



SMALL-SCALE FISH FARMING IN BANGLADESH

Introduction

For many people in Bangladesh small-scale fish farming is an important opportunity to generate income and is a significant nutritional source providing protein-rich food all year round. It comprises of a range of options that can be adapted to suit the needs and capacity of people living in rural Bangladesh.

The two approaches commonly implemented on a small scale are:

- Local pond fish farming
- Open water fish farming in lakes, rivers, dams and reservoirs



Figure 1: In Manikdaha, local villagers are harvesting raised in the village pond. Photo credit: Practical Action / Jon Hellin

The benefit to low-income farmers is that they are able to invest in fish cultivation when there is sufficient income, which will then be able to generate additional income and food when other sources of income are limited.

Much of Bangladesh is flooded annually during the monsoon season as water flows into the country through the Ganga (Ganges), Brahmaputra and Meghna rivers. This provides an extensive range of habitats for wild and cultivated fish species. Fish catches are highest after the monsoon rains when supplies of other foods, such as rice, are low. With so much water, fishing plays a vital role in the economy of rural villages.

Fish farming options

Capital intensive

One of the main trends in fish culture over recent years has been towards capital-intensive, high-input high-yield systems, which can dramatically improve the rate of production if operated in ideal conditions.

The development of practical hatching techniques has vastly improved fish cultivation and allowed careful breeding and selection of desired species to take place. Although these techniques were introduced to Bangladesh some years ago, it has taken time for them to become established. Commercially produced fish have become a significant proportion of the total fish supply.

But intensive cultivation methods increase the cost of fish production beyond the reach of poorer farmers. Consequently, alternative low-cost approaches have been promoted by NGOs working in the country.

Fish farming for the poor

An enormous variety of water bodies, including rivers, irrigation canals, flood plains, beels (large depressions), ox bow lakes and ponds are dispersed throughout Bangladesh offering considerable potential for fish cultivation, but a general lack of capital, access to resources and knowledge means that many farmers are unable to provide all the commercial inputs required for intensive production methods.

An alternative low-cost approach is more appropriate for many people, relying on existing water bodies and natural vegetation and household waste, supplemented with animal protein in the form of snails and homemade supplements for fish feed.

Many NGOs are adopting strategies to minimise the inherent riskiness of fish culture by undertaking research into low-input systems, low-cost technology, fast growing species and alternative management practices.

Pond culture

Site selection is an important factor in the success of a fish farm but the ideal site is usually not available to poorer families.

Site location will be dependent on a number of factors:

- The fish species being raised.
- Soil quality, which affects water quality and productivity.
- An adequate supply of water.
- Land ownership.
- Marketplace and market conditions.
- Fish food and other inputs available to the farmer.
- Groups adjacent to water.
- More than 1 metre water retention capacity for at least 6 months of the year.
- Pollution free.

Ideally, the fishpond should be 0.5 to 1.0 metres at the shallow end and sloping to 1.5 to 2.0 metres at the drain end. Drain vales, baffle boards or tilt-over standpipes should be incorporated into the design. It should be possible to drain the pond within three days. The edges of the pond should have a slope of 2:1 or 3:1 on all sides.

If possible the pond should be located to take advantage of the effect of the wind on the surface of the pond to mix the water; although locations that are too windy can cause erosion of dykes. If the site is very windy the long side of the pond should be at right angles to the prevailing wind. Hedges and trees can be used to protect the pond.

In practice, existing ponds and pools are abundant in Bangladesh, often located near to farmers' homes. Small-scale fish cultivation is mainly a secondary occupation for farmers. These ponds tend to be small (less than 0.25 acres) and do not have any water drain facility. They are commonly referred to as fishponds but are in fact "borrow pits", where earth has been removed for building.

Fish breeding is just one of the activities that the ponds are used for. Other uses may include domestic water use, washing, irrigation or duck keeping. Ponds are occasionally integrated into paddy fields as additional ditches. Consequently, the ponds have many limitations for producing fish.

