in the east of Bangladesh where risks of escape are low and threatens to end any migration of native fish or access for non-shareholders in the returns.

However, there are encouraging examples of systems that allow a wider involvement of the community, for example some villages in the Jessore area have built community *ghers* in waterlogged areas. In the dry season, each farmer cultivates one crop of rice, but for the rest of the year the community acts together investing either their land, their labour or their money into a prawn and fish harvest. The proceeds are distributed according to the level of investment whether labour, land or money. In this way landless people also share in the harvest (Nabi and Ahmed, 2001).

STOCKING

Choice of species: indigenous versus exotic

In Bangladesh the choice of species to be stocked depends mainly on the price and availability of fingerlings. This is not the proper way to plan a stocking programme as the decisive elements should be the suitability of the species with respect to the local environment and the needs and benefits to the stakeholders.

The choice of which species to stock once stocking has been decided upon is not easy however. Intensive stocking, with any species native or exotic, in high quantities will have a significant impact on the biodiversity and ecology of the ecosystem and thus also on the people who make use of the latter (Box 6).

The most popular species for stocking are the indigenous major carps Rui (*Labeo rohita*), Mrigel (*Cirrhinus cirrhosus*) and Catla (*Catla catla*), because they are easily available from hatcheries and fingerling traders, grow reasonably fast and can when harvested be sold for a high price. However, there are significant problems involved with stocking them because of poor broodstock management at many of the hatcheries that provide fingerlings, and the already severely reduced self-recruiting stocks of the species are in danger from becoming wiped out completely in the country because of loss of genetic diversity (Rajts *et al*., 2006).

Among the exotic species the greatest fear arises from irreversible impacts on the ecosystem. A species such as Silver carp (*Hypophthalmichthys molitrix*) for example competes with several indigenous planktivorous fishes especially Catla, and Chapila (*Gudusia chapra*). Stocked fish species may also compete with people for particular resources Black carp (*Mylopharyngodon piceus*) for instance feeds on snails and will therefore compete with people who collect these molluscs for sale or for feeding their ducks. Grass carp (*Ctenopharyngodon idella*) which feeds on higher plants may if stocked in too

BOX 6

Yields and returns from wild and stocked fish

When a waterbody is stocked other management measures especially access restrictions need to be adopted as well if those investing are to earn a return on that investment. The consequently lower fishing pressure will everything else being equal lead to a higher fish biomass and a higher catch per unit effort (CPUE), but not necessarily a higher production (Lorenzen *et al*., 1998).

To determine the profitability of stocking it is essential to know the production of indigenous species already present in the waterbody. This production can have a higher value than the value of production after stocking even if the total yield increases – this is because the mixture of wild indigenous species are the most popular food fishes in the country, and some of them have high market prices and their relative prices have been increasing (Thompson *et al*., 2005).

In floodplains stocked in the early 1990s, Hossain, Ehsan and Mazid (1999) found no clear trend in how stocking affected fish diversity indices. However, Haque *et al*. (1999) showed that in OLPII baors, the number of species did decrease from 58 naturally occurring fish species in lightly stocked *baors* to 43 species in heavily stocked. On the other hand fish species diversity did not differ between lightly stocked and non-stocked baors (Haque *et al*., 1999). But even though wild fish still account for a considerable part of the yield after stocking (e.g. 20 percent in some Oxbow Lakes) natural fish populations may well decline after stocking. For example Haque *et al*. (1999) reported two oxbow lakes with yields of stocked fish of 1 800 kg/ha yielded only 235 kg/ha of wild fish compared with a non-stocked lake yielding 530 kg/ha.

Such impacts depend on the interactions between the stocked species and the species already present in the waterbody. It is therefore crucial for any predictions of the outcome that the composition of fish species in the waterbody is known in advance so that the right species for stocking can be determined (to minimize competition) and the best size of fingerlings can be decided depending on the presence and nature of predators (stocking large fingerlings will reduce mortality but large fingerlings are also much more expensive).

