



Aquaculture Options for Alternative Livelihoods: The experience of the Adivasi Fisheries Project in Bangladesh

KEY FACTS

- The Adivasi Fisheries Project (AFP) built on 2 decades of WorldFish Center research in Bangladesh on aquaculture techniques for smallholders and community fisheries management and targeted disadvantaged rural minorities called Adivasi.
- The AFP is implemented in five districts of north and northwest Bangladesh, with EURO1.13 million (US\$1.49 million) in funding from the European Union and EURO0.12 million (US\$0.17 million) in funding from the project implementing partners.
- The livelihood options made available to beneficiaries were pond aquaculture, rice-fish culture, fingerling production in cages, habitat restoration, forming netting teams, and fingerling and food fish trading.
- Monitoring surveys found all of the project's fisheries-related livelihood options profitable in the first year of the intervention and likely to become more profitable with time.
- The AFP lifted the average income of participating Adivasi households from Tk44,075 (US\$647) in 2007 to Tk52,035 (\$763) in 2008, largely by quadrupling the contribution of fish.
- The increased income improved the food security of Adivasi households, reducing their food deficit period from 1.7 months in 2007 to 1.4 months in 2008.
- Adopting a household approach increased the share of women among active participants to 40% in 2008 from 28% in 2007.

ADIVASI FISHERIES PROJECT

Bangladesh is one of the world's most crowded countries. In addition to 140 million mainstream population are 2 million Adivasis, that live mostly on the margins of Bangladeshi territory and society. Population pressure, resource depletion and shrinking aquatic habitats have undermined Adivasis' traditional livelihoods of hunting and gathering food in wetlands. The Adivasi Fisheries Project (AFP) set out in 2007 to help Adivasis in the north and northwest of Bangladesh find new and more sustainable livelihoods.

The WorldFish Center in collaboration with Caritas Bangladesh and the Bangladesh Fisheries Research Forum is implementing the project, with EURO1.13 million (US\$1.49 million) in funding from the European Union and EURO0.12

million (US\$0.17 million) in funding from the project implementing partners.

Building on 2 decades of WorldFish research in Bangladesh on low-input aquaculture for smallholder farmers, the project aimed to extend the benefits of these proven techniques to the country's most marginalized communities.

Pond aquaculture was an appropriate livelihood option for many, as ponds naturally materialize in Bangladeshi homesteads as farmers remove soil to build a plinth to raise their houses above flood level. Rice-fish culture was another attractive option, as the emerging technique of culturing fingerlings and food fish in rice paddies reduces pesticide use by up to 67%, while boosting net farm profits by up to 65%. Options for the landless were fingerling production in

cages, habitat restoration, and such fisheries-related micro enterprises as netting teams performing harvesting services, and fingerling and fish trading.

Working with the Santal, Oraon, Pahan, Mahato, Mahali and Singh communities in northwest Bangladesh, and with the Garo, Hazong, Coch, Barman and Dalu communities in the north, the AFP directly benefited 3,650 households. A survey of a quarter of the beneficiaries found that the project had lifted their average income from Tk44,075 (\$647) in 2007 to Tk52,035 (\$763) in 2008, largely by quadrupling the small but growing contribution of fish. The increased income improved the food security of Adivasi households, reducing their food deficit period from 1.7 months in 2007 to 1.4 months in 2008. The project indirectly benefited a further 6,000 households. Adopting a household approach, increased the share of women among active participants to 40% in 2008 from 28% in 2007.

Following are descriptions of the livelihood options adopted by project participants and a profile of a successful adopter of each option.

POND AQUACULTURE

The AFP provided financial support and training through Farmer Field School (FFS) for 1,251 households' adoption or improvement of pond aquaculture. Training included how to control predatory fish; stagger stocking and harvesting regimes; apply fertilizer and supplementary feed; control aquatic weeds; monitor water color and turbidity, fish behavior, and natural nutrient presence; and manage water, pond dikes and on-farm resources.

