Tilapia Hatcheries–Lake or Land Based?

MALCOLM BEVERIDGE
IFDR
College of Fisheries
University of the Philippines in the Visayas
Diliman, Quezon City

The tilapias are probably the most widely cultured fishes in the tropics and are grown both in ponds and in cages and pens. To date the rearing of fry and fingerlings has been largely restricted to land-based units. However, lake-based hatcheries and nurseries are becoming increasingly popular in such areas as the Philippines.

Conventional land-based tilapia hatcheries use either open pond or hapa-in-pond methods of producing fry and fingerlings. The open pond method is the oldest and still the most widely practiced method. In the Philippines ponds are stocked with breeders, which are fed on diets compounded from locally-available agricultural by-products and vegetable materials, such as rice bran, fish meal and copra meal. Ponds may be fertilized with inorganic and/or organic fertilizers in addition to, or as an alternative to reliance on feeds. Using seine or scoop nets, fry are removed from the edges of the ponds where they congregate, and are graded and either sold immediately or transferred to nursery ponds. Here the fry are kept and regularly graded to minimize cannibalism until sold. Larger fry (0.5-3.5 g) are preferred by cage farmers, whilst smaller ones are usually sold to pond operators.

Using the hapa method, breeders are stocked in small cages or hapas (2 x 2 x 0.75 m) made from inverted mosquito nets, which have a very fine mesh (1-3 mm). These are attached to 'ipil-ipil' *(Leucaena leucocephala)* stakes driven into the substrate, so that the bottom of hapa remains 10-20 cm above the pond bottom (Fig. 1). Fish rely on natural production and/or supplementary feed, and fry are removed at regular intervals by concentrating them in a corner of the enclosure, and then scooping them out with a small net (Fig. 2). They may then be transferred to nursery hapas and kept till sold.

Since the late 1970s, researchers from Southeast Asian Fisheries Development Center (SEAFDEC), Laguna Lake Development Authority (LLDA) and various universities in the Philippines have been experimenting with lake-based hatcheries and nurseries. Today there are several commercial lake-based fry and fingerling units in operation, particularly in the San Pablo Lakes and in Laguna de Bay, in southern Luzon. Most operators use large inverted hapa nets attached to bamboo or 'anahaw' *(Livingstonia rotundifolia)* posts driven into the lake bottom (Fig. 3). The cages are usually sited in shallow (3-8 m), sheltered areas, and stocked and managed in a similar manner to the pond hapas (Fig. 4).

Advantages

The advantages of using a lake-based hatchery to produce tilapia fry are many. First of all, it is a highly adaptable type of system which can easily and cheaply be constructed from local materials. With little capital investment and no land, a small hatchery can be established which can then expand as

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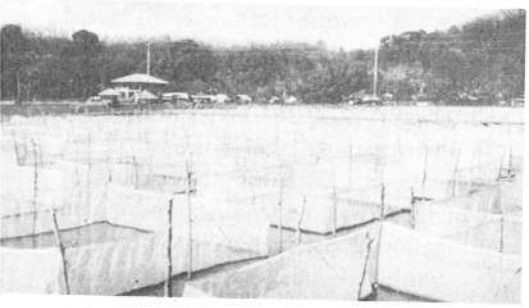

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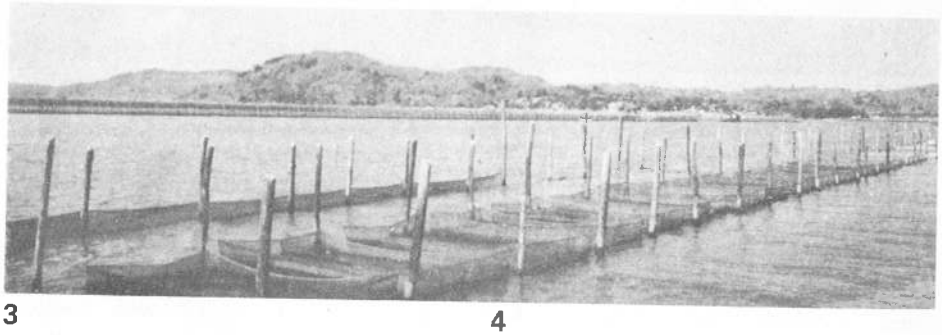