In managing the ponds there are many potential problems to be considered, including:

- Broken pond banks; check the pond walls on a regular basis.
- An irregular water supply, too much water in the monsoon season and too little in the summer.
- Predators; check the pond for signs of snake and rat holes. The Boal fish is a particular menace that eats smaller fish.

Small-scale fish farming

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- Grazing animals can damage the pond banks and should be kept out of the way.
- Silting or a build up of organic matter; check the bottom of the pond and scoop silt out when required. Mud on the bottom of the ponds can be agitated with a rope to release harmful gasses.
- Leakage; check the inlet and outlet on a regular basis.
- Fish diseases; check the fish on a regular basis.
- Poor water quality; lime can be added to improve the water quality.

Open water fish farming

Open water fish farming is particularly suited to Bangladesh with its many water sources. Cages or pens are used to separate an area of larger water bodies for fish cultivation. The selected water source should be of good quality with low turbidity.

Dams and reservoirs primarily exist to store water but as a secondary function these bodies of water can be stocked with fingerlings or fry and the fish can be harvested later on using nets.

In river locations a slow current is necessary and there should be little disturbance from water traffic.

The disadvantages are:

- Fish farmers have little control of the water, as they do not own the dam or reservoir.
- Water cannot be drained, as the main function of the resource is to provide water.
- There are likely to be more predators of the fish in the water.
- It is not possible to feed or fertilize the water, as occurs in more intensive fish farming, so there is a reliance on naturally occurring fish food.
- There is a potential risk from disease but stock held in small-scale cages scattered around villages will probably be less vulnerable than stock held in more concentrated and centralized commercial systems.
- The risk from theft and vandalism is a serious problem in some places. This is especially real for the poorest people who are perceived as easy victims.
- A significant expansion of cage culture activities in some villages could lead to local depletion of snail or other foods, to the detriment of ducks and other domestic and wild animals.
- Multiple ownership of ponds can be a major drawback to the effective use of such resources. Consensus over access to the water for the poor has to be developed.

Fish cages

Cages are used as a form of farming in their own right within flowing or large bodies of water and can also be used in small pond fish culture to protect fingerlings in the initial stages of development. Small cages with a capacity of one cubic metre are suitable for fingerling protection. The cage can hold up to 300 fish at a time. People grow fish in their local ponds using a simple fish cage known locally as a "hapa". A few young fish are put into each "hapa", which acts as their home, floating just below the surface of the pond.



Figure 2: Bilkish Begum and Hamida Begum working with fish cages. Photo credit: Practical Action / Zul.

Cage construction

Cages can be made using a few cheap materials. Bamboo poles form an outer frame that is covered in netting; inside is a "nursery" section for the younger, more delicate fish; and floats are added at the corners.

A cage is a very simple means of restraining fish in one place and it can be easily made using local materials. Cage design must incorporate certain physical properties, including the ability to hold fish securely but also to be within the financial means of the cage operators. The cages presently used are small in size, measuring between 1 and 2m³, inexpensive and simple to construct.

Farmers use both fixed and floating cages. In general, fixed cages are installed in water where the depth is relatively low and bamboo poles can be fixed into the riverbed or substrate. Floating cages do not have this limitation and can be used in deep water. Floating cages tend to be easier to manage but when selecting the type and design the following points should be considered:

- Ability
- Input availability
- Natural disaster
- Type of water body
- Water depth
- Water current
- Water retention period over one year
- Social problem
- Cage management

Fixed cages

Fixed cages are very easy to construct and only require a small amount of capital investment. The materials needed to make fixed cages are netting with an 8mm mesh size, bamboo, rope, twine and sinker. Routine management is difficult for these cages and storms, strong currents, tidal surges and flooding may cause damage if precautionary measures are not taken. Fixed cages are difficult to move from one place to another during water fluctuation.

