

Tilapia broodstock and hatchery management

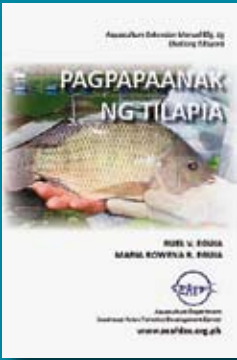
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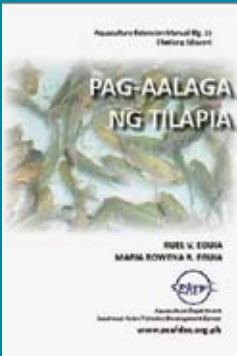
Aquaculture Department
Southeast Asian Fisheries Development Center
www.seafdec.org.ph



TILAPIA MANUALS IN FILIPINO FROM THE AUTHORS



PAGPAPAANAK NG TILAPIA is the Filipino translation of this manual. It covers the same topics on broodstock selection, hatchery and nursery management, cost-returns analysis, and health management.



PAGAALAGA NG TILAPIA covers topics regarding the grow-out of tilapia in tanks, netcages, and ponds. The different species of tilapia reared in the Philippines, culture methods, harvest, and health management are also tackled among others.

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Foreword

Tilapia is one of the easiest species of fish to culture because it grows fast, breeds easily, and requires little technical input. In the mid-1980s, AQD authored tilapia publications including one on feed formulations for Nile tilapia broodstock and nursery. Work on a farm-based genetic selection scheme was conducted a decade later to give tilapia farmers a more scientific guide in selecting and managing breeders. The SEAFDEC/AQD will continue to promote tilapia hatchery and grow-out technologies through regular trainings and publications.

As an output of the AQD's Smallholder Freshwater Aquaculture Program, this manual was published to achieve its objective of disseminating science-based aquaculture technologies.

This manual will surely assist tilapia operators and technicians in producing good-quality fry and fingerlings which the industry currently needs. Fisheries researchers, teachers, and students will also find this manual as a good source of basic information regarding tilapia broodstock and hatchery management.

Let us all work together for the development of sustainable aquaculture for food security in the ASEAN region.



Joebert D. Toledo, D. Agr.
Chief, SEAFDEC/AQD

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Introduction

Nutrition, environmental changes, and water quality are important factors that influence the growth of freshwater fishes like tilapia. Rearing tilapia does not only depend on feeding and water quality management, but also on the genetic background of the stocks used for farming.

Tilapias have been domesticated in the Philippines for almost three decades and it is inevitable that most of the stocks found in several hatcheries are slow-growing, less resistant to diseases, early maturing, and sometimes physically deformed. These characteristics could be indications of inbreeding due to poor broodstock management practices.

This manual discusses the important principles in tilapia broodstock and hatchery management, problems experienced by hatchery operators and by the industry in general, and the solutions through which these constraints are addressed.



Breeding characteristics

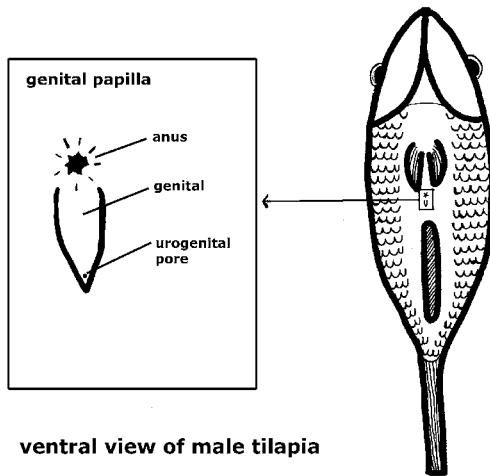
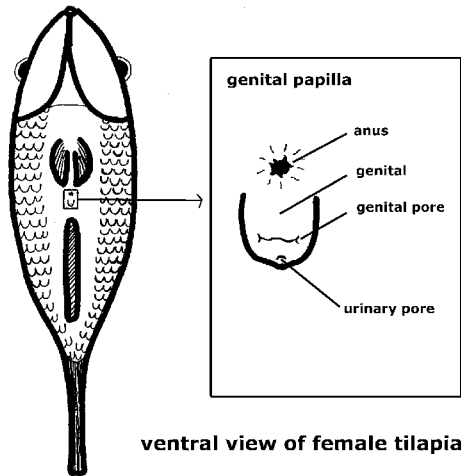
The hatchery operator should be familiar with the physical characteristics of tilapias that are used for breeding. Success in hatchery management can be achieved if the farm staff has sufficient knowledge of the ideal characteristics of tilapia broodfish and the reproductive behavior of tilapias in their natural habitat.

Physical or external attributes (phenotype):

Good body shape, color, body thickness, no physical deformities

Genetically heritable traits (genotype):

Fast growing, disease-resistant, efficient feed converter, not aggressive



Sex determination

Apart from size, the male tilapia can be distinguished from the females through its secondary sex characteristics. The female tilapia is usually smaller than males of the same age. It is approximately 9cm in size at three months. Apart from size, the male tilapia can be distinguished from the females through its secondary sex characteristics. The genital papilla of the female is oval and has two pores. The male tilapia is usually bigger than the female. Its total length is roughly 11 centimeters at three months. It displays a marked brilliant colouration that attracts female tilapias during courtship. The male genital papilla has a pointed tip where the urogenital pore is located.

Nesting, courtship, mating, and spawning

Tilapias often spawn in the shallower areas of swamps, lakes and earthen ponds. The water depth in these areas ranges from 0.15-0.80 meters.

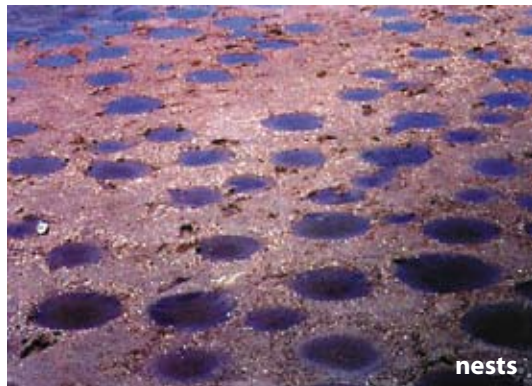
The male tilapia builds a nest in preparation for courtship and reproduction. The nesting zones are normally shallow, circular dug-out areas (about 20-25cm diameter in size) on the earthen pond bottom. It is in these nests that the male tilapias try to attract females for mating.

Courtship lasts for a few hours. Sexually mature tilapias can spawn from 200-2000 eggs depending on the size of the female. Immediately after the female deposits its eggs in the nest, the male tilapia releases its milt over the eggs to fertilize them. After fertilization, the female takes the fertilized eggs in her mouth for incubation. It takes three days before the fertilized eggs are hatched.

Nursing hatchlings

From the time the eggs hatch, the mouthbrooding female takes care of the yolk-sac fry inside her mouth for another 3-4 days. Once the yolk sac is resorbed, the mouthbrooding female allows the swim-up fry to swim out of her mouth.