It is vital that all the costs involved with stocking (screening, fingerling costs, loss of wild fish, etc.) are included in the equation when profitability of stocking is calculated.

high quantities damage aquatic vegetation including plants that may be used for human consumption or other domestic purposes, and if they are allowed to enter rice fields they may also damage the crops. However, this species is still promoted for some fisheries by aquaculture-oriented specialists who see high quantities of aquatic plants as reducing the suitability of *beels* for other carps, ignoring environmental issues.

Courtesy of P. Sultana

*Silver carp (*Hypophthalmichthys molitrix*) is an introduced species and one of the most popular species in stocking programmes in Bangladesh. However it may compete with indigenous planktivorous species, and is not a highly esteemed food fish and prices are comparatively low.*

Because of the irreversibility of any introductions of exotic species capable to reproduce in the receiving environment, such actions should be guided by the precautionary principle, which means that a thorough hazard assessment should be carried out in advance of any introduction (FAO, 1996). In Bangladesh 18 different exotic species and hybrids have been used in aquaculture and stocking over the last 54 years (Rajts, Akanda and Shameem Ahamed, 2004), and Common carp (*Cyprinus carpio*), *Thai sharputi* (*Barbonymus gonionotus*) and several species and varieties of Tilapia (*Oreochromis* spp.) are already breeding out of captivity and have become established in the country (Rajts, Akanda & Shameem Ahamed, 2004).

Another danger involved with the introduction of exotic species is the potential co-introduction of diseases or parasitic species to which indigenous wild species have a much lower level of tolerance. In Bangladesh *Thai sharputi* has been accused of being the vector for the introduction of Epizootic Ulcerative Syndrome (EUS) which has caused large-scale fish mortality in the floodplains (Minkin cited in Pallewatta, Reaser and Gutierrez, 2003) with severe economic consequences for the affected communities resulting from lower catches and lower prices for sold fish (Lilley, Callinan and Khan, 2002).

Exotic species are also not always easily accepted by consumers who may prefer indigenous species for traditional and cultural reasons. This may be because the exotic species taste differently, have more bones, need to be prepared in a certain way, or cannot be used for traditional dishes. In Bangladesh Thai pangas (*Pangasianodon hypophthalmus*) which in terms of aquaculture production is a great success is for example not well liked because of the high fat content, and Silver carp which is widely used both in culture facilities and for stocking is considered of poor quality and fetches a very low price.

Other issues that should be considered when taking the decision on which species to stock include the nutritional qualities of the fish, the ability of the species to reproduce in the environment where it is stocked and thus the

need for further stocking, whether the species requires habitat modifications, whether predators need to be removed, and whether the species should be stocked alone or in combination with other species.

Predator removal

A large proportion of the species naturally present in permanent waterbodies on the floodplain are carnivorous. Stocking may therefore be considered an expensive way of feeding these fish, and it will often be attempted to remove predatory species within a stocking programme. However, serious objections have been raised regarding the environmental impacts of some attempts at predator removal. For example, one attempt to stock large floodplains adopted the technically attractive approach of stocking carp fry in permanent *beels* within the floodplain from which they could naturally move into the floodplain when water levels rose, thereby reducing transport problems. However, to minimize mortality of small fry this strategy required the use of rotenone in the *beels* to kill predators and all other aquatic life (Ahmed, 1999), unfortunately these same *beels* are the dry season refuges of the fish and aquatic biodiversity that would naturally repopulate the floodplain in the monsoon. This strategy would tend to replace many small species caught by the poor with a few stocked species that are only caught by participant professional fishers or the leaseholders.