In a sample of 319 households practicing improved pond aquaculture, the average pond measured 0.04 ha, with 42% of the ponds perennial and the remaining 58% seasonal, retaining water on average for 7.5 months. The fish species cultured for food fish in ponds mainly included rohu, catla, mrigal, silver carp, common carp, grass carp, silver barb and tilapia. With the introduction of scientific culturing methods, fish production grew from 961 kg/ha in 2007 to 2,537 kg/ha in 2008. Fish consumption in participating households doubled, from 15 to 30 kg/household, and annual income from fish nearly tripled, from Tk2,036 to Tk5,644. Whereas before the project ponds contributed 4% to total household income, after the project ponds contributed 10%. Annual income from vegetables grown on pond dikes rose from Tk116 before the project to Tk720 after.

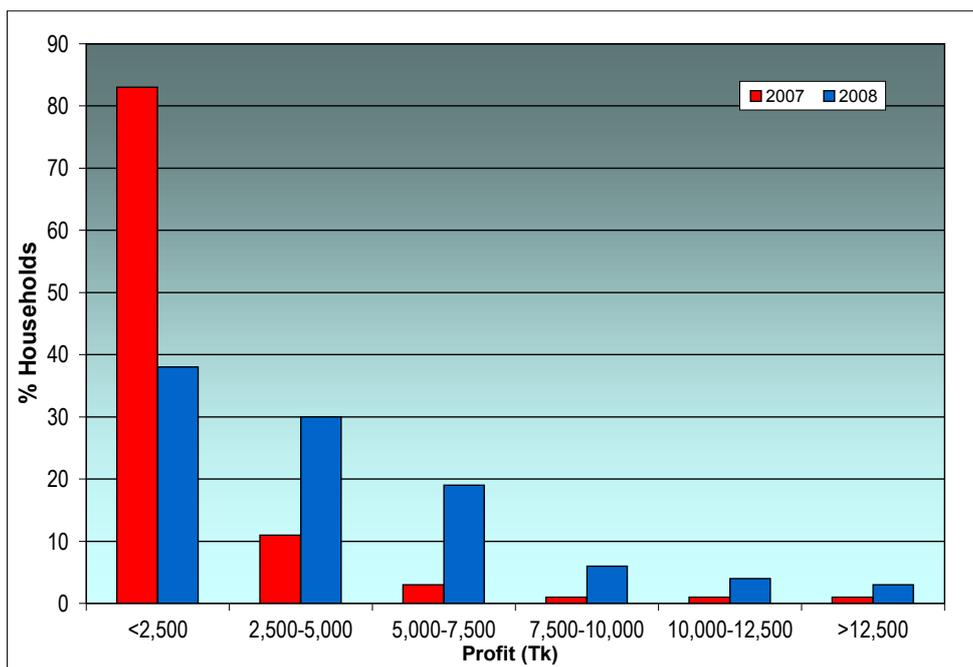


Figure 1: Adivasi household profits from fish culture in ponds

The average net profit Adivasi households generated from ponds rose from Tk1,455 in 2007 to Tk4,196 in 2008. Figure 1 shows six brackets of profits, with 45% of the households that were in the lowest bracket in 2007 (earning less than Tk2,500) migrating to a higher bracket in 2008. The proportion of households in the top three brackets (with profits greater than Tk7,500) quadrupled from 3% in 2007 to 13% in 2008.

Shulekha Hazong, successful pond fish farmer

Shulekha Hazong, a member of Hazong community, lives in the village of Gopalpur in Durgapur Upazila, Netrakona District. Shulekha lives with her husband, Monoranjan Hazong, two daughters and two sons in a small house constructed on public land near the bottom of a hill. They own 0.26 ha of agricultural land but can grow only one crop per season for lack of irrigation. The couple's work as agricultural daily laborers used to provide most of their family income, but work was not always available, leaving the family hungry.



Shulekha Hajong during fish harvest from her pond

They live near a derelict pond, whose owner lives away in town. Shulekha and her family used to catch wild fish in the pond for home consumption. When Shulekha learned from the AFP how to make the pond more productive, she obtained permission from the owner to improve and stock it. Putting into practice the technical training on fish culture provided in the project's farmer field school, she stocked the carp species rui, catla, mrigal, silver carp and common carp. She built bamboo trellises on the pond dikes and planted pumpkin and bitter gourd. In 2008, she produced 170 kg of carp worth Tk17,005 from her 0.04 ha pond, which was 47% of her family income for that year, and an additional Tk4,250 worth of vegetables — all from an investment of Tk2,756. The contribution of the pond lifted her family income from Tk18,480 in 2007 to Tk35,885 in 2008.