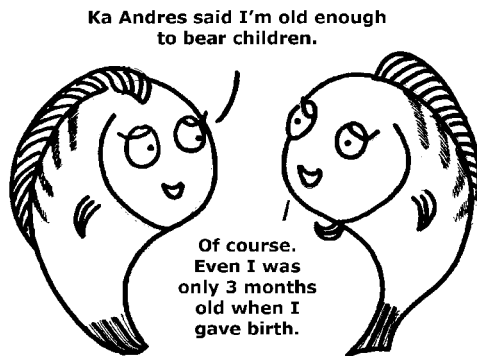
At this stage, the swim-up fry are ready to feed on natural food or on finely ground artificial diets that may be administered to the fry. The swim-up fry can occasionally seek refuge inside the female's mouth especially when the fry are threatened by other adult tilapias in the same spawning enclosure.



Guide to breeding tilapias in the hatchery

Developing potential broodstock

- ▶ Procure fingerlings (~ 4000 pcs.) from a reputable government or private hatchery that produces good quality seedstock. As much as possible, obtain the following information on the stock that was purchased:
 - Age of the fry/ fingerlings (date when hatched)
 - Type/ name of stock or strain
- ▶ Rear the seedstock under optimal husbandry conditions. If the fingerlings are to be on-grown in tanks, they can be fed a formulated artificial diet containing 25-30% crude protein. The diets can be administered 2-3 times daily at a rate of 3-7% of the fish biomass. Good water quality should be maintained by changing the rearing water once a week or when deemed necessary.



- ▶ If the fingerlings are to be reared in netcages or in earthen ponds, supplemental feed should be provided especially when natural food in the rearing water is not sufficient. Supplemental feed can be administered twice daily at a rate of 2-3% of the fish biomass.
- ▶ Harvest the fish after four months of rearing. Separate the big individuals (75-100g) from the harvested lot. From the large fish, choose the potential breeders based on the following criteria:
 - Body thickness (2-2.5 cm)
 - Body girth (4.5-5.5 cm)
 - No physical abnormalities
- ▶ From the potential broodfish, choose and stock males and females separately in tanks.

Genetically improved stocks

From 1984 to date, growth of several Nile tilapia stocks have been enhanced through genetic improvement methods such as selective breeding. Genetic improvement programs were implemented by the SEAFDEC/AQD, Central Luzon State University, Bureau of Fisheries and Aquatic Resources, GIFT Foundation International Inc., PhilFishGen and Genomar Supreme Philippines Inc. Thus, several Nile tilapia strains were produced from conventional selective breeding (1-5), genetic manipulation (6), and hybridization (7).

In selecting male broodfish, choose individuals that easily release milt upon slight pressure on the lower abdominal area (specifically the genital region).

1. Genomar Supreme Tilapia
2. Genetically Improved Farmed Tilapia (GIFT)
3. Freshwater Aquaculture Center Selected Tilapia (FAST)
4. Genetically Enhanced Tilapia – Extra-Large, Excellent (EXCEL or GET-EXCEL)
5. SEAFDEC-Selected Tilapia (SST)
6. Genetically Male Tilapia (GMT) or YY-supermale tilapia
7. SaltUNO or Molobicus (hybrid from a Nile and Mozambique tilapia cross)

Based on a survey of 136 private and government tilapia hatcheries in the Philippines, about 94.3% of the fingerlings stocked for culture in 2003 were from improved strains. Most of these improved seedstock were the Genomar Supreme Tilapia and the GET-Excel Tilapia. The GET-Excel Tilapia is a strain developed by the Bureau of Fisheries and Aquatic Resources and supported by the government. The GET-Excel fingerlings were distributed to fishfarmers as part of its nationwide tilapia seed dissemination program.

If one plans to procure any of the improved stocks for use as breeders in the hatchery, it is best to contact any of the agencies that developed these



genetically enhanced strains (the addresses and contact numbers of these agencies are found in the latter part of this manual). The agencies that propagate the improved stocks have their own mode of distribution as well as policies regarding accreditation of interested hatcheries or farms.

Breeding or spawning tilapias

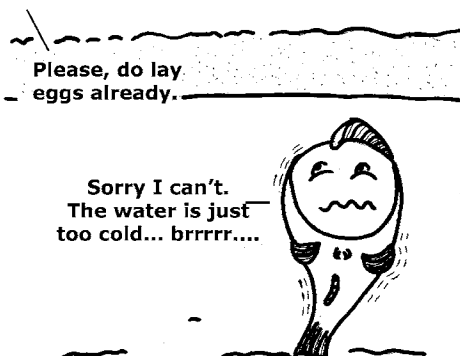
Tilapias can be bred in any of the following spawning enclosures:

- ▶ concrete tank
- ▶ fine-meshed (hapa) net cage
- ▶ earthen pond

Based on research and practical hatchery experience, seed yield varies depending on the type of spawning enclosure used. One of the main reasons for the difference in seedstock production is the quality and varying temperature in the rearing water used for spawning. It has been observed that tilapia breeders spawn continuously when water temperature is kept within the range of 29-31°C.

Tilapia seed production is highest in tanks, followed by production from netcages and earthen ponds.

Water temperature in lakes and earthen ponds are easily influenced by climatic changes. Hence the water temperature in lake-based netcages or earthen ponds used for spawning is often very variable. Seedstock production from these hatcheries is high only during warmer months of the year. Apart from water quality, another cause for poor seedstock production in lake-based netcages and ponds is the seedstock harvesting method and the presence of non-tilapia species that prey on the eggs/hatchlings.



In tank hatchery systems, water quality management can be easily done and controlled hence seed yield is higher. However, inspite of the fact that seedstock production in tanks has more potential, the initial capital required to put up tank hatchery facilities is too costly for small-scale hatchery investors.

There are two ways of harvesting tilapia seedstock regardless of the type of hatchery system. These are:

1. Egg Collection

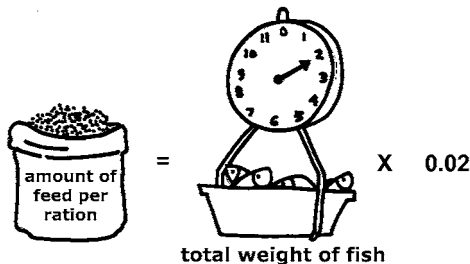
This is performed 14 days from the time the tilapia breeders are stocked in the enclosure for mating. Here, 75% of the seedstock that are harvested are eggs while 25% are fry. This method requires the use of artificial incubators where the eggs shall be hatched.

2. Fry collection

Hatchlings/swim-up fry are scooped daily from the spawning enclosure, 10-21 days after the breeders are stocked for spawning.

Concrete tanks

- ▶ Stock four pieces of sexually mature tilapia (3 females and 1 male) for every square meter of tank space. Water in the concrete spawning tank should be maintained at a minimum level of 0.5m.
- ▶ Feed the broodstock an artificial diet. By sampling at least 20 pcs. of tilapia, calculate the daily ration (amount of feed) that should be given to the spawners. A diagram of how the ration is computed is given below:



Example: A 5 x 10 m concrete tank holds 200 potential breeders that weigh 100 g each. The total fish biomass is computed as follows:

100 g x 200 pcs. of breeders = 20,000 g or 20 kg breeders

The feeding rate is 2% of the total fish biomass. For 20 kg fish biomass,

20 kg fish biomass x 0.02 = 400 g feed per day

The estimated feed is based on a rate of 2% of the fish biomass. The feed can be divided into two rations per day.