Moreover, it is probably not possible to eliminate these, often hardy, species even in almost completely closed waterbodies. Snakeheads can for example move over land and often occur in even relatively isolated ponds, and other predators are common such as Koral (*Lates calcarifer*) in coastal areas and Boal (*Wallago attu*) a voracious silurid catfish in *beels*. Stocking larger fingerlings and species that are not so vulnerable to predators (e.g. spiny catfishes) is a better option.

Finally it must be remembered that the predators form an important part of the biodiversity and constitute an important and valuable part of the catch, and many of the methods applied by subsistence fishers aim directly at catching these species (e.g. hook and line and longline).

Courtesy of P.M. Thompson

*It is often attempted to eliminate predatory fishes when a waterbody is stocked, but they constitute an important part of the catch. Here it is a catch of Boal (*Wallago attu*).*

Habitat modifications

Screening or closure of river branches

If money is invested into stocking fish, people obviously do not want that the fish escape, it is therefore normal to screen off all exits after fish have been released in a waterbody. However, the logic for this is debatable. The Indian major carps used for stocking in Bangladesh (i.e. Catla, Mrigel and Rui) are strongly migratory and therefore instinctively move towards the main river before the spawning season, but in culture-based systems they are mostly caught before reaching sexual maturity. Common carp, another species used for stocking, has gained its popularity exactly because it does not move away from its release areas (Coates, Rajts and Hasan, 2003).

Moreover, screening seriously interferes with fish ecology and impacts negatively on the fisheries for naturally occurring species. Screening off the connection with the river apart from preventing fish leaving the waterbody also stops migratory fishes from entering. Depending on the importance of this connection this may be a big loss or a small loss. However, in most floodplain waterbodies, it is probably much more significant that there are large areas of rice fields and other wetlands that have some degree of connection. These seasonally flooded areas constitute the spawning and feeding grounds of the "black fishes" that spend the dry season in permanent waterbodies in the floodplain, and enter the flooded areas through small drainage/irrigation canals. The total floodplain or rice field area around a *jalmohal* may be 20 times larger than the average area of many *jalmohals* themselves (E. Keus, personal communication). If we consider that the fish production in the rice fields is around 50–150 kg/ha, the contribution of the fish production in rice fields to the fisheries in the *jalmohals* must be very significant even if only a small fraction of the fish escape to the waterbodies at the end of the flood season. Opening the side canals will thus not only benefit people fishing in the rice fields it will also improve catches of laterally migrating fishes in the *jalmohal*.

Courtesy of M.R. Hasan, FAO

When a waterbody is stocked all outlets are normally screened to avoid the escape of the fish. However, screens have a negative impact on biodiversity and are expensive to install and maintain.

Very important subsistence fisheries are

carried out in these inundated areas during the flood season and there is normally open access for everybody to fish. If the side canals that link the waterbodies with these spawning grounds are screened off, fish will no longer be able to repopulate floodplains and rice fields around them. The consequences for people who have access to fish only in the flooded areas because they have been excluded from the *jalmohals* are particularly severe.

Courtesy of J. Valbo-Jorgensen

Dense carpets of waterhyacinths are common feature in waterbodies that have been out of lease for some time and they are considered a nuisance when fish is to be stocked. However they may be used for a variety of purposes including building floating gardens.

Removal of vegetation

Waterbodies that have dropped out of leasing (no bids) are often highly degraded and for example covered by dense carpets of water hyacinth. Before stocking fingerlings, it is therefore standard practice to remove most of the floating vegetation in order to improve the penetration of light and thus increase phytoplankton and periphyton production, thereby creating more food for herbivorous fishes such as the Indian major carps and thus a higher production of these species.

The removal of water hyacinth will lead to changes in fish species composition including a decimation in the populations of certain indigenous species i.e. catfish and predators, although other indigenous planktivorous species, such as Chapila, which often proliferates enormously in stocked waterbodies because the water hyacinth is

Courtesy of PBAEC

*Chapila (*Gudusia chapra*) is a small indigenous shad that often proliferates enormously when waterhycinth is removed and thus contributes significantly to catches.*

removed, will benefit. Water hyacinth is also used by rural people for a range of purposes (Box 7).