Yet Shulekha identifies another outcome of AFP participation as the most significant to her household. "Now we can eat fish every day," she says.

RICE-FISH FARMING

The AFP helped 533 Adivasi households adopt improved rice-fish farming. Almost all the rice-fish beneficiaries produce fingerlings and/or food fish concurrently with rice, with only 1% opting to grow rice and culture fish in rotation. This system is usually adopted in rice-growing areas protected from excess flooding. Farmers adapt rice paddies by digging along one bund a small trench or ditch, or else by connecting the paddy to a pond, to provide refuge for the fish as paddy water levels fall prior to the rice harvest. At first, 4% of the households cultivated vegetables on the plot dikes, but this percentage increased to 66% after the project intervention.

The two main seasons for growing rice in Bangladesh are *aman*, during the wet monsoon, and *boro*, which depends on irrigation. Demand for fingerlings is high during the boro season in April and May, which marks the beginning of other forms of aquaculture, notably pond culture, so many fish farmers produce fingerlings then, as well as food fish. In the aman season, most rice-fish farmers prefer to culture food fish.

The surveyed households, numbering 138, used on average 0.10 ha for rice-fish culture, with 9% of that area occupied by the ditch and therefore unavailable for rice. The fish species cultured in rice plot as food fish included the common carp, tilapia, silver barb, rui, catla and mrigal. For fingerling production, Adivasi farmers favored tilapia and common carp, as these species can reproduce under local culturing conditions. After the project intervention fish production in these households grew from 35 kg/ha in 2007 to 580 kg/ha in 2008. Fingerlings and food fish provided an average income in 2008 of Tk4385, or 6% of annual family income.

Figure 2 shows that fingerling and food fish production in paddies is more profitable in the boro season than in the aman, and that integrated production is more profitable than cultivating only rice in either season.

Most of the Adivasi households introduced rice-fish culture in 2008. Profits generated from the plot from integrated rice-fish farming nearly doubled on average, from Tk8,414 in 2007 to Tk14,720 in 2008. Figure 3 shows the extent to which Adivasi rice-fish households shifted into higher profit brackets. Before the project, 54% of the farmers earned less than Tk7,500, a proportion that dropped to 30% after the intervention.

Meanwhile, the proportion of farm families with a profit greater than Tk30,000 was 13% in 2008, rising from none in 2007.