The formulated artificial feed given to tilapia broodstock must contain 35-40% crude protein to enhance their reproductive performance and increase seed yield. Commercially available feeds can be used, otherwise diets can be formulated if the farm has facilities for feed development and production. The formulated list in the table below can be used as a reference:

Example of a feed formulation for tilapia broodstock

| Ingredients | Amount (wt. in g/100g feed) |
|----------------------|-----------------------------|
| Fish meal | 36.2 |
| Corn gluten meal | 20.4 |
| Soybean meal | 17.7 |
| Copra meal | 11.8 |
| Rice bran | 7.5 |
| Starch | 3.2 |
| Cod liver oil | 0.5 |
| Vegetable oil | 0.5 |
| Vitamin-mineral mix* | 2.2 |

From Santiago et al. (1985) and Feed Development Section (1994)

| Nutrient content | % dry matter |
|-----------------------|--------------|
| Crude protein | 44.0 |
| Crude fat | 5.5 |
| Crude fiber | 9.1 |
| Nitrogen-free extract | 29.6 |
| Ash | 11.8 |

*This provides vitamins (amount/kg) such as: ascorbic acid (50mg), biotin (0.05mg), choline (275mg), D-calcium panthotenate (25mg), folacin (2.5mg), inositol (50mg), pyridoxine (10mg), riboflavin (10mg), thiamin (10mg), vitamin A (2750 IU), vitamin D3 (500IU), vitamin E (25IU) and vitamin K (5mg). The minerals (g/kg feed) are: CaCO₃ (3.75), CaHPO₄·2H₂O (10), CuSO₄·5H₂O (0.03), FeSO₄·7H₂O (0.25), KIO₃ (0.001), MnSO₄·H₂O (0.015), NaCl (3.75), ZnSO₄·7H₂O (0.35)

- ▶ Two to three weeks after stocking the spawning sets, one can check for the presence of swim-up fry/ hatchlings that normally swim along the sides of the concrete tank.
- ▶ Once swim-up fry are found, gradually drain the water from the tank. While water is being drained, breeders will swim towards the catch basin and stay there until the water has been completely drained. In the catch basin, some of the breeders shall release swim-up fry which were incubated inside their mouth. The swim up fry can be scooped out gradually using fine-meshed scoop nets. Meanwhile, the breeders can be individually inspected and examined for eggs/fry which are manually removed. The fertilized eggs can be incubated further in artificial incubators while the swim up fry can be pooled and reared in nursery tanks.

- ▶ After each spawning cycle, the male and female breeders can be stocked in separate tanks for a brief conditioning period. Conditioning may last for three days. During the conditioning phase, the breeders are given the time to rest in preparation for the next spawning cycle.
- ▶ Repeat the aforementioned steps for the succeeding spawning cycles.

Maintain two batches of tilapia broodstock. The second batch can be used as an alternate set once the first set of breeders are allowed to rest after several spawning cycles. This way, the hatchery would be assured of continuous seedstock production.

Netcages

The cages used for nursing seedstock in ponds and lakes are fine-meshed netcages referred to as “hapa”. If the hapa net cages are to be set up in an earthen pond, the recommended size is 3 x 10 x 0.75m. In lakes, the ideal size has a longer depth hence the cage can have the following dimensions: 3 x 10 x 1.5m. These netcages are hung from a stationary module made from bamboo frames.

- ▶ Install the netcage (uncovered) in the rearing water. The netcage should be hung from the module with at least a 25cm allowance from the water surface to avoid the escape of breeders from the spawning net enclosures.
- ▶ Stock the selected breeders at a density of 4-8 pcs/m². Administer supplemental feeds (e.g. rice bran) at a rate of 3% of the fish biomass.
- ▶ Check for the presence of swim-up fry in the netcages three weeks after stocking the breeders.
- ▶ To harvest seedstock, lift the netcage using a canoe (if the set-up is in a lake) or



a bamboo pole (if the cages are set in a fishpond) placed strategically under the cage. Gradually lift the netcage in a manner that the breeders will be gathered on one side of the cage while the other part of the cage would be empty.

Give enough space in the cage for the breeders to swim in. After a few minutes, fry will escape and swim out of the mouth of the mouthbrooding females. Gradually scoop out the swim-up fry using a fine-meshed scoop net.

- ▶ If few swim-up fry are left swimming freely inside the netcage, gradually move the netcage by alternately lifting and submerging the netcage in the water. This shall disturb the fish and would allow the remaining fry or eggs to be expelled from the mouth of the spawners. Scoop out the remaining seedstock.



- ▶ Individually check the spawners and manually remove any eggs or fry from their mouths and place the harvested seedstock onto a pail or another hapa net cage where the fry will be nursed. The breeders that no longer have any eggs/fry in their mouth should then be moved to the empty part of the spawning netcage.
- ▶ As soon as the harvest is through, remove any unwanted debris from within the net into the water outside the enclosure. Slowly remove the canoe or the bamboo pole from underneath the netcage to allow the breeders to swim freely within the entire netcage. Secure the cage onto the module frame.
- ▶ Follow the same harvesting method after two weeks when the second spawning cycle ends.

Avoid exposing the breeders to unnecessary handling stress or any form of disturbance especially during harvest as the breeders might accidentally ingest eggs or fry that are being incubated in their mouth.

Fishponds

- ▶ Prepare the earthen pond following these steps:
 - Level the pond bottom. Sun dry the pond bottom to kill unwanted organisms. Another means is to apply chemicals or natural toxins such as derris root, teaseed cake, tobacco dust, rotenone, saponin, and ammonia fertilizers, to the pond bottom. These toxins work well against pests, potential predators and parasites.
 - Prepare the pond soil by means of proper soil conditioning. Lime may be applied to stabilize the soil and water pH (lime is unnecessary when the pH of the bottom soil is above 7.5 and the alkalinity of the pond water is above 50mg/liter of CaCO_3). If the soil pH is to be adjusted to the recommended level (pH 6.5 – 9), the amount of lime that could be applied is 0.1kg/m^2 or 1000kg per hectare.
 - Apply fertilizers to the pond bottom based on the recommendation of the Bureau of Soils and Water Management. Fertilizers can be added to a dried pond at a rate of 50-100 kg/ha commercial fertilizer and 1000 – 2000 kg/ha organic fertilizer). The following commercial fertilizers may be used: urea (46-0-0), ammonium sulphate, superphosphate (20% P_2O_5) and triple superphosphate (40% P_2O_5). Organic fertilizers include manure from chicken, pig, cow, and carabao.



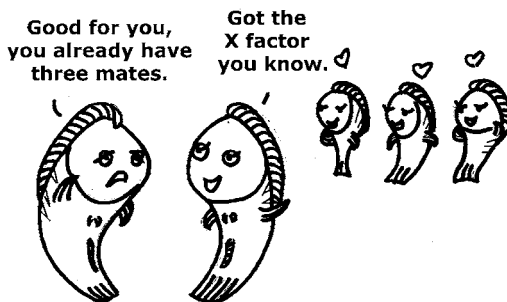
- Immediately after pond fertilization, add water into the pond. The amount of water to be added should be approximately 20cm from the pond bottom.