BOX 7
Is water hyacinth a liability?

Although an invasive exotic plant, water hyacinth should not be removed indiscriminately; it should be kept in mind that it is not exclusively harmful and should not be considered as a waste product. Water hyacinth is in fact another aquatic resource and should be treated as such:

- poor people use is as fuel (although probably not of very good quality);
- it is an excellent source of fertilizer;
- it is sometimes fed to livestock (although nutrient content is low);
- it can be used for making floating gardens;
- technologies are available to produce biogas from water hyacinth using small-scale plants;
- fish use them as shelter and spawning substrate and some should be left as a habitat/sanctuary; and
- it has become an important part of brushparks and fish attracting device, and may attract different species from brushparks without a "roof".

Implications for fish consumption and nutrition

Most households in Bangladesh, even professional fishers, buy a considerable proportion of the fish they consume. Multiple studies in Bangladesh have shown that a majority of the fish consumed by local poorer households, even in culture-based systems, are small indigenous fish and shrimp species (Thompson *et al*., 2002). Team catches, larger fish and species of higher value, such as the native major carps and exotic carps that are stocked are usually sold. The small fishes, on the other hand, because they are eaten whole, play an important role in enriching the Bangladeshi diet which is typically poor in minerals and vitamins.

Stocking a waterbody changes the characteristics of the fishery by increasing the proportion of the caught fish that is sold and reducing the amount consumed domestically. This is particularly true in closed culture-based systems where the group members need to fish in teams and sell through their central marketing system if they are to avoid members disobeying fishing rules and the benefits being unequal, and so even much of the catch of wild species tends to be through team/group fishing. However, many of these small species are opportunistic breeders that reach sexual maturity in a few months. They are therefore extremely resilient to high fishing pressure and

can be caught with other methods than the ones used for catching the much larger species that have been stocked. It therefore seems obvious that subsistence fishers should be allowed to continue benefiting from this resource that otherwise would be underexploited. However, in all projects and sites reviewed those managing the waterbodies have set rules to stop people fishing from the time of stocking until the stocked fish are big enough to be harvested. This may not be a problem for people with other sources of income. However for landless and possibly unemployed people the fishery may be their only source of food and income. If the waterbody is stocked and fishing is banned for several months these people will be deprived of their daily rice.

Courtesy of P.M. Thompson

Small indigenous fishes are the most important for the fishers' own consumption and they constitute a considerable part of the catch even in stocked waterbodies; the larger-sized stocked fish are nearly always sold.

ALTERNATIVES TO STOCKING

When initiating a project on culture-based fisheries the net benefits of stocking are often grossly overrated. The Fourth Fisheries Project found that in most of the floodplains that were stocked there was a lack of clear economic benefits achieved. The conclusion is that the entry point for fisheries management should not be stocking which requires a high level of control over the waterbody,

Courtesy of M.R. Hasan, FAO

Small indigenous species may be caught by different fishing gears than the major carps that are most commonly used to enhance fisheries, and they can therefore be caught without posing a danger to stocked fish. The box traps used by this fisher provide an example of such a gear.

organizational coordination and ability to raise funds (Thompson, 2005). In most waterbodies there are less risky options that user communities are more prepared to invest in than stocking; interventions such as sanctuaries and limits on fishing effort that are low cost, easy to implement and visible, and cause little or no social conflict, have been found to be more effective and equitable in implementation. Subsidized stocking should be avoided completely until group cohesion within community-based organizations has been clearly demonstrated and procedures for maintaining transparency and sound financial management are in place and well understood.

Although natural floodplain fish production may have fallen to low levels, it does not mean that production will remain at this level. Experience has shown that yields can be increased with rehabilitation and management activities. It should be of particular priority to connect canals and lowland floodplains attached to the waterbody and manage them in a sustainable way even if they are not *jalmohals*. This is particularly an issue where well defined waterbodies have been managed with stocking ignoring their role as a refuge for wild fish that repopulate the floodplain seasonally.

