Case study 4

Fish diversity and fish consumption in Bangladesh

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Introduction

Bangladesh prides itself on being very rich in fish diversity. Its numerous and diverse inland waterbodies – beels (floodplain depressions and lakes), ponds, rivers, canals, ditches – and paddy fields, are home to over 267 freshwater fish species (Rahman, 1989). In terms of production, it is reported that only China and India outrank Bangladesh in freshwater fisheries. In addition, coastal and marine fisheries also have a large biodiversity. In the mangrove waters in Sundarbans, over 400 fish species, as well as other aquatic animals such as shrimp, prawn and crab are reported (Islam and Haque, 2004). In rivers and estuaries, the fish catch is dominated by one migratory species, hilsa (*Tenualosa ilisha*; "Macher raja ilish – hilsa, the king of fish"), which makes up 11 per cent of the annual total fish production (Department of Fisheries, 2010). Millions of people, especially the rural poor, are dependent to varying degrees on these fisheries for their livelihoods, income and food. These rich fishery resources, which are intrinsically intertwined with rice production, are exemplified in the old proverb "Machee bhatee bangali", literally translated as "Fish and rice make a Bengali". Together with the staple, boiled rice eaten by many at least twice per day and vegetables, fish is an essential and irreplaceable animal-source food in the Bangladeshi diet.

Changes in the rice–fish production system in Bangladesh

With over half of the country comprised of floodplains, in the past, agriculture and capture fisheries complemented one another in a natural cycle of wet and dry season and monsoon rains. During the dry season (approx. May–December), most of the land was cultivated and fish were restricted to beels, rivers and canals. In the monsoon and post-monsoon periods (June–November), the floodplains were inundated and cultivation of deepwater rice was practised. This vast area provided an ideal habitat for the many freshwater fish species and people had access to fish (Payne and Temple, 1996).

In the early 1970s, Bangladesh was unable to produce enough rice to feed its population of 75 million. In the following three decades, rice production tripled,

Figure C4.1 Bangladeshi women preparing a fish curry. Photograph by Finn Thilsted

and today, with a population of 160 million, the country is considered almost self-sufficient in rice. This has changed the overall agricultural production and management of land and water drastically, favouring rice production: high-yielding rice varieties were introduced, more areas were brought under rice production, irrigation was expanded greatly, areas were drained and protected by flood control embankments, and fertilizer and pesticide use increased. Increased agricultural production intensity brought about reduction in soil fertility, decrease in groundwater level and siltation. These changes have been at the expense of inland fisheries; the area of inland waterbodies and the duration of inundation have fallen, with degradation and loss of fish habitat, as well as obstruction in fish movement to floodplains (Craig et al., 2004).

In the past 25 years, freshwater aquaculture has grown, and many households with a pond practise varying intensities of pond polyculture. Mostly, a mixture of carps was stocked, with silver favocarp (*Hypophthalmichthys molitrix*) being the most popular species. In recent years, the monoculture of the introduced species, Nile tilapia (*Oreochromis niloticus*) and pangas (*Pangasianodon hypophthalmus*) in ponds and closed waterbodies has been growing rapidly. Also, large areas near the coast have been converted to shrimp farms. Marine and coastal catches have grown to a certain extent due to the use of mechanized trawlers and new gears; however, in recent years, decline in catches has been reported, due to overfishing (Mazid, 2002).

Trends in fish intake

Official national data for fish production and catch are an inadequate proxy for intake, as it is well-recognized that these data fail to capture fish bought in small,

Figure C4.2 Pond polyculture in Bangladesh. Photograph by Finn Thilsted

rural markets, as well as fish caught by household members for consumption. Data from consumption surveys carried out in rural Bangladesh are used. In national rural consumption surveys conducted in 1962–1964 and 1981–1982, the average fish intake was 28 g fish/capita/d and 23 g fish/capita/d, respectively (Thompson et al., 2002). Data from household (rural and urban) income and expenditure report fish intakes of 38 g fish/capita/d and 40 g fish/capita/d, in 2000 and 2005, respectively (Bangladesh Bureau of Statistics, 2005).