Allow algae to grow for the next three days. If the source of water is irrigation, river, or swamp, it would be ideal to have a water reservoir within the farm facility. The water reservoir can be stocked with some adult tilapia to check whether the water that

shall be used for culture is safe and has no toxic substances. Meanwhile, once algae are found to grow in the earthen pond the water level can then be increased to about 0.75-0.80 meters from the pond bottom.

- ▶ Stock one male and three female broodstock for every square meter area of the earthen pond. Therefore in a pond that is 500 m², one can add 1500 pcs. female and 500 pcs. male tilapia.



- ▶ Weigh about 50 pcs. of broodfish to determine the amount of feeds that should be administered daily. Three percent of the fish biomass is the recommended amount of supplemental feed that should be given to the broodstock. If the amount of natural food is sufficient, the amount of supplemental feed may be reduced.
- ▶ Two to three weeks after stocking, observe the water surface near the edge of the earthen ponds for the presence of swim-up fry. Scoop the swim-up fry using fine-meshed scoop nets and place the harvested fry in nursery hapa netcages set within another pond or directly into a separate earthen pond.
- ▶ After six weeks or after the second or third breeding cycle, collect the male and female breeders and stock them separately in netcages set within the spawning pond. Drain water from the pond and remove the small recruits or fry that were left unharvested. Let the pond dry.
- ▶ After three days, fill the pond with water and re-stock the male and female breeders together for another round of spawning.



It has been noted that the most productive or sexually active phase in the life cycle of adult tilapias is during the next 18 months from the time they become sexually mature. Hence it is recommended that after 1 ½ years, breeders should be replaced by a new batch to ensure continuous seed

production and minimize the production of poor quality seedstock. Moreover, since the adult breeding tilapias have grown too big after a year or so of production, using a new set of relatively smaller broodstock will also be more economical in terms of lower feed inputs for the maintenance of the spawners.

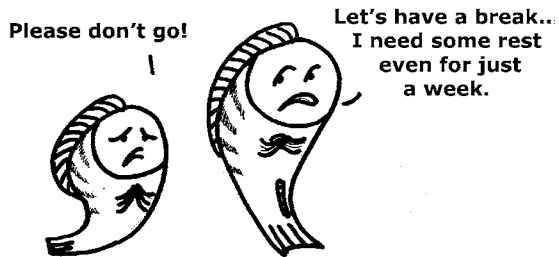


Seed production depends on the adoption of fry nursing techniques, nutrition and regular size grading. Fry/fingerlings should be sorted once every two weeks during the nursing period to help minimize cannibalism.

Tilapia breeding and seed production are influenced by climatic changes. In the Philippines, it has been observed that fry production is poor during cool months (from November to February).

Ways to increase seed yield

Several methods can be used to help increase seed production. This entails proper broodstock management. One method is to adopt a conditioning scheme to allow spawners to 'rest' between spawning cycles. During this period, the male and female breeders are stocked separately and allowed to 'rest' from three days to a week.



Another method is broodstock exchange. After every spawning cycle, the female breeders that have just spawned or are spent are replaced by rested or conditioned female spawners. However using this scheme, one should have at least two or three batches of tilapia broodstock and would therefore require higher investment costs. More inputs are necessary, that is, in terms of feed and overall cost of broodstock maintainance.

Another technique to increase seed yield is to regularly check and harvest swim-up fry found along the sides of spawning enclosures, especially

tanks and ponds. If the hatchery has a lot of laborers or technicians, scoop harvesting can be done as often as needed or for a minimum of 2-3 times a day.

One can also manually remove eggs from the mouth of incubating females. Fertilized eggs removed from the oral cavity of mouthbrooding females can be hatched in artificial egg incubators.



If tank enclosures are used for spawning, monitor the quality of the rearing water. It has been observed that spawning frequency is influenced by changes in the temperature of the rearing water. The ideal water temperature for spawning tilapias ranges from 29-31C. The temperature of the rearing water in tanks can be maintained at desired levels by adding warmer water if the water in the spawning enclosure is cool.

Hatchery/nursery rearing

Tilapia breeding does not end with the successful spawning of broodstock. It continues with the production of sufficient numbers of quality seedstock that are healthy and fast-growing.

It is easy to breed tilapia. What is more difficult is the rearing of hatchlings or yolk-sac fry as this is a critical phase in the life cycle of tilapia. Caring for newly-hatched fry is similar to attending to the needs of a newborn baby. One has to provide proper larval rearing and feeding conditions. It is very important to know the ideal site for nursery rearing, nutritional requirements, and the different techniques on rearing, feeding, fry handling, counting, etc. If all these factors are optimized, one can be assured of healthy, fast-growing seedstock.

In the following sections of this manual, details regarding proper care of newly hatched tilapia fry are discussed.

Rearing fry

A female tilapia breeder that weighs 100g can produce from 250-400pcs of eggs/fry in a single spawn. Fertilized eggs are incubated inside the mouth of the female parent. Hatching occurs 3 days after fertilization while the hatchlings' yolk sac is completely absorbed 7 days thence.

As mentioned earlier, the common practice in commercial hatcheries is to manually remove fertilized eggs or fry from mouthbrooding females and then incubating them in artificial egg incubators until the swim-up first feeding fry stage.

The first feeding tilapia fry does not yet have an efficient digestive system unlike adult tilapias, hence they feed primarily on microscopic organisms





(phytoplankton and zooplankton) which are easier to digest. Zooplankton are ideal natural food organisms as these contain essential nutrients like protein, fats (lipids), carbohydrates, vitamins, and minerals which are important for the growth and development of tilapia fry. Apart from these nutrients, the tilapia fry are also able to obtain digestive enzymes from eating zooplankton. It is believed that the first feeding fry are still incapable of producing enzymes which they need for digestion.

Several research studies have been conducted

regarding artificial diets that can completely replace natural food organisms as feed for tilapia swim-up fry. Until now, no artificial diet has been developed that can compare with the efficacy of natural food to enhance the growth and quality of tilapia fry.

The only problem with natural food organisms as sole food source for tilapia fry is the difficulty in quantifying the amount necessary during feeding. Moreover, it is time-consuming and laborious to produce natural food organisms on a commercial scale. It is for this reason that several feed producing companies have developed formulated diets purposely for tilapia and other fish fry. At present, formulated fish fry diets are used in many tilapia hatcheries/nurseries all over the country.

Ways of nursing fry

Tilapia fry can be nursed in ponds, lake-based or pond-based hapa net cages, and concrete tanks.