Many fishes have very modest habitat requirements but, with few exceptions, they do demand access to water all the year. As long as it is connected with permanent waterbodies seasonally flooded land is also a prime fish habitat and is often much more productive than permanent waterbodies. So two simple things that can be done to increase fish habitats and therefore fish abundance are to increase the area which permanently holds water, and next improve the access routes for the fish to enter these areas. This means that deeper pockets in silted up *beels* should be excavated, degraded side canals that are jammed with mud or water hyacinth should be reopened, holes should be made in the embankments or they should be fitted with culverts, so the fish can enter floodplains and rice fields to spawn and feed. Satellite images, aerial photography, interviews with local people (both fishers and other stakeholders) and discussions with the Bangladesh Water Development Board (BWDB) are ways to find out exactly where such improvements should be made.

However, a major problem associated with improving fisheries through habitat rehabilitation is that it is impossible to estimate how much fish production can be improved from this activity alone. Production potential is highly variable between waterbodies because of each waterbody's geographical position and individual physico-chemical characteristics, and for most waterbodies in Bangladesh there are no historical fisheries data available. Moreover, recent work to restore habitats has been part of a suite of community activities to sustain their fisheries. For example, the MACH project has supported excavation, creation of sanctuaries, observance of closed seasons and gear limits,

limited restocking of some native species, and provided alternative livelihood support to encourage reduction in fishing effort. By 2004–2005, some five years after its single baseline set of data, fish yield in Hail Haor (a large productive wetland) was double the earlier level, and in a floodplain-river site that had been more degraded catches were up from 57 kg/ha to over 300 kg/ha (MACH, 2005). Another success story was the first re-excavation of a link canal to restore a fishery in a wetland in Tangail District, where fish catches were reported to have increased by 3.6–4.9 times after rehabilitation (Rahman *et al*., 1999a).

Courtesy of P.M. Thompson

Fisheries can be improved by rehabilitating habitats and improving connectivity between waterbodies. Here a canal is being excavated at Hail Haor where it currently forms a part of the main sanctuary.

Throughout Bangladesh sluice gates are managed by sluice committees which are under the control of farmers, who typically do not take the interest of fishers into consideration. Although it is possible to manage sluices in a way that benefits fishers and farmers at the same time (Shankar, Halls and Barr, 2004). Promoting a shift of crops away from rice towards less water consuming crops will lower the demand for irrigation and will thus maintain a higher water level in permanent waterbodies during the dry season with significant benefits for fish populations (Shankar, Halls and Barr, 2004) such a diversification would also have the added benefit of decreasing farmers' vulnerability in case of a failed rice harvest.

If sluice gates are opened at the time when juvenile fishes and prawns are available outside the gates the waterbody will be stocked from natural sources. Purpose built fish passes may further improve the survival of fishes compared with opening regular sluice gates (Kabir and Sharmin, 2003). However, while it costs only an additional 25 percent to make a sluice gate fish friendly when it is being installed (personal communication BWDB Patuakhali, August, 2003) it may not be cost effective to install a fish pass for smaller waterbodies especially if it requires modifications of existing sluices.

One way of improving habitat quality is to install brush parks or keep a small area covered with water hyacinth. Brush parks offer shelter and spawning substrate for fish and at the same time they provide a hard surface for periphyton growth. Consequently almost every fish sanctuary established

by communities through different projects includes within its area a brush park as a way of attracting and enhancing fish habitat and a way of preventing fishing with nets.

Planting riparian vegetation and introducing, or reintroducing, aquatic and semi-aquatic plants can further improve the quality of the habitat. A more heterogeneous environment will automatically lead to a more diversified fish fauna.

REACHING THE POOR

Who benefits from stocking?