Several rural surveys have shown the effect of location, seasonality, year and household socio-economic status on fish consumption. In a survey conducted in 1997–1998, in Kishoreganj, an area in northern Bangladesh with rich fisheries resources, the average fish intake in the peak fish production season (October), 82 g raw, edible parts/person/d, was more than double that in the lean season (July). Fish intake data were collected by size of fish: small indigenous fish species (SIS, growing to a maximum length of 25 cm) and large fish; the intake of SIS was two-thirds of total fish intake (Roos, 2001). Surveys in Mymensingh, in 1996–1997, in three different seasons, among households practising pond polyculture of carps showed that in the low-income tertile households, the average intake of SIS was 76 g raw fish/capita/d, more than twice that of large fish. The high-income tertile consumed 44 per cent more fish in total than the low-income tertile, with a smaller proportion of SIS, 60 per cent of total fish intake, than large fish (Bouis et al., 1998). In a survey conducted in two rural upazilas in northern Bangladesh, in one upazila, in October 2007–May 2008, and in the other, in January–June 2007, the usual mean fish intake in women (n = 455) was estimated at 12 g fish/woman/d (5th–95th percentile: 2.1–34.2) (Yakes et al., 2011). It is important that fish intake data are collected at species level, and both interviewees and interviewers pay special attention to the intake of small fish, consumed fresh, as well as dried and fermented (M.A.R. Hossain, personal communication, 20 October 2010).

The frequency of fish consumption in Bangladesh is high, ranking second (after rice) or third (after rice and vegetables). In a survey on biodiversity of fisheries and nutrition in four rural areas, in 520 households in total, during three seasons in 1992 (a drought year, the lowest flood levels in the preceding 20 years), 7 days' household food frequency consumption was conducted (Minkin et al., 1997). Fish was consumed by 85 per cent of households at least once per week; and the average number of days per week of fish consumption was 3.5. In the Nutrition Surveillance Project implemented by Helen Keller International (HKI), the frequency of consumption in seven days preceding an interview of four nutrient-rich foods – eggs, fish, green leafy vegetables and lentils – was collected for over 51,000 rural children, aged 12–59 months, twice a month, in 2000. The fish was the most frequently eaten of these four foods (HKI, 2002). A similar food frequency consumption pattern was recorded in mothers of children less than five years of age, in rural Bangladesh in 2005. Fish was the second most frequently consumed food, after rice; followed by milk, lentils, green leafy vegetables, eggs, red/orange/yellow vegetables and fruits, chicken and meat, in descending order of frequency of consumption (J. Waid, personal communication, 28 February 2011).

The diversity of fish species consumption in Bangladesh is very high. In the above-mentioned study in Kishoreganj, 44 common names for fish and two common names for shrimp were recorded (Roos, 2001). One SIS, puti (*Puntius* spp), consumed both fresh and fermented, covering 10 species accounted for 26 per cent of the total fish intake; and five species, puti, silver carp, taki (*Channa punctata*), baim/chikra (*Macrognathus aculeatus, M. pancalus, Mastacembalus armatus*) and mola (*Amblypharyngodon mola*); in descending order of proportion of total weight of fish consumption made up 57 per cent of total fish intake (Roos et al., 2003). In the above-mentioned study in four rural areas, a total of 75 fish species were consumed; small fish accounted for 43 per cent of the total fish intake (kg/household/y); catfish and carp, 13 per cent; hilsa, 9 per cent; and snakehead, 7 per cent (Minkin et al., 1997).

Even though the quantity of fish consumed may be low and probably continues to decrease among the rural poor, the high frequency of fish consumption and diversity of fish species consumed perhaps reflect the positive perceptions of fish, in particular SIS, for good nutrition, health and well-being (Thilsted and Roos, 1999; Deb and Haque, 2011).