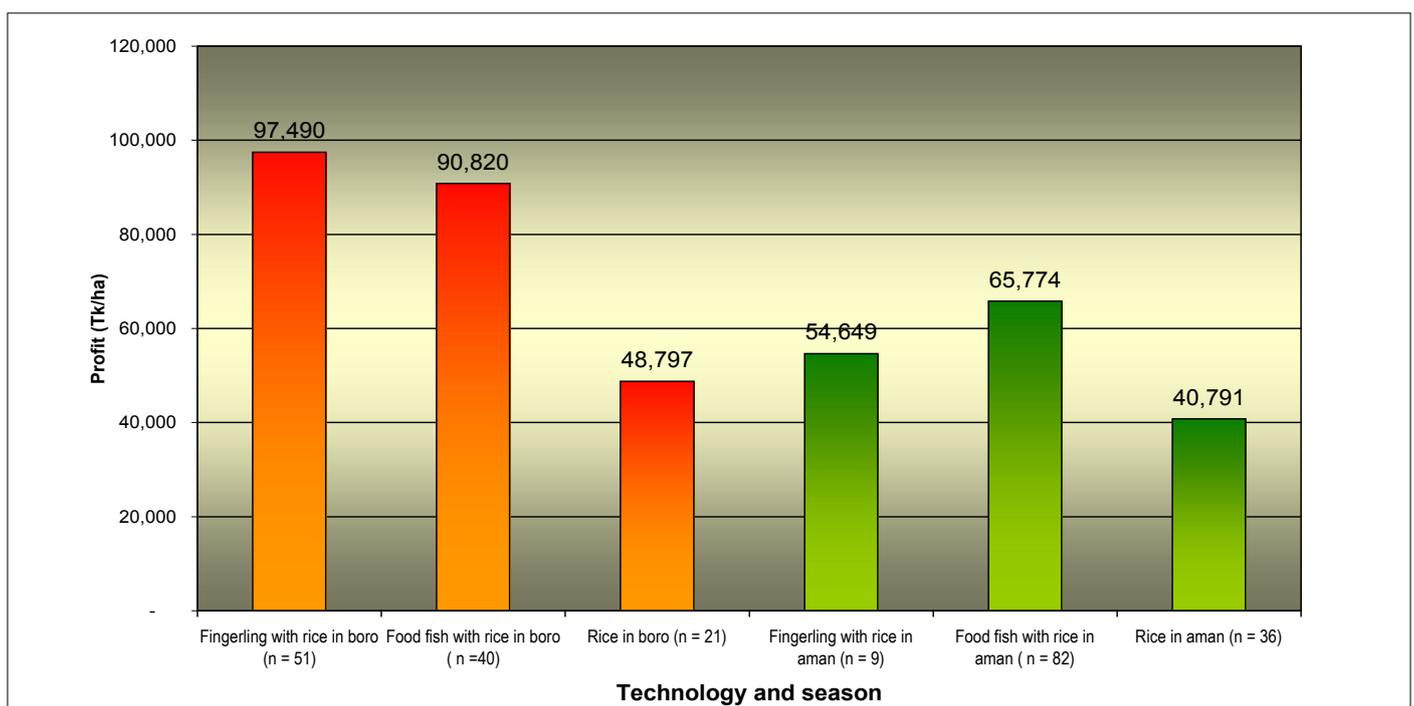


Figure 2: Profitability of rice-fish farming systems in different seasons

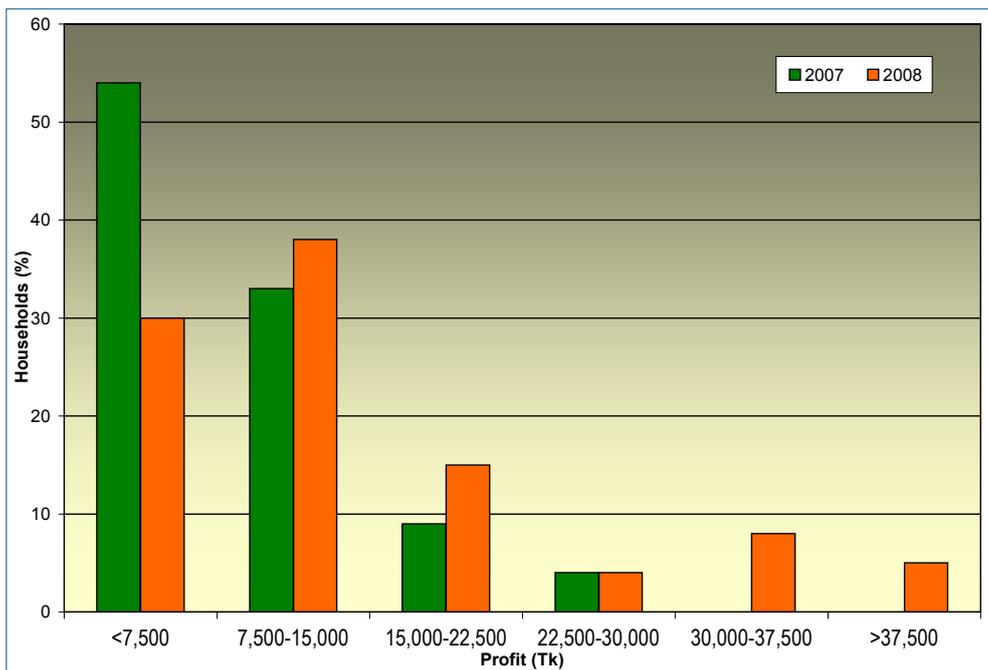


Figure 3: Adivasi household profit from rice-fish plot

Nogen Tigga, successful rice-fish farmer

Nogen Tigga, a member of the Oraon community, lives in the village of Anayetpur in Pirgonj Upazila, Rangpur District. He had seen food fish cultured in his neighbors' rice paddies but never imagined that fingerlings could be similarly cultured. With financial support from the AFP to renovate his paddy and training on input management, he started rearing fingerlings in the boro season and carried on with food fish in the aman. Stocking only 56 kg of rui, mrigal, silver barb, silver carp, common carp and tilapia fry in his 0.16 ha rice plot, he harvested 115 kg of fingerlings worth Tk10,200 in the boro season and 361 kg of food fish worth Tk19,700 in the aman. His family income rose by half from Tk41,400 in 2007 to Tk74,900 in 2008.