After stocking new management regulations are likely to be implemented, the scope of these will depend on the objectives of the stocking programme, however it is also very much dependent on the nature of the communities and the environment concerned. There is a tendency for new entrants into culture-based fisheries to come from farming communities. To a large extent, these people are already comparatively resource rich, because they have access to land. The people who rely most on common pool resources including fish and other living aquatic resources are often characterised by a lack of access to agricultural land, including *inter alia* unemployed individuals, day labourers and destitute people and among these women. From the experience of stocked floodplain *beels* in Fourth Fisheries Project it was concluded that in most cases subsistence fishers either derived no benefit or were adversely affected by stocking (Thompson, 2005). While stocking of fingerlings, gear bans and seasonal bans on all or some fishing gears were successful technically to conserve and enhance resources it led to exclusion and suffering of poor fishers. When a ban was imposed these people could not fish and lost part of their protein intake or had to switch to another waterbody – provided that it was available. Often there was a transfer from a de facto open access fishery to group ownership (or private ownership in the case of individual leaseholders or financiers of fisher groups), with the exclusion or strong limitations put on non-beneficiaries of the stocking programme. BRAC (1995) found that 26 percent of the households around the OLPII *baors* were fishing in their respective *baors* before the project was implemented, and of the 16 percent displaced by the project 70 percent were poor.

If fish production increases dramatically there is also a larger risk of interference by influential elites. Once again in terms of poverty targeting to reduce the dependence on elites for finance and minimize the need for credit, focus should be on low cost interventions such as sanctuaries; waterbodies with low lease fees; encouraging savings; and providing support for alternative income generating activities. A further issue is that the initial investments of

projects in stocking tend to attract interest from those with an intention to profit from the process. Inevitably only some people are directly involved in purchasing fingerlings and other financial matters, and this brings opportunities for funds to be diverted from the intended purpose at different stages of the process. For example, it has been common, when projects started informing that they expect to support stocking of waterbodies, for local influential people to seek to involve themselves in the community organizations in the expectation of profiting from this. Accusations of exploitative collusions may arise concerning each party involved in handling funds associated with such programmes.

Alternative income generating activities

It is inevitable that for sustainable fisheries some restrictions on fishing will be required. One important way in which the seasonal impacts of closed seasons and restrictions on fishing can be mitigated is through livelihoods components that are part of work to improve fishery management. This is relevant whether the management approach is culture-based (as in some CBFM sites (Thompson, Sultana and Islam, 2003)) or is based on wetland restoration (as in the MACH project (MACH, 2005)). Although microcredit programmes and various NGOs already cover many of the rural poor this coverage is not complete and does not target to mitigate adverse impacts on subsistence fishers who may lose access. The critical issues are for the training and credit for alternative or additional income sources to be linked with acceptance by the participants of rules and management practices adopted in the concerned waterbodies, and for the program to be non-fish related in order to diversify the livelihoods of the people involved. Such programmes need to be of sufficiently long duration and well targeted to make a real contribution to the participant's lives. Traditional fishers may, at least initially, be reluctant to change occupation completely, but the approach of many NGOs to work with women

Courtesy of P.M. Thompson

Creating alternative income generating activities for the fishers themselves or their families diversifies their livelihoods, and may to some extent mitigate adverse impacts caused by restrictions on access to fishing. Here the wife of a fisher assisted by the MACH project has started a poultry farm.

may add resilience to the economy and food security of the households and eventually give an entry point to involving men during the closed season.

MEASURING IMPACTS ON LIVELIHOODS

In many cases the decision to stock has been based exclusively on the desire to increase production. Existing uses and users have by default been considered non-existent, and it has been common practice to initiate management for intensive fish production without a baseline survey, even when NGOs or donor funded development projects are involved (Thompson, 2005).