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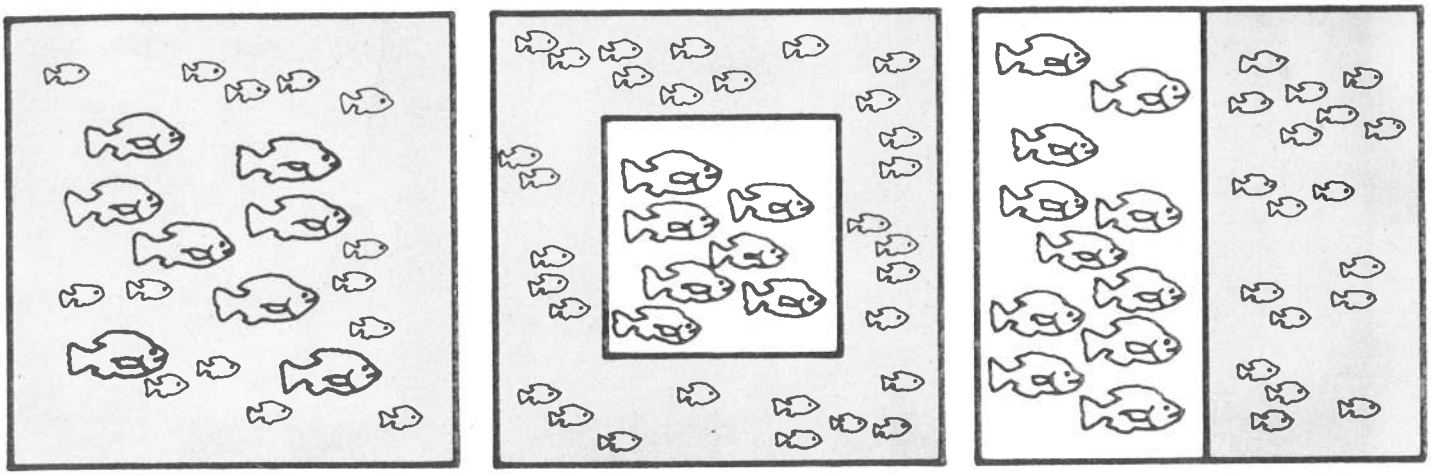
Fig. 1. Hapa-in-pond method of breeding tilapia. Rizal, southern Luzon.
Fig. 2. Harvesting fry from pond hapas. Using a bamboo pole, the fry are concentrated in a corner of the bag, and scooped out into a basin with a small net. Fry smaller than a certain size pass through the mesh of the scoop net.
Fig. 3. A lake-based hatchery in Laguna Lake. The net bags have been fitted with top nets to reduce the risk of loss during typhoons. The nets are attached to stout anahaw palm trunks.
Fig. 4. Harvesting of fry from lake-based hatchery using a dug-out. The method is similar to the harvesting method used in pond hapas. Using the boat, fry are concentrated in a corner of the net cage and then scooped out into a basin.



Designs for lake-based hatchery cages. *Left:* fry mix with broodstock; fry collection disrupts the breeders. *Center:* double hapa net unit improves production per breeder. *Right:* divided hapa also improves production.

expertise and prospects improve. If the hatchery is established at a productive site, then supplemental feed requirements may be minimal. Algae fouling the fine meshed hapas are grazed on by the broodstock, thus contributing to the food intake whilst reducing the need for net changing and cleaning. The system can be easily integrated with tilapia cage and pen farms.

In Table 1, fry production details for land and water-based hatcheries in the Philippines are summarized. There is

Table 1. Summary of tilapia fry production in the Philippines, from various sources.

Hatchery type	Fry production (No./m^2/month)
Land-based	10 – 240
Water-based	70 – 280

an enormous variation in production, depending on broodstock quality, stocking density, stocking ratio and management methods. Highest production comes from the larger and better-run commercial and government-run operations, where good quality broodstock, high (4-8 breeders/m^2) stocking densities, and high protein feeds are used and where regular harvesting of fry is practiced. Optimum stocking ratios are around five female to one male breeder. Despite the wide variations in results, fry production from lake-based systems can be as high as that achieved from conventional land-based units.

Several alternative designs of lake-based hatchery cages have recently been used in the Philippines. These have been tried to solve one of the age-old problems of tilapia hatcheries: cannibalism of young by older fry and broodstock. One simple way to minimize this is frequent collection of the fry. However, this is disruptive and can stress the broodstock and interfere with breeding. In land-based pond systems, various modified hapa units have been tested over the years, and the recent developments in the Philippines owe something to these designs.

At the LLDA lake-based hatchery in Looc, Rizal, Dr. Rafael Guerrero evaluated the performance of a double hapa net unit in comparison with the standard design. The special unit was identical in size to the original, but contained a smaller cage of larger mesh size inside, in which the same number of broodstock were placed. Fry were free to move out of the broodstock area into the outer unit and thus escape parental predation. Trials showed that on a per unit area basis, there was no significant difference between structures in fry production. However, production per breeder was almost doubled, and thus early separation of fry from breeders is to be recommended.

Some aquaculturists believe that flow conditions in the above design might be impaired by the double net structure, thus restricting O_2 and food supply to the broodstock. In order to overcome this, another design has been tested in Laguna Lake by Dr. A. Bautista of SEAFDEC. The hapa net is divided by a large mesh wall with broodstock on one side. Fry are thus free to move into the refuge area whilst flow conditions to the broodstock are maintained. Good results have been reported for this method.

Vulnerability

Despite the advantages discussed above, and the encouraging results to date, there are some negative aspects of lake-based hatchery systems which should be considered. The disadvantages can be summed up by the term "vulnerable". Cages are usually sited in water bodies which are multipurpose, and over which no single person or agency has jurisdiction. Thus water quality at a site can deteriorate through industrial pollution or over-exploitation by other cage farmers. Toxic pollution can harm the fish, whilst a decrease in productivity may mean a fall in fry production and/or a greater dependency on supplemental feeds, thus eroding profitability.

Lake-based hatcheries are also vulnerable to theft and vandalism, and the vagaries of climate. In the Philippines, many lakes and reservoirs are hit by typhoons each year. In July 1983, for example, Typhoon Bebeng caused a great deal of damage to the cage and pen industries in Central Luzon and Bicol Region. Hatchery operators may not be willing to risk their valuable broodstock, and indeed several lake-based hatchery operators in Laguna de Bay have decided to move to pond or concrete tank systems, which are safer, and where they have a greater control over production.

Nevertheless, lake-based systems do deserve further study, and may still play an important role in tilapia production.

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