Proper feeding – Hatchlings harvested from the spawning enclosures are approximately 1-3 days old and need food that contains all the nutrients necessary for growth and survival. Hence to ensure good survival, it is advised

to administer live food (*Artemia*, *Moina* etc.) to the newly hatched fry. Once the fry are ready to feed on artificial diets, one can either use commercial feeds or the farm operator can produce his own feed based on the following artificial feed formulation:

Example of a feed formulation for tilapia fry

| Ingredient | Amount (wt. in g/100 g feed) |
|----------------------|---------------------------------|
| Fish meal | 30.17 |
| Soybean meal | 25.95 |
| Copra meal | 11.48 |
| Rice bran | 14.97 |
| Ipil-ipil leaf meal | 8.10 |
| Cod liver oil | 1.00 |
| Vegetable oil | 1.00 |
| Vitamin-mineral mix* | 4.33 |
| Starch | 3.00 |

*This has vitamins (amount/kg) like: ascorbic acid (100mg), biotin (0.1mg), choline (550mg), D-calcium panthotenate (50mg), folacin (5mg), inositol (100mg), pyridoxine (20mg), riboflavin (20mg), thiamin (20mg), vitamin A (5500 IU), vitamin D3 (1000IU), vitamin E (50IU) and vitamin K (10mg). The minerals (g/kg feed) are: CaCO₃ (7.5), CaHPO₄·2H₂O (20), CuSO₄·5H₂O (0.06), FeSO₄·7H₂O (0.50), KIO₃ (0.002), MnSO₄·H₂O (0.03), NaCl (7.5), ZnSO₄·7H₂O (0.70)

| Nutrient content | % dry matter |
|-----------------------|--------------|
| Crude protein | 38.1 |
| Crude fat | 8.7 |
| Crude fiber | 5.6 |
| Nitrogen-free extract | 30.8 |
| Ash | 16.8 |

From Santiago et al. (1982) and Feed Development Section (1994)

sex reversal method using feed containing methyltestosterone (optional)

If the hatchery operator wishes to produce all-male fingerlings, sex reversal of 1 to 3 day-old fry is done through hormonal manipulation. The synthetic hormone known as methyltestosterone (MT) is used and incorporated in the fry feed at 6-10mg MT per kilogram commercial feed. The hormone-lined feed is administered to the fry for 21-30 days.



Hormones (MT) are dissolved in 95% methanol. MT is mixed with the feed at a rate of 1L methanol to 2-3kg feed.

For example:

$25 \text{ kg feed} \times 6 \text{ mg MT/kg} = 150.0 \text{ mg MT}$

$25 \text{ kg} \div 2 \text{ L methanol} = 12.5 \text{ L methanol}$

Dissolve 150mg MT in 100ml alcohol (methanol) then mix the solution with 12.4 L of the same type of alcohol. Place the MT solution in a handsprayer then spray the solution onto the feed while manually mixing the feed. Place the hormone-lined feed in a well-ventilated area. Do not let the feed dry directly under the sun. In mixing the MT solution to the feed, the hatchery laborer should wear handgloves for protection.



Concrete tank

Tank nursery operations require a higher capital investment compared to fry rearing in earthen ponds. The major inputs include equipment – aeration system or blower, water pump, and generator. Concrete nursery tanks should be constructed based on sound engineering design and should have a

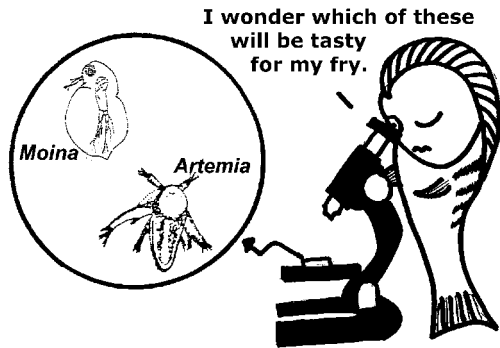


provision for a catch basin. The catch basin is where fry/ fingerlings are gathered while water in the tank is being drained. This design helps minimize unwanted stress on the fingerlings during harvest or regular size grading activities.

High seedstock production can be expected from tank-based nursery operations since almost all aspects in the management and rearing of fry can be controlled by the farm operator. The operator can easily maintain good water quality, follow optimum feeding management protocols, and regularly size-grade stocks unlike in cage-nursed fingerlings.

The size of the concrete tanks used for nursery rearing depends on the scale of the seed production activity and the technical capability of the farm operator. The recommended size and number of tanks that is considered manageable and practical would be fewer nursery tanks that are as large as 5m x 10m x 1m than several small tanks (~3m x 5m x 1m).

Artificial diets are administered to the tilapia fry reared in concrete tanks. The farm operator can also give cultured natural food organisms such as zooplankton (*Moina*, *Brachionus*) and small crustaceans such as *Artemia* as supplemental feed to help hasten growth. This protocol can be adopted depending on the ability of the farm operator to produce or obtain these natural food organisms.







Tilapia nursery operations require effective water quality management. Occurrence of diseases can be avoided if the quality of the rearing water is good. It would also be beneficial if the farm operator has some technical background on fish health management to ensure that the fry being reared in nursery tanks are disease-free.

Nursery rearing method

- ▶ Stock approximately 1000 pcs. of tilapia fry per m² in a tank filled with water to about 30-50 cm level. Feed the fry *ad libitum*, three to five times a day for as long as the fish are observed to consume the artificial feed being administered. Natural food organisms such as *Artemia* or *Moina* can also be given on the first three to four days of rearing to ensure fast growth.
- ▶ Collect the fry/fingerlings from the tank 15 days after stocking by draining the water until most of the fry are swimming inside the tank's catch basin. Scoop out the fry from the catch basin and place them in a conditioning tank or in a hapa net set inside a small concrete tank. Sort

the fry/fingerlings into small, medium and large sizes. Record important information about the fry/fingerlings e.g. date when spawned, estimated number of hatchlings, estimated number of fry for each size classification, number and location of spawning and rearing tanks, exact date of sale of fingerlings.

Actual sizes of tilapia fingerlings (reference: BFAR-NFFTRC)

| Fingerling size | Length (standard length) and body depth |
|-----------------|------------------------------------------------------------------------------------------|
| Size 24 | 16 mm  |
| Size 22 | 23 mm  |
| Size 17 | 37 mm  |
| Size 14 | 46 mm  |

- ▶ Prepare three tanks where the batches of fry/fingerlings belonging to the three size classes can be stocked and on-grown. After sorting the harvested fry/fingerlings, one can stock the different batches into separate nursing enclosures.
- ▶ Follow the recommended stocking density below for each size class of fingerlings that will be on-grown in nursery tanks.

| Size of fingerling | Number of fingerlings per m ² of rearing tank (stocking density/m ²) |
|--------------------|---------------------------------------------------------------------------------------------|
| 32 | 300-500 |
| 22 | 200-400 |
| 17 | 100-200 |
| 14 | <100 |

- ▶ After another two weeks, sort the fingerlings by size following the protocol described earlier. Set aside the batch which are already large enough to be sold. Meanwhile, the smaller-sized fingerlings can be grown for another two weeks. Repeat the rearing and sorting



procedure for two to three more episodes or until such time that the majority of fingerlings are large enough to be sold. On the final cycle of sorting, the smallest size class fingerlings can be discarded as their relatively small size is an indication that these fish are slow-growing and are definitely not very suitable for farming.

- ▶ After every rearing and sorting cycle, clean the nursery tanks by means of disinfection with saltwater. This is a simple method that can be adopted to prepare the tanks for the next round of nursery rearing. Salt is mixed with the water used for cleaning and disinfecting the tanks. This prevents the proliferation of parasites and bacteria and therefore avoids the occurrence of diseases among the fry or fingerlings that will be reared in the tanks.