The baseline survey should cover the entire wetland management unit including linked floodplains not just the *jalmohal* which has been leased, and all relevant institutions and stakeholders must be identified and the latter's reliance on aquatic resources for their livelihoods assessed before any intervention. Such a baseline survey is needed both for planning purposes and in order to be able to monitor the impact of fishery management activities. The baseline survey should shed light on the reliance of various stakeholders on aquatic resources in the area under management, and assess whether the relationships between different user-groups are largely cooperative or competitive, or whether any one group is dependent on another. It should further assist in identifying potential problems and conflicts and finally help measure the impact of the activities in improving people's livelihoods. The baseline should also serve as a reference point to measure the impact of project intervention.

Ideally fish catches and other indicators should be monitored for at least a year before any interventions are undertaken. However, poverty alleviation means not only an increase in income, nutritional quality of food and food security, but also improvement in social conditions including access to training, higher social status and better housing (Nathan, Apu and Middendorp, 1999) thus a broader range of indicators is needed than may be regarded by fisheries specialists as necessary or appropriate.

Conclusions

In addition to private aquaculture, culture-based fisheries continue to dominate many Government actors' visions for inland fisheries in Bangladesh without the required attention to access and property rights arrangements. The link between community participation and culture-based strategies, while laudable in its sentiment, is undefined (Muir, 2003). This attention focuses on a production policy theme, without sufficient attention to access and poverty issues in culture-based fisheries, and more fundamentally diverting resources from addressing the much larger issues of managing capture fisheries well before it is too late. The increases in aquaculture production have only brought marginal benefits for destitutes and landless people. Sustaining the inland fisheries is of immense importance in order to ensure the food security of the poorest part of the population. In addition administrative and institutional constraints have discouraged cooperation and a holistic approach to maintaining capture fisheries and the wetlands they depend on.

Any stocking should be promoted through means that maximize its sustainability and minimize scope for diversion of funds. For example, developing low cost nursery ponds near to the waterbody that are under the control of the fisher group. Before deciding on stocking a waterbody and controlling movement of fish, the potential costs and benefits of alternatives such as habitat restoration should be assessed, and an extensive effort made to work with local fishing communities to understand their priorities and help them organize to address their problems and take up opportunities, of which stocking is but one.

In Bangladesh most stocking is carried out with species that are not expected to reproduce, and so fingerlings need to be released each year, making financial sustainability of the group managing the process just as vital as the biological sustainability of the waterbody and fishery. Projects have tended to take advantage of availability of fingerlings, without addressing the cash flow problems of fisher groups trying to manage closed culture-based systems. The end result is that poorer members of the society are affected over the long term because native fish stocks have become depleted and the capture fishery has become relatively isolated both within the policy arena and in practice (Parveen and Faisal, 2003).

The attraction of subsidized fingerlings for stocking and profits from stocking that might be controlled through a project-community base tend to result in dependence on DoF-projects and to attract opportunists who are not

fishers but see a chance to make money from a new intervention. Subsistence fishers either derived no benefit or were adversely affected by stocking (Thompson, 2005). While stocking of fingerlings, gear bans and seasonal bans on all or some fishing gears were successful technically to conserve and enhance resources it led to exclusion and suffering of poor fishers.

The conclusion is that the entry point for fisheries management should not be stocking which requires a high level of control over the water body, organizational coordination and ability to raise funds (Thompson, 2005). In most waterbodies there are less risky options that user communities are more prepared to invest in than stocking; interventions such as sanctuaries and limits on fishing effort that are low cost easy to implement and visible, and cause little or no social conflict, have been found to be more effective and equitable in implementation.

Before deciding on any stocking, careful management planning is needed with the community to identify simpler options and to address rehabilitation of the waterbody which may have higher capital cost but does not require the community to invest each year in stocking species that do not reproduce in the waterbody. However, the current lease policy in Bangladesh unfortunately discourages this type of management because normal lease duration is three years, and it may take as long or longer for leaseholders to complete rehabilitation and show results, in which case their investment could be lost to the next leaseholder.