The nutritional contribution of fish consumption

Fish, especially SIS, are a rich animal-source food of multiple, essential, highly bioavailable nutrients; animal protein, and some, for example hilsa, have a high content of fat and beneficial polyunsaturated fatty acids. As shown in Table C4.1, some common SIS – mola, chanda (*Chanda nama, Parambassis ranga*, *Pseudambassis baculis*), dhela (*Ostreobrama cotio cotio*) and darkina (*Esomus*

Table C4.1 Vitamin A, calcium, iron, and zinc contents in selected, common fish species in Bangladesh

		Contents per 100 g raw, cleaned parts (mean ± SD (n)[a])				
Common name[b]	*Scientific name*	*Vitamin A RAE*[c]	*Calcium g*	*Calcium*[d] *g*	*Iron mg*	*Zinc mg*
Small indigenous fish species						
Baim/Chikra	*Macrognathus aculeatus*	90 ± 15 (3)	0.4 ± 0.1 (5)	0.2 ± 0.0 (5)	2.4 ± 0.4 (5)	1.2 ± 0.2 (5)
	Macrognathus pancahu	30 90 (1)	—[e]	—	—	—
	Mastacembalus armatus	(1)	—	—	—	—
Chanda	*Parambassis ranga*	1679 ± 1000 (3)	1.0 ± 0.3 (5)	0.9 ± 0.3 (5)	1.8 ± 0.7 (5)	2.3 ± 0.6 (5)
	Parambassis baculis	340 ± 105 (3)	—	—	—	—
	Chanda nama	170 (1)	—	—	—	—
Darkina	*Esomus danricus*	890 ± 380 (3)	0.9 ± 0.4 (3)	0.8 ± 0.3 (3)	12.0 ± 9.1 (3)	4.0 ± 1.0 (3)
Dhela	*Rohtee cotio*	937 (1)	1.3	—	—	—
Kachki	*Corica soborna*	90 ± 20 (7)	0.5 ± 0.0 (2)	0.4 ± 0.0 (2)	2.8 ± 1.2 (2)	3.1 ± 0.5 (2)
Mola	*Amblypharyngodon mola*	2680 ± 390 (7)	0.9 ± 0.1 (3)	0.8 ± 0.0 (3)	5.7 ± 3.7 (3)	3.2 ± 0.5 (3)
Puti	*Puntius sophore*	60 ± 20 (3)	1.2 ± 0.2 (4)	0.8 ± 0.1 (4)	3.0 ± 0.9 (4)	3.1 ± 0.5 (4)
	Puntius chola	70 (1)	—	—	—	—
	Puntius ticto	20 (1)		—	—	—
Taki	*Channa punctatus*	140 ± 45 (3)	0.8 ± 0.2 (3)	0.3 ± 0.1 (3)	1.8 ± 0.4 (3)	1.5 ± 0.2 (3)

Commonly cultured large fish species: carp						
Mrigal	*Cirrhinus cirrhosus*	< 30 (1)	1.0 ± 0.1 (3)	0.0 ± 0.0 (3)	2.5 ± 1.3 (3)	—
Silver carp	*Hypophthamichyths molitrix*	< 30 (3)	0.9 ± 0.4 (3)	0.0 ± 0.0 (3)	4.4 ± 1.8 (3)	—

Notes
a n: number of samples. For small indigenous fish species, a sample consisted of 10–300 fish and for large fish, 1–2 fish.
b Fish species are listed in alphabetical order in each sub-group.
c RAE: retinol activity equivalent
d In raw, edible parts, after correcting for calcium in the plate waste (mainly bones)
e —: not measured
Sources: Thilsted et al., 1997; Roos et al., 2007a

danricus) – have high contents of vitamin A. As most SIS are eaten whole, with bones, they are also a very rich source of highly bioavailable calcium. Darkina has a high iron and zinc content (Roos et al., 2007a). In the above-mentioned study in Kishoreganj, SIS contributed 40 per cent and 31 per cent of the total recommended intakes of vitamin A and calcium, respectively, at household level, in the peak fish production season (Roos et al., 2006). In addition, fish enhances the bioavailability of iron and zinc from the other foods in a meal (Aung-Than-Batu et al., 1976). The edible parts of large cultured fish such as silver carp, tilapia and pangas do not contain vitamin A, iron or zinc, and as the bones of large fish are discarded as plate waste, they do not contribute to calcium intake (Roos et al., 2007b).