A top cover is usually provided on cages to reduce the risk of fish escaping, especially in areas prone to flash floods where water levels rise very quickly. A small opening is kept at one edge or in the middle of the top covering for feeding purposes. A feeding platform made of fine mesh is placed on the bottom of each cage to minimise food loss. To fix the cage, four bamboo poles are fixed in the substrate and the four top and bottom corners of the cage are tied to the bamboo poles with nylon rope, allowing the cage netting to stretch.

To minimise installation cost and to reduce daily management labour, cages are sometimes fixed in rows with a narrow space between the adjacent cages.

Floating cages

The size of the cage is usually 1m³. A top net is always used to minimise escapees because the cage is only a few centimetres above the water surface. The top of the cage is on hinges that can be opened to allow feeding, the checking of fish, the removal of waste and harvesting.

A layer of fine mesh net is placed along the bottom of the cage and 10 centimetres up each side which reduces food loss. However, where water has a high turbidity, the use of fine mesh is not recommended as it clogs up the mesh and causes structural stress on the cage frame. In these areas, feeding trays should be used instead of fine mesh. Buoyancy is achieved by using four plastic floats (buoys) which are tied to the four horizontal frames, approximately 10 centimetres from the top of the cage.

Bamboo frame cage

To make a 1m³ bamboo cage, twelve one metre long bamboo sticks (about 2cm in diameter) are required and fixed into the holes of the angles, one angle for each corner, giving a box shape.

Advantages and disadvantages of fixed and floating cages

Fixed cages	Floating cages
Advantages	Advantages
<ul style="list-style-type: none"> • Cost per unit is small • Not damaged by storms • Easy cage management • Cage bags spread properly in the water • Easy to construct 	<ul style="list-style-type: none"> • Water volume remains constant even with a fluctuation in the water level • Cage can be installed in deep water • Floating cage with box type frame gives adequate space inside • In tidal water bodies the effective cage depth is greater
Disadvantages	Disadvantages
<ul style="list-style-type: none"> • Water depth inside cage varies with the fluctuation of the water level • Vulnerable to tidal surge and storm • Cage cannot be installed in all types of water bodies • Prone to crab cutting • Poorer fish growth and higher mortality rate 	<ul style="list-style-type: none"> • Cost per unit is higher than fixed cages • Algae deposits on cage net affect the water exchange • Cage management i.e. cleaning, moving and sampling are not easy • Due to water flow sometimes the cage bag does not spread properly • Easy to steal fish by lifting the cage • During flooding may wash away

Cage management

Care of cages – cleaning of aquatic weeds nearby, removal of water hyacinth, cleaning of waste feeds from cages, cleaning of deposited silts from cage, removal of dead fishes, checking cage frames, floats, ties, anchors, feeding trays etc., cage shifting, considering the water level, checking water pollution and guarding.

Care of net – Algae attachment should be cleaned at regular basis to ensure water exchange, net holes must be checked properly and need quick repairing when necessary.

Care of fish – profitability depends on proper attention to the fish growth, regular, adequate and quality feeding is important. Fish health and disease should be monitored during feeding and sampling. The fish must be fed daily using aquatic weed or a mixture of rice bran, oil cakes, kitchen waste, chopped snails or cow dung.

Minimising risk of cage culture

- Appropriate cage design can help minimise failure.
- The use of more than one cage per household greatly reduces the risk of an individual losing all fish.
- Placing many cages together in clusters also reduces the risk of poaching.
- Individual farmers can form groups that can guard the fish and therefore considerably reduce potential poaching threats.

Fish types

Fish is an important part of the diet for the people in Bangladesh providing protein calcium, fatty acids and vitamins.

Traditionally, a variety of local species were used in ponds, mainly carp, caught from the wild as spawn (fertilised eggs or small fish). One of the main drawbacks of this source of supply is that along with the desired fish species come many undesirable ones

Most of the species currently used in the cages in Bangladesh are exotics. However, for decades these fish have bred naturally and distributed themselves throughout the flood plains and the delta.