Specific recommendations for community-based fisheries management

It is vital that the facilitators and field workers of involved NGOs are suitably skilled and trained.

Pre-determined physical and technical interventions must not be imposed on the community.

Before any management intervention costs and risks for the fisher community should be worked out realistically, and it should be widely discussed if costs and risks are acceptable.

Reduce the dependence on elites for finance and minimize the need for credit, focus should be on low cost interventions such as sanctuaries and waterbodies with low-lease fees and encourage savings and provide support for alternative income-generating activities.

All management initiatives and regulations (sanctuaries, closed seasons, screening/non-screening, gear bans, etc.) should only be implemented in small steps and always be subject to change whenever new information becomes available (adaptive management).

Full participation of all stakeholders is necessary to ensure acceptance of rules and management practices adopted in the concerned waterbodies.

Seasonal impacts of closed seasons and restrictions on fishing can be mitigated through livelihoods components that are part of the work to improve fishery management.

Provide training and credit for alternative or additional non-fish related income sources to be linked with the rules and management practices adopted in the concerned waterbodies in order to diversify the livelihoods of the people involved and mitigate the seasonal impacts of closed seasons and restrictions on fishing. It may be an advantage to initially work with women instead of men.

The entry point for fisheries management should not be stocking which requires a high level of control over the waterbody, organizational coordination and ability to raise funds and open floodplains should not be stocked. Subsidized stocking should be avoided completely until group cohesion within community-based organizations has been clearly demonstrated and

procedures for maintaining transparency and sound financial management are in place and well understood.

It is vital that all the costs involved with stocking (fingerling costs, loss of wild fish, etc.) are included in the equation when profitability of stocking is calculated.

Fisher groups involved in stocking must have access to credit on favourable rates and help to develop their own revolving funds, for example through NGOs.

The composition of fish species in a waterbody must be known before stocking so the right species and the best sizes of fingerlings to be stocked can be determined. Preference should be given to large fingerlings and species not so vulnerable to predators.

Subsistence fishers should be allowed to catch small unstocked indigenous fishes caught with gears that do not or only to a limited degree capture stocked fish.

Side canals should not be screened because this affects lateral movements of indigenous fish.

Do not remove all floating vegetation including water hyacinth.

Permanent waterbodies and seasonally flooded land should be connected by reopening side canals and making holes in embankments or fitting them with culverts to improve catches of laterally migrating fishes.

The area which permanently holds water should be increased.

Crops should be diversified away from rice and towards less water consuming crops.

Sluice gates should be opened at the time when juvenile fishes and prawns are abundant outside the gates.

Fish passes should be installed where possible.

Riparian vegetation should be planted and aquatic and semi-aquatic plants introduced, or reintroduced to improve the quality of the habitat.

A thorough baseline survey should be conducted covering the entire wetland management unit including linked floodplains, and not just the *jalmohal*, which has been leased, and all the relevant institutions and stakeholders must be identified.

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Fisheries policy in Bangladesh is still trying to get to grips with the major dilemmas of maximizing benefits from natural resources while ensuring an acceptable degree of equity in the distribution of benefits and protecting the ecosystems that support the resources. During the twentieth century Bangladesh adopted one-sided production-oriented policies in the agricultural sector to feed its rapidly growing population. This strategy included increasing fish production, then in decline mainly as a result of environmental degradation brought about by the expansion of agriculture. The solution was to develop aquaculture and later to promote culture-based fisheries and large-scale stocking in the floodplains and beels (lakes) that previously sustained capture fisheries. Although fish production *per se* in many cases may have increased as a result of this type of intervention, benefits have not been socially and environmentally sustainable. This document reviews and discusses the development of culture-based fisheries and community-based fisheries management in Bangladesh with regard to socio-economic impacts as well as environmental effects and biodiversity loss.

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