Measures to promote and protect fish biodiversity and fish consumption

Reduction in biodiversity of indigenous freshwater fish species in Bangladesh is a major concern, with 15 per cent of species reported to have disappeared, 20 per cent critically endangered, and the rate of disappearance increasing in recent years (IUCN Bangladesh, 2000). Over the last six decades, 23 fish species have been introduced in Bangladesh, mainly for cultivation in closed pond systems. It is reported that the escape of these species to rivers and floodplains during the monsoon and floods is a threat to the biodiversity of SIS, as some are highly carnivorous and predatory (Hossain and Wahab, 2010). Many other factors contribute to decreasing fish biodiversity and production, including rapid population growth, water pollution by industry, natural disasters, sea intrusion, salinity, overexploitation of fisheries, use of harmful gears and dewatering of waterbodies.

Conservation and management of common fishery resources and fish migration routes are crucial for promotion and protection of biodiversity, as well as fish consumption. Community-based and community-managed fisheries approaches, ensuring fishers access rights and tackling the diverse interests of various stakeholders, offer opportunities for improving fish diversity and increasing fish intake, in particular of SIS. These approaches are important for the rural poor – 60 per cent being functionally landless, lacking access to land and water for agricultural production, and dependent, to some extent, on common resources for their livelihoods and food.

Work initiated in 1994 in Sigharagi Beel, north-central Bangladesh, on the re-establishment of fish migratory routes, through rehabilitating a channel to floodplains by desiltation resulted in restoration of fish habitats. A five-fold increase in total fish production, a doubling of the proportion of fish (mainly SIS) caught and consumed by the landless and small farmers, and an increase in the number of fish species (mainly SIS) from 46 to 64, pre- to post-restoration were recorded (Center for Natural Resource Studies, 1996).

The Management of Aquatic Ecosystems through Community Husbandry (MACH) projects (1998–2003) included interventions to restore three major

Box C4.1 Shefali and her family no longer depend on Hail Haor (wetlands ecosystem) for their livelihood and income

Figure C4.3 Shefali in her shop, selling rice to a villager

"The Hail Haor (a large shallow lake in north-east Banagladesh) resources were disappearing day by day due to overexploitation by the people. Our livelihood was under great threat and our daily income was decreasing. We had little money and many days we did not have enough food to eat". These were the words of Shefali Khatun (about 35 years of age), a woman from Hajipur village, Maulvi Bazar district, describing the dependence of her family – and many others – on the Hail Haor, before the MACH project. "I was a housewife and mother of a son; my husband, Korom Ali, was a fisherman and he also caught birds in the Haor. Our livelihood was fully dependent on the Hail Haor", Shefali said, in an interview in 2004.

"I heard about the MACH project and got interested to protect the Haor. I became a member of the Machranga Mohila Samity, a Resource User Group (RUG) for women. My husband and I received skill development training. Afterwards, I took a small loan of BDT 5,000 and began buying and selling rice. As my business grew, I took more loans and bought some cows. As my savings grew, I opened a small shop. My husband helps me with my work, especially in buying goods for my shop from the market."

Shefali has paid back all her loans. She has supported her husband in starting a small business, buying and selling dried small fish. He no longer catches fish or birds in the Haor. "Today, my family lives well; I have purchased a small piece of land and leased a fish pond for two years. My son goes to school and is in fifth grade. We are all happy."