Fishpond

Nursing tilapias in ponds can be done especially if the operator does not have enough initial capital for the construction of concrete nursery tanks or for the fabrication of modules and netcages. This method is also ideal if the targeted seedstock yield from one production cycle would range from 500,000 to more than a million.

Nursery ponds can be at a minimum size of 200m² with a depth of 0.5m. This is ideal for easy harvesting of seedstock. With this size, water from the pond can be drained readily and the fingerlings can be easily harvested by means of a net.

The expected seed yield from fishponds is usually lower than those harvested from other hatchery systems (e.g. tanks and netcages). The yield is usually lower by 50% of the initial stocking density because of the intrinsic variation in fry size and growth that results to competition for food and fry cannibalism. The only advantage in nursing fry in ponds would be the assurance that the fingerlings that survive at the end of the nursing period are the fittest (healthiest and hardiest) among the lot as a result of natural selection.



Nursery rearing method

- ▶ Prepare the nursery pond according to the protocol described earlier in this manual.
- ▶ After preparing the pond and drawing in water, stock newly hatched fry at a density of 1000-1500 pcs. per square meter. This can be done after roughly estimating the number of newly harvested fry
- ▶ The fry in nursery ponds are fed artificial diet apart from the natural food organisms that are found in the rearing water. The fry are maintained in the nursery ponds for about a month or until they have reached the desired size for marketing or disposal to prospective buyers/grow-out operators.
- ▶ Once the fingerlings are to be harvested either for further on-growing or marketing, gradually drain the rearing water to about 50% of the original depth. With the use of a fine-meshed drag net, collect all the fingerlings and place them in a temporary holding container (small netcage or tank). The remaining fry can then be collected using fine meshed scoop nets. Once the pond has been emptied of the fingerlings, the pond can be prepared for the next rearing cycle

- ▶ Prepare three netcages for the newly harvested fingerlings. Sort the harvested fingerlings according to size (small, medium, large or size 32, 22 etc.). Follow the recommended stocking density (based on initial stocking size) for on-growing in the new rearing enclosures.

| Size of fingerling | Number of fingerlings per m ² of fishpond or netcage (stocking density/m ²) |
|--------------------|----------------------------------------------------------------------------------------------------|
| 32 | 400-600 |
| 22 | 300-500 |
| 17 | 200-300 |
| 14 | 100-200 |

Hapa or fine-meshed netcage within pond

In the course of describing the methods adopted for nursing fry in earthen ponds, limitations that cause low fingerling yield have been noted. Some of these limitations can be resolved if the tilapia hatchery operator considers growing or nursing fry in netcages (hapa) set within ponds. However, this system would require additional expenses on the part of the operator, that is, in terms of the cost of fabricating nursery net cages. In spite of the additional investment cost, the operator can easily recover this expense because of the expected increase in fingerling yield. The size of netcage that can be used may range from 4m x 8m to 5m x 10m, depending on the size of the fishpond. If the nursery rearing methods are optimized, the fingerling yield can result to a recovery of not less than 70% of the original stocking density. The hapa or fine-meshed netcages that can be placed in one nursery pond can occupy a total area of about 1000 m².

Method of rearing

- ▶ Prepare the pond according to the method described in this manual.
- ▶ Set the netcages in the pond in a manner where there would be a sufficient gap between them. This way the hatchery staff can easily move around the cages inside the fishpond. Stock enough fry in each netcage (about 800-1000 pcs. per square meter). Feed the fry supplemental feeds for the entire duration of the nursing phase. This is one method for avoiding or minimizing cannibalism among the fry. It is necessary to monitor and manage the quality of the rearing water in the pond.
- ▶ After two weeks, sort the fry in each hapa netcage and re-stock fingerlings (according to size) in separate netcages for on-growing. Always remember to record important information such as initial fry stocking density, number of fry harvested from each rearing enclosure,

and the number of fingerlings at each size range. This would aid the hatchery operator in determining how many fingerlings are available for disposal at a single time. It can also give the operator an indicator on how successful his farm is in



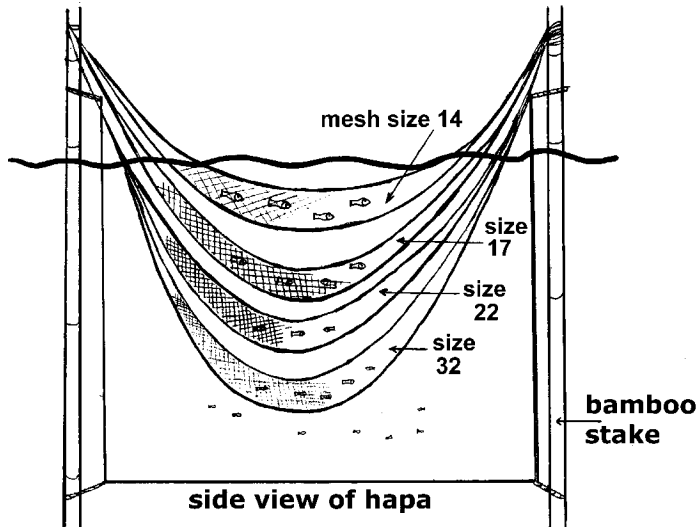
producing marketable seedstock. On the first episode of size-grading, one can expect about 60% of the on-grown fry to be graded as size 32 and 22 while the remaining 40% would be comprised of shooters with sizes ranging from 17 to 14.

- ▶ Sort the fingerlings after another two weeks. The expected size of the fingerlings in the nursery hapas will be from size 22 to size 17. Record all pertinent information (seedstock inventory) to ensure proper monitoring of nursery rearing activities.
- ▶ After each round or cycle of nursery rearing, the cages should be cleaned by removing algae and other debris that clog the meshes. The hapas should also be inspected for torn-out portions that need to be repaired. It is also recommended that the condition of the rearing water in the nursery ponds be maintained properly to ensure that the water is suitable for fry rearing. This is done by regularly adding or applying organic or commercial fertilizers in the pond to ensure good primary productivity.

Rearing or nursing fry in hapas set within ponds is more advantageous especially if one considers the ease during frequent harvesting of seedstock either for on-growing or for marketing. The hapa-in-pond method does not require constant or regular draining of water from the pond during each size-sorting episode. Also, the technique wherein one size-grades and rears the fingerlings in separate hapa enclosures helps minimize cannibalism among differently-sized fingerlings otherwise reared in a single enclosure such as in an earthen pond or tank.

Ways of sorting or size grading

- ▶ Hang a fine-meshed net with a size of 2m x 2m x 1m, from four bamboo pole stakes set inside the earthen pond.
- ▶ Arrange four sorting nets with various mesh-sizes inside the hapa. The net with a size 32 mesh should be placed at the bottom of the series of sorting nets. On top of this, the net with mesh size 22, then the one with mesh size 17 and finally the size 14 mesh net. The net with the largest mesh size should be on the top of the series as this is where the largest fingerlings will remain after allowing the harvested seedstock to swim through the various sorting nets. Arrange the sorting nets in a manner similar to how hammocks are hung .



- ▶ The fingerlings that will be sorted are released on top of the sorter. This way, the fingerlings having a size smaller than the mesh size of the first sorting net will pass through to the next net in the series of sorters. The large size fingerlings will remain on the first sorter. Meanwhile, as the





smaller-sized fingerlings pass through the second sorter, slightly larger ones will remain and the smaller ones will pass through onto the next sorter and so on.