In addition to fish, Nogen harvested from the paddy 700 kg of rice worth Tk11,500, almost matching the previous year's rice harvest. His total profit from the plot almost doubled, from Tk19,424 in 2007 to Tk35,443 in 2008. Nogen reports that rice-fish production has allowed his family of four to consume



Nogen Tigga boosted his family income by half by rearing fingerlings in rice-fish plot

fish almost everyday, which he never thought possible before. His success also earned him respect in the community, with Oraons and non-Adivasis alike coming to him for advice on fish culture.

CAGE CULTURE OF FINGERLINGS

Rearing fingerlings in cages floated in large ponds owned by either the community or accommodating neighbors is especially attractive to women, as a manageable cage measuring 1 cubic meter can produce 10-20 kg or more of fingerlings in less than 2 months. The AFP introduced 493 landless Adivasi households to fingerling production in cages, providing financial support to secure

cage materials and other inputs, farmer field school training in cage-culture techniques, and help in securing owners' permission to place cages in large ponds.

A survey of 144 cage fish farmers found them engaged in fingerling production for an average of only 114 days, or 2 cycles, in 2008. The households produced on average 19 kg of fingerlings. Silver carp accounted for 58% of the fingerlings produced, tilapia 37% and silver barb 3%, with the rest being bighead carp, grass carp, rui and mrigal. Farmers earned on average Tk1,810 from fingerling production, which was 4% of their total family income in 2008. Culturing time was lost in 2008 to preparing cages, discussions with pond owners and establishing links for supplies of high-quality fry. Beneficiaries consider it possible to complete 3-4 fingerling cycles if they start at the beginning of the season.

Surveyed households earned an average profit of Tk1,005 from fingerling production. Table 1 shows that 62% of the households earned a profit of less than Tk1,000, but profit

Table 1: Distribution of cage aquaculture households by profitability in 2008

Profit (Tk)	Households (%)	Production cycles (no.)	Culture period (days)
<500	15	1.23	94
500-1,000	46	1.56	106
1,000-1,500	26	1.90	120
1,500-2,000	6	2.25	139
2,000-2,500	3	2.25	164
>2,500	4	2.50	179

rises with the number of days of fingerling rearing, indicating that farmers can earn a good profit by producing in more cycles.



Rajen Hasda and his wife, Menok Kisku, were surprised that a household with no ponds could engage in fish culture

Rajen Hasda, successful cage fish farmer

Rajen Hasda was 6 years old when he lost his father and 12 years old when he started working for food. A member of the Santal community in the village of Tarapur in Kaharol Upazila, Dinajpur District, he owned only a 0.06 ha homestead, which he purchased with a loan from a local nongovernmental organization. Rajen and his son are both day laborers, struggling to support their family of five, as work is available only seasonally.

With the help of the AFP, Rajen started culturing fish in a cage measuring 1 cubic meter in a neighbor's pond, feeding them rice bran. In two cycles 2008, he produced 47.5 kg of tilapia and silver carp fingerlings worth Tk5,025. From an investment of Tk1,284, he earned a profit of Tk3,741.

Rajen and his wife, Menok Kisku, were surprised that a household with no ponds could engage in fish culture. They report that the technology requires minimal labor for a quick return. Rajen is especially thankful that cage culture helped his family face the hungry period in October and November, as they were able to harvest fingerlings for sell when necessary.

HABITAT RESTORATION

The AFP undertook habitat restoration to increase the production of fish and sustain or expand the biodiversity of fish and other aquatic animals such as snails, mussels and crabs. Habitats were restored in two community-managed water bodies in the northwest and four small, privately managed small lowlands in the north. Work in the northwest employed 37 beneficiaries,

15 to manage Khorgoni Beel and 22 to manage Damail Beel. Four individuals, three from the village of Senpara and one from Manikpur, in Kalmakanda Upazila in the north, managed four lowlands near their homesteads. Beneficiaries were trained in establishing sanctuaries, beel management and habitat restoration.