Common fish types

The selection a suitable fish species will depend on various biological and economic factors, such as;

- Market price
- Growth rate
- Ability to reproduce simple culture of young fish
- Match of fish and available fish feed
- Water temperature is an important criteria in assessing which fish species is suitable.

The main types of cultivated fish are Carp, Tilapia and Catfish. Other fish suitable to cultivation are eel, tawes, mullet, snakeskin, and rohu.

Some fish are more suitable to pond conditions than others, some fish will not adapt the confined conditions while others such as the indigenous Koi (*Anabas testidunous*) have been found to thrive in cages.

Small indigenous species

In addition to the main cultivated species there are many indigenous breeds of fish that play an important role in the nutrition of the population. These fish are classed as small indigenous species although not all fish within this classification are particularly small.

Of the 260 species of fresh water fish found locally, over 140 species are classified as Small Indigenous Species (SIS) and account for over 80% of the total catch, consumed by the poorer section, as preferred species. The term SIS would seem to be a recent re interpretation of the Bangla word chotmach (literally small fish) as opposed to Boromach (literally large fish). Common fish within the small indigenous species category include:

Small catfish
Knifefishes
Snakeheads
Needlefishes
Minnows, Rasboras, and bards
Loaches
Anchovies and sardines
Spiny eels
Climbing perch
Gobies
Mud Perches
Glassfishes
Fresh water prawns

Small, low-value fish are particularly important for the extremely poor after the rice harvest when the demand for their labour declines.

Feeding the fish

With the non-intensive approach it is possible to feed fish on nothing more than scraps and waste, duck weed, oil cake, kitchen waste, rice bran and snails which will provide all the nutrition required. Some low-cost feeds are bought in by the households, typically rice bran and oilcake, but these costs are



Figure 3: Bilkish with prepared food for her fish. Photo credit: Practical Action / Zul.

minimal. Occasionally, the diet may be supplemented with commercially available compound feeds. In most cases a mixture of diets is offered, according to their availability and needs of the fish.

Fish harvesting and marketing

Growth is rapid in the warm climate of Bangladesh and the fish attain marketable size within 3-9 months, providing farmers with a rapid return on their investment and labour.

Fingerling production culture cycle is between 1 and 2 months. Cage nursery producers can sell fingerlings to the pond farmers and ox-bow lake operators.

Fish for food culture cycle is between 4 and 6 months. Fish food producers consume the cage fish as well as selling them in the market.

Profitability depends on many factors including the type of water body and culture, cage construction materials, the choice of fish species, fingerling size and price, stocking density, feed price, availability of protein rich feed, culture duration, cage management, harvesting and marketing.

Another concern relates to *economies of scale*.

Almost all enterprises are subject to economies of scale, and cage culture is no exception. The labour of looking after one small cage is far greater per kilogram of product than that for looking after a large one. The cost of the cage per kilogram of production will also be higher for a small cage versus a large cage. However, co-operative use of labour can be used to realise economies of scale in relation to labour, and this is already done in many villages.



Figure 4: A group of landless women discussing finances in Madaripur. Photo credit: Practical Action / Neil Cooper.

The third concern, related to the second, is *comparative advantage*. A significant proportion of the fish is intended to be sold for cash rather than consumed by the farmer and his family. In the medium term, an important question is whether small-scale producers in villages are well placed to compete – either with larger commercial producers, or producers from elsewhere. If they are not, and if competition increases, then prices - and returns - will steadily decline. In practice there is strong local demand for fish throughout the country, and small-scale producers are well placed to serve widely-dispersed rural markets. Secondly, the use of surplus off-season and/or family labour is itself a comparative advantage. Thirdly, in those systems which use local food resources, such as natural foods and kitchen wastes, feed costs are relatively low compared with those for commercial producers. Small-scale fish producers should therefore be able to survive competition in much the same way as village-scale poultry producers have survived, and even to some extent benefit from the increasing number of intensive poultry operations.

References and further reading

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