- ▶ Always remember to allow the fingerlings to swim freely through the sorters. Make sure that there is enough space between the net sorters to allow the small fingerlings to swim through.
- ▶ Transfer the sorted fingerlings immediately to the separate netcages where the fingerlings will be on-grown. At this stage, one can also get estimates of the number of fingerlings at each size range. Doing an estimation of the seedstock number on a separate occasion shall expose the fingerlings to unnecessary handling stress. Undue stress makes the fingerlings weak and more susceptible to parasites and diseases.
- ▶ Fingerling size and number estimations must be done at each sorting episode. It is advisable to observe or visually gauge the size range of the fingerlings so that only the required sorting net will be used for size-grading. After sorting, clean and allow the net sorters to dry in preparation for the next sorting phase.

Counting fry/fingerlings

Every hatchery operator has his own method or practice for estimating seedstock number. In some areas, the customer can suggest the type of procedure in estimating or counting fingerlings.

By weight – this method requires the weighing of the sorted seedstock or fingerlings that already have the same size. A scoop of fingerlings is weighed and then the number of weighed fingerlings is counted. This procedure shall be done thrice and the results averaged after which the total number

of the harvested fry shall be computed from the estimate as seen in the example on the right:

This method avoids or minimizes handling stress. It has a 95% accuracy especially if sorting has been done properly and the fingerlings are almost uniform in size.

Example:

| WEIGHT | NUMBER |
|----------------|--------------------------------------------------|
| 100 gms | 176 pcs |
| 100 gms | 184 pcs |
| 100 gms | 171 pcs |
| <hr/> | |
| Average number | 177 pcs/100 g fingerling or 1770 pcs/kilogram |

Estimation by volume – here, the operator uses a small plastic scoop or dipper for estimating the number of fingerlings. Examples of containers that are commonly used are old plastic containers like a strainer, dipper, margarine tub or the scoop inside a can of an infant milk formula. Small containers or scoops can be used for small sized seedstock (fry, #32 and 22) and larger ones for larger seedstock (#17,14,12). Without weighing each scoop of fish, the operator or farm technician counts the number of fingerlings or fry that one scoop can hold. The sampling procedure is done thrice and the counts averaged. Again the accuracy of the total estimate depends on whether the sorting as well as the scooping method have been done properly.



Example:

| | |
|----------------|-------------------|
| First scoop | 234 |
| Second scoop | 211 |
| Third scoop | 227 |
| <hr/> | |
| Average number | $671/3 = 223$ pcs |



Direct counting or head count

– In this method, the fry or fingerlings are counted individually. This is usually done if the fingerlings that are to be sold are highly priced and are larger. This method is also done if there are fewer fish to be sold.

Packing and transporting fry



Another important hatchery procedure that the farm operator should be most familiar with is the proper method for packing and transporting fingerlings. If this is done properly, there would be fewer mortalities caused by handling and transport stress. Before one packs fingerlings for transport, it is suggested that the stocks be

conditioned in tanks and not fed for at least two days before the set transport date. This shall ensure that the water in the transport bags/box will not be polluted with fish excreta that may cause unnecessary stress and mortalities during transport.

Packing is done ideally in the evening or at dawn when air temperature is cooler. The time of packing is scheduled so that the estimated arrival schedule at the destination is before the break of dawn. The timing is such that the prevailing air temperature is low and the dissolved oxygen levels in the earthen pond where the fingerlings will be stocked is increasing. Hence when stocked in the grow-out pond, the newly transported fingerlings will be able to take advantage of the high dissolved oxygen as well as available natural food organisms in the pond water.

Ways of transporting tilapia fry

- ▶ **Transporting fingerlings packed in plastic bags.** This method is ideal for newly hatched fry until size 14 fingerlings. Packing fingerlings in plastic bags is also recommended for long distance transport or travel that requires a minimum of four hours. Few fish mortalities are usually encountered if fingerlings are packed and transported in plastic bags. The recommended or optimum number of fingerlings placed in a double-lined polyethylene bag depends on the size of the fish as well as the

Materials

oxygen-filled tank
plastic bag
clean water
basin
plastic sack bag
rubber band
ice
salt or methylene blue (chemical used for disinfection)

distance or duration of transport. The density used for transport is 250 pieces of 1 inch fingerlings in 4 liters of water for a maximum of 4 hours travel time. After the fingerlings have been placed in a double-lined



plastic bag, inflate the bags with oxygen at a water to air ratio of 1:3. Tie the bags securely with rubber bands. The transport bags are then placed individually either in native buri bags or in styrofoam boxes before being loaded onto the transport vehicle. To minimize mortalities due to transport problems or stress, make sure that (a) the transport bags are sturdy enough and do not have any leak and (b) the number of fingerlings stocked in each bag is based on the size of the fish and the distance or length of travel from the hatchery to the grow-out farm.

- ▶ **Transporting fingerlings by boat.** This mode of fingerling transport is suitable especially when the destination is more accessible by boat and the water tributary where the boat traverses is clean (e.g. rivers, lakes). Here, the fingerlings are directly placed in the boat's hull. The hull should have a provision where water in the river/lake is able to continuously flow in and out of the boat. This method of transport is appropriate for small fingerlings and even tilapia or carp broodstock. Moving fish by boat is not as stressful as transporting fish using a land vehicle. Transporting fish by boat allows the fish to swim more freely in the water and are not subjected to any other stress due to the movement of the vehicle.



- ▶ **Transporting fish using aerated transport boxes.** This method is normally recommended for short travel periods (4 hours or less). The transport boxes where the fish are stocked have aerators powered by the vehicle's battery. The aerators provide oxygen to the fingerlings during transport. If battery-operated aerators are not available, oxygen tanks can be used. This method allows the transport of more fingerlings than the other modes of packing and transport.



Materials

- scoop nets
- 2-3 oxygen-filled tanks
- pails/basins
- plastic tubing



Is tilapia seedstock production profitable?

According to tilapia hatchery operators, tilapia seedstock production is profitable. To give you an idea of how much profit one can earn from such an enterprise and to help potential investors in tilapia hatchery operations, an economic analysis is provided below. The estimates for total investment requirements are based on a hatchery that can produce 100,000 fry a month.