The water bodies under the AFP are managed as stocked fisheries. As the rainy season starts, fingerlings of carp, eel and other fish are stocked in the beels and lowlands, along with turtle, crab, oyster and aquatic plants. The project established sanctuaries, and fishing was restricted near them. Further fishing restrictions were imposed during the breeding season from April to June. The numbers of fish and other aquatic animals have subsequently increased in the managed water bodies. A survey found that households harvesting fish from them saw their catches increase from 13 kg per household in 2007 to 49 kg in 2008. The harvest of aquatic animals also increased, from 32 kg per household to 111 kg.

Households earned on average Tk3,711 from habitat restoration, accounting for 7% of household income. Figure 4 shows that all the water bodies under the project provided higher profit in 2008 than in 2007. Beneficiaries believe that they will be able to generate more profit in 2009, as they have followed the prescribed management practices to restore fish populations, including ensuring that fish and other aquatic animals are not completely fished out during the dry season.

Khorgoni Beel habitat restoration

Khorgoni is a small closed beel measuring 1.34 ha in Nawabgonj Upazila, Dinajpur District, surrounded by two villages. Fish and other aquatic animals enter the water body through a canal during the wet monsoon. Ownership rights to the water body belong to three Adivasi households and one non-Adivasi household. Limited enforcement capacity meant people from adjacent villages used to harvest fish almost at

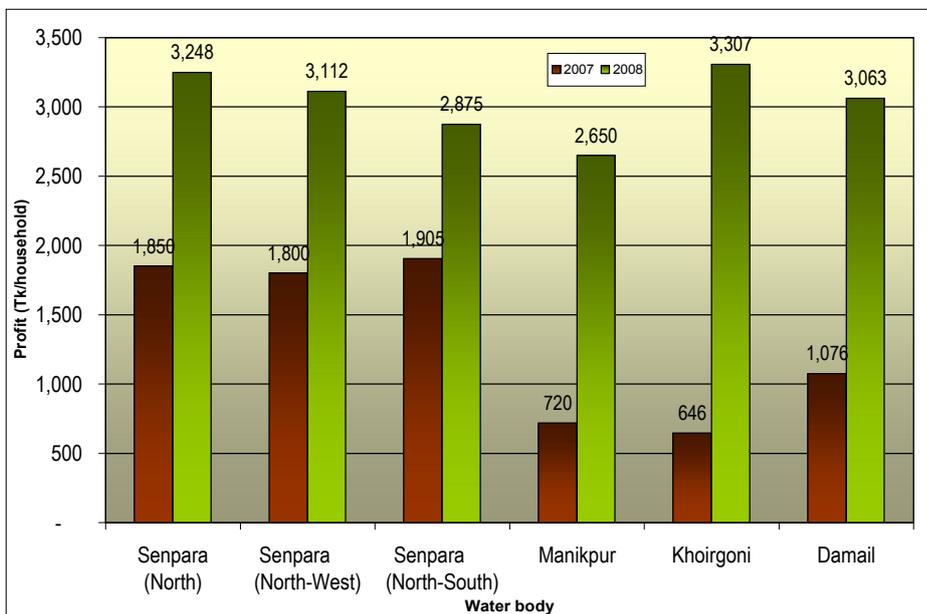


Figure 4: Profit earned from aquatic habitat restoration



Beneficiaries of habitat restoration release a turtle

will, all but emptying what had been a beel rich in aquatic resources only a few years earlier.

In 2007, AFP staff members discussed with the beel owners and Adivasi households the potential for producing fish and other aquatic animals. The owners agreed to establish a sanctuary in the water body. In addition to the three Adivasi owners, 12 Adivasi households with no resources for fish culture were included in beel management, whose 15-member committee would provide 10% of the fish catch to the Bengali household and distribute the rest of the benefits equally among themselves. The AFP project supported sanctuary construction, stocking the beel, and developing the capacity of beneficiaries in beel management. In 2008, the white fish catch from the beel increased to 622 kg from 109 kg in 2007. The catch of crab, snail, oyster and other aquatic animals increased from 611 kg in 2007 to 1,826 kg in 2008. Each member of the beel management committee earned in 2008 a profit of Tk3,307. The members expect that the availability of the fish and other aquatic animal in the beel will double in 2009 and that self-recruiting species will regenerate, as they left the sanctuary totally undisturbed in 2008.

FINGERLING TRADING

Fingerling traders are critical actors in a complex network linking hatcheries and fish seed nurseries to fish farmers. The AFP involved 157 landless Adivasi households in fingerling trading, building their capacity in this profession utterly new to the community — one that carries significant risk, especially of fingerling mortality during transportation. Fingerling identification and handling and financial management were taught in FFS. The project initiated network-building activities to link Adivasi fingerling traders with hatcheries and nurseries able to supply high-quality fingerlings. Links were also established with fish farmers.