Box C4.2 Shanti has expanded her fish pond after one year of fish farming

Figure C4.4 Shanti and her neighbours harvesting fish from her pond

Figure C4.5 Shanti and other Nepalese women farmers attend a field trip in Bangladesh

Shanti Mahato lives with her husband, two young sons and her parents-in-law in Khairini village, Chitwan, Nepal. She received project support to dig a pond (100 m^2) in 2010 and stock carps and small fish. Together with other women in her village, she received training in pond polyculture. In a period of 9 months, Shanti and her family consumed about 20 kg of fish and sold 25 kg for NPR 4,200. She reported that her family enjoys eating fish, especially small fish as they are tasty. Together with about 20 women farmers, Shanti visited Bangladesh on a one-week trip in 2011. She was pleasantly surprised to see that pond polyculture was very popular in Bangladesh and the farmers knew a lot about fish production. She found the growing of many different vegetables on the dykes of the ponds very interesting and began this practice when she returned home. However, as her pond is small, not many vegetables could be planted on the dykes. She also expanded her pond to 130 m^2. Shanti is an active member of a women's farmer group and spends time going to nearby villages to teach women farmers about fish production in ponds. She likes fish farming and plans to convert a rice field to a big fish pond.

wetland habitats, ensure sustainable productivity and improve the livelihoods of the poor who depend on these wetlands, through community based co-management. Activities included forming community organizations and links to local government, excavation of beels and canals to expand dry season water holding, establishment of fish sanctuaries and a closed fishing season, release of indigenous fish species, and tree planting. In Hail Haor, north-east Bangladesh, data were collected for the baseline year (April 1999 – March 2000) and intervention years (April 2000 – March 2003). The number of fish species increased from 71 (baseline year) to 85 (average of three intervention years); average fish consumption increased from 45 g/capita/d (baseline year) to 61 g/capita/d (third intervention year); small fish species, consumed fresh, dried and fermented, accounted for 85 per cent of average total consumption; and the proportions of fish consumed which were caught or bought from rural markets were 30 per cent and 70 per cent, respectively (Anonymous, 2003).

Conclusions

Biodiversity of fish species is important for nutrition and livelihoods of the rural poor in Bangladesh. There are promising fisheries technologies which have been developed and are being practised for improving fish biodiversity and nutrition. More stakeholders are becoming aware of the importance of small fish species, both freshwater and marine, for improving human nutrition, and the implications for national development. The Bangladesh Country Investment Plan (CIP), a roadmap towards investment in agriculture, food security and nutrition (2011–2016), the CGIAR Research Programs, and other initiatives such as Feed the Future and Scaling Up Nutrition (SUN): 1,000 Days provide good opportunities for developing and implementing interventions which can improve fish biodiversity and increase fish consumption in Bangladesh.

Box C4.3 Practices to increase production of small fish species

Carp production, together with management of indigenous fish species, including enforcement of fishing regulatory measures were carried out in a large beel (40 ha), in north-west Bangladesh. This approach resulted in a total fish production of over 25 tonnes in 6 months, of which 45 per cent were non-stocked fish, mainly SIS (Rahman et al., 2008). Depending on geographical location and season, different culture practices with fish and rice can increase fish diversity, as well as the nutritional quality of the combined rice and fish production. Allowing fish in ponds access to rice fields with water, as well as concurrent or rotational rice–fish culture technologies are being practised (Dewan et al., 2003; Kunda et al., 2009).

Recognizing the above-described nutritional contribution of SIS, polyculture of carps and SIS, especially mola, in small ponds was introduced in the late 1990s. No significant difference in total fish production was seen between ponds stocked with carps and mola, and those with carps alone. However, the nutritional quality of the total fish production improved considerably in the ponds with mola. In this production system, the eradication of indigenous species, the majority being SIS by repeated netting, dewatering, and the use of a piscicide, rotenone, prior to stocking of carp fingerlings – based on the rationale that competition exists between native and stocked fish – was stopped. In addition to the production of carps, production of the vitamin A rich-mola of only 10 kg/pond/y in the estimated 4 million small, seasonal ponds in Bangladesh can meet the annual recommended vitamin A intake of 6 million children (Roos et al., 2007b). This production technology of carp–mola pond polyculture has gained wide acceptance by the government and development partners in Bangladesh, and is also being practised in Sundarbans, West Bengal and Terai, Nepal.

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