Adivasi fingerling traders traded on average 5.3 kg of fingerling per day, with 69% of them collecting their fish seed directly from Bengali farmers' nurseries, 10% from Adivasi farmers' nurseries, 17% from private and government hatcheries, and 4% from the wild. Most traveled by bicycle or on foot to reach buyers. A survey of 39 fingerling traders found them involved in trading on average for 3.8 months from April to October 2008, working 37 days, 4.5 hours per

day. Most Adivasi fingerling traders used the wide-ranging knowledge acquired at farmer field schools to serve as extension agents, offering advice to customers on various aspects of fish farming.

The average income of surveyed households from fingerling trading was Tk6,228, which was 15% of total household income in 2008. Traders received an average profit of Tk5,321 from fingerling trading. Table 2 shows that 18% of traders earned a profit of more than Tk10,000 from fingerling trading. These groups spent more time than did traders in other profit brackets, indicating the higher profits available to those who invest more time.

Table 2: Distribution of fingerling traders by profitability in 2008

Profit (Tk)	Fingerling traders (%)	Involvement in trading (days)
<2,500	36	14
2,500-5,000	18	27
5,000-7,500	13	47
7,500-10,000	15	57
10,000-12,500	10	51
>12,500	8	89

Padma Soren, successful fingerling trader

Padma Soren, a member of Santal community, lives in the village of Araj Bochapukur in Birgonj Upazila, Dinajpur District. He is functionally landless, a farmer with only 0.10 ha of cultivable land. He has been dogged by hardship since he lost his father at the age of 5. He and his wife are now the only working members of his family of five, living primarily on day labor and going hungry during an annual lean period that lasts 4 months.

Padma received training from the AFP on the technical aspects of fingerling trading, building networks with fish seed suppliers and fish farmers, and managing finances. He traded fingerlings for 96 days from April to October 2008, earning



Fingerling trader Padma Soren bought a bicycle to better reach his customers

from this an income of Tk15,600, or 30% of his total family income for the year. Fingerling trading lifted his family income from Tk29,998 in 2007 to Tk51,400 in 2008, when it brought a cash profit of Tk12,165. He purchased a bicycle with part of the income, so he could supply fingerlings to more fish farmers in the coming year. He also bought livestock and rented a parcel of land to establish a plant nursery. The rest of his income went to investment in the fingerling business and purchasing food for his family. Padma hopes to buy a mobile phone in the coming year to improve communication with his customers.

FOOD FISH TRADING

The market chain in Bangladesh from fish farmers to consumers passes through primary, secondary and retail markets, involving local fish traders, sales agents, wholesaler-distributors and retailers. The development of aquaculture in the area of the AFP created great potential to involve 414 Adivasi households with no resources in retail and wholesale fish trading. As this was a new occupation for most Adivasi households, the project emphasized training in such fish-handling skills as cleaning, sorting, grading, icing and transport, as well as in financial management. The project initiated network-building activities to establish strong links among local fish traders, sales agents, wholesaler-distributors and retailers.

A survey of 110 Adivasi food fish traders found them involved in trading on average for 77 days in 2008, 5.4 hours per day, mostly selling white fish, eel and dried fish, on average 7.9 kg per day. Sixty-four percent of the fish was sold in village and roadside markets, 25% in district markets, and 8% in upazila markets. Traders collected 27% of the fish for trading directly from the fishponds of Adivasi and other households, 35% (mostly eels) from the wild, 24% from wholesale markets and 14% from retail markets.

Food fish traders earned on average Tk12,829 from fingerling trading in 2008, which was 28% of their annual household income. The traders earned a profit of Tk10,009 from food fish trading. Table 3 shows that 47% of the households earned profits that placed them in brackets > Tk10,000, with higher profits going to those who invested more time.

Table 3: Distribution of profits among food fish traders in 2008

Profit (Tk)	Food fish traders (%)	Involved in trading (days)
<5,000	26	24
5,000-10,000	27	72
10,000-15,000	21	92
15,000-20,000	20	120
20,000-25,000	5	140
>25,000	1	160

Anjana Chesim, successful food fish trader

Anjana Chesim, a member of Garo community, lives in the village of Madhukura in Kalmakanda Upazila, Netrokona District, with her family of four. Anjana and her husband, Metision Banowary, are completely landless, living on relatives' land. They survived by day labor until the AFP, but since the intervention Anjana's main business has been retailing dried fish, live eels, carp and other fish types door to door, 3-4 days a week. This lifted their annual household income from Tk22,984 in 2007 to Tk45,000 in 2008, when she earned Tk21,000, or 47% of the total family income, from fish trading. As fish trading was new to her, she initially had trouble keeping records, but farmer field school training and other guidance from project staffers helped her overcome this problem.



Fish trading helped Anjana Chesim almost double her family income

Delighted with her new profession, Anjana plans to establish a grocery shop in the nearby market for selling dried fish along with other food items. She deposited Tk5,100 in a savings account with the nongovernment organization Caritas and invested Tk2,000 in two piglets that she intends to sell after fattening them for a year. She aims to buy homestead land to ensure a bright future for her 4-year-old son and 3-year-old daughter.

NETTING TEAMS

Fish are generally harvested in Bangladesh by groups of commercial harvesters rather than fish farmers themselves because the latter lack the required skills and equipment. The growth of fish farming in the project area boosted demand for harvesting services, so the AFP help 758 Adivasi households form 114 netting teams, providing financial support to purchase two nets each, one fine net for harvesting fingerlings and the other for harvesting food fish. Capacity development consisted of FFS sessions on fish harvesting, maintaining and repairing nets, group dynamics, and financial management. The project also conducted network-building activities to help netting teams assemble a client base of local fish farmers.

A survey of 191 households in 66 netting teams, which averaged 6.5 members per team, found each team harvesting food fish and fry on average 55 times from an

average of 29 ponds and rice paddies, spending 2 hours in each. Netting teams earned on average Tk14,926 from netting in 2008. Each team member received an equal share of the income received, earning the average member Tk2,627, or 6% of annual family income.

Deducting the operation costs of netting such as net repair and transportation, team members earned a cash profit of Tk2,413 in 2008. Table 4 shows that a large proportion of netting team members in the bottom profit bracket of < Tk1,500. Delay in adopting the profession is the main reason survey respondents gave for low income in 2008, but they believe that their income will rise in 2009 as they are now acquainted with the profession. The positive correlation between profit and frequency of netting supports their view.

Table 4: Distribution netting team members by profitability in 2008

Profit category (Tk)	Netting team members (%)	Frequency of netting
<1,500	31	24
1,500-3,000	43	53
3,000-4,500	17	77
4,500-6,000	1	67
6,000-7,500	4	207
7,500>	4	133

Dahatpur netting team

The Dahatpur netting team was formed under the AFP by seven extremely poor Adivasis of the Mahato community in Panchbibi Upazila, Joypurhat District. All members are functionally landless, with only 0.02-0.06 ha each. Working as agriculture labors and peddling rickshaw vans contributed 90% of their family income. The seasonality of agricultural labor means they led a very hard life during the lean period. When AFP staff discussed forming a netting team and assured them of financial and technical support, they gladly accepted the proposal, receiving two nets at the end of 2007.

WorldFish factsheets present current issues on fisheries and aquaculture with a course for action outlined. These factsheets as an impetus for action and update of WorldFish research.

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The Dahatpur netting team sets aside money to buy another net to allow them to harvest more ponds.

After some initial training, team members started contacting pond owners. In 2008, they had 40 fish farmers as regular clients, harvesting their ponds 146 times and earning the team Tk62,414, which was distributed according to member presence on harvesting days. The average profit for each team member was Tk8,178, which was only third of what they earned doing agricultural labor but earned in much less time. In addition to cash income, each received on average 60 kg of fish from client fish farmers in 2008, which mostly went for home consumption and, according to the team members, was a big advantage of being on the team. They are saving money to buy another net to allow them to harvest more ponds in 2009.

CONCLUSION

The Adivasi Fisheries Project significantly improved Adivasi households' livelihoods. Monitoring survey results found all of the fishery-related livelihood options profitable. As farmers were able to improve their livelihoods after a single year of AFP intervention, it is expected that they will not only sustain this improvement but build on it as their experience grows and with continued technical support from the AFP in 2009.

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