HAPA-BASED TILAPIA POND HATCHERY (production = ~350,000 fry/month)

| Technical considerations | | |
|-----------------------------------------------------------------------------|--------------------------------------------|---------------------|
| Number of production cycles (21-30 days per cycle including preparation) | | 1 |
| No. of fry per female | | 200 |
| % female broodstock that produces fry | | 80% |
| % fry available after a month from stocking spawners | | 70% |
| Production per cycle (size 22) | | 179,200 |
| Price of size 22 fingerlings | | 0.30 |
| Total production/ month | | 358,400 |
| Total sale per month (assuming all the fry are sold) | | P 107,520.00 |
| Initial investment | | |
| Fishpond construction | | 234,806.00 |
| Submersible pump | | 15,000.00 |
| Deepwell pump | | 100,000.00 |
| Sub-total | | P 349,806.00 |
| Materials | | |
| 10 pcs | 10x5x1 Hapa net | 25,000.00 |
| 10 pcs | 10x5x1 B-net | 25,000.00 |
| 5 pcs | 8x3x1 CC-net | 8,000.00 |
| 100 pcs | Bamboo poles | 5,000.00 |
| 5 pcs | 50 L Plastic basins | 500.00 |
| 5 pcs | 30 L Plastic pails | 500.00 |
| 2000 pcs | Tilapia breeders (1600 females; 400 males) | 50,000.00 |
| 2 pcs | Oxygen tank | 6,000.00 |
| Sub-total | | 120,000.00 |
| Total | | P 469,806.00 |

| Monthly operational expenses | | |
|---------------------------------------|----------|--------------------|
| 1 technician (salary) | 7,500.00 | 7,500.00 |
| 2 fishery aides (salary) | 5,000.00 | 10,000.00 |
| Petrol and electric power consumption | 5,000.00 | 5,000.00 |
| 10 sacks broodstock feeds | 400.00 | 4,000.00 |
| 12 sacks fry feeds | 500.00 | 6,000.00 |
| Miscellaneous expenses | 5,000.00 | 5,000.00 |
| Transportation cost | 5,000.00 | 5,000.00 |
| Total | | P 42,500.00 |

Initial investment

| | |
|-----------------|---------------------|
| Capital outlay | P 469,806.00 |
| Working capital | 42,500.00 |
| Total | P 512,306.00 |

| Estimated expenses for fishpond construction | | | |
|-----------------------------------------------------|------------------------------------------------|------------------|---------------------|
| Qty/Unit | Items | Unit cost | cost |
| 30 hours | Pond construction (soil digging and transfer)* | 2,800.00 | 84,000.00 |
| 12 pcs | 4" PVC Elbow | 80.00 | 960.00 |
| 10 pcs | 4" PVC Sanitary sched 40 | 350.00 | 3,500.00 |
| 4 rolls | PE pipe 3" | 7,500.00 | 30,000.00 |
| 2 | Conditioning tank | 45,000.00 | 90,000.00 |
| 1 | Shade/work area | 5,000.00 | 5,000.00 |
| 10% of total estimate | Contingencies | | 21,346.00 |
| Total | | | P 234,806.00 |

*rate for renting a bulldozer (about 5 days, 6 hours/day) = P2,800/hour

| | per month | per year |
|-----------------------------|------------------|------------------|
| Production of size 22 | 358,400 | 3,584,000 |
| Total sales | 107,520 | 1,075,200 |
| Less operational cost | 42,500 | 425,000 |
| Net profit | P 65,200 | P 650,200 |
| Return of Investment | | 127 % |

Tilapia health management

In aquaculture, fish diseases are brought about by the interaction of three components: (a) the farmed fish; (b) the organism that causes the disease; and (c) the environment and conditions that cause undue stress to the fish (e.g. poor water quality, insufficient oxygen, excessive feeding). In other words, diseases occur when the organisms that cause them infect weak or susceptible fish that are grown in poor environmental conditions. Tilapias that are affected by diseases exhibit symptoms like unusual swimming behavior, poor feeding, body discoloration, skin lesions and presence of ectoparasites, etc.

Some of the diseases that affect tilapias are as follows (Lio-Po et al. 2001) :

| Disease (Cause) | Symptoms | Prevention/ Treatment options |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Spinning tilapia syndrome or ST (<i>Iridovirus</i>) | in fry/fingerlings: <ul style="list-style-type: none"> • unusual swimming behavior (swimming in a spiral pattern, sink to the bottom then rise and hang at 45 degrees angle under the water surface • frequent gasping for air • loss of appetite • often darker in color • die within 24 h of onset | none |
| Edwardsiella septicaemia or Edwardsiellosis (bacteria known as <i>Edwardsiella tarda</i>) | <ul style="list-style-type: none"> • small (3-5mm) skin lesions found dorso-laterally on the body • skin loses pigmentation • enlargement of liver/kidney | <ul style="list-style-type: none"> • improve water quality • decrease stocking density • apply oxytetracycline at 55mg/kg fish for 10 days |
| Pseudomonad septicaemia or red spot disease (bacteria like <i>Pseudomonas fluorescens</i> , <i>P. anguillaseptica</i> , <i>P. chlororaphis</i>) | <ul style="list-style-type: none"> • small hemorrhages in the skin around the mouth and opercula and along ventral or abdominal surfaces | <ul style="list-style-type: none"> • ensure good water quality • reduce stocking density • transfer fish in a tank and raise temperature to 26-27°C for 2 weeks |

| | | |
|-----------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Saprolegniosis or Saprolegniasis (<i>Saprolegnia</i> spp, <i>Achyla</i> spp and <i>Aphanomyces</i> spp fungi)</p> | <ul style="list-style-type: none"> • presence of white (to brownish) cottony growth on fish eggs and affected tissues in adult fish • gills, eyes and olfactory pits may also be infected • affected fish become lethargic, tire easily, and become less responsive to stimuli | <ul style="list-style-type: none"> • use of <i>chemotherapeutants</i> (zinc-free malachite green, salt, or formalin) mixed into a water bath solution |
| <p>Streptococcus</p> | <ul style="list-style-type: none"> • erratic swimming • darkening body color • unilateral or bilateral exophthalmia, corneal opacity • hemorrhages on the operculum and the bases of fins • ulceration of body surface • difficulty in breathing • lose ability to orient themselves in water • eye becomes opaque, necrotic and may lead to blindness | <ul style="list-style-type: none"> • avoid overcrowding, over-feeding, and unnecessary handling • remove fish that are nearly dead to prevent wide-spread infection • apply erythromycin at 25-50mg/kg body weight of fish for 4-7 days |
| <p>Ichthyophthiriasis "Ich" or white spot disease (ciliate known as <i>Ichthyophthirius multifiliis</i>)</p> | <ul style="list-style-type: none"> • presence of many whitish/grayish spots on the skin and gills • loss of appetite • lethargic with dull, opaque or haemorrhagic eyes • heavily infested fish produce a lot of mucus | <ul style="list-style-type: none"> • increase water temperature to 30°C for 6hours daily for 3-5 days • place fish in water with 0.05% salt solution • 100ppm formalin for 1 hour for 2-3 days • 25ppm formalin + 0.1ppm malachite green • transfer infected stock in dry, parasite-freer tanks 2-3 times at 3 day intervals |

| | | |
|-------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Infestation by parasites <i>Trichodina</i>, <i>Trichodinella</i> or <i>Tripartiella</i></p> | <ul style="list-style-type: none"> • parasites attached on gills and skin of the affected fish • fish appear weak • excessive mucus production • frayed fins • presence of excessive numbers of parasites on skins and gills affect respiration. | <ul style="list-style-type: none"> • 2-3 % salt solution for 2-5 minutes for 3-4 days • 100% freshwater bath for 1 hour for 3 days. • 100ppm formalin + 10ppm Acriflavin for 1 hour for 3 days |
| <p>Infestation by <i>Argulus</i>, <i>Alitropus</i>, "anchor worm" or <i>Lernaea</i></p> | <ul style="list-style-type: none"> • parasite attached on the skin, mouth, and gills of host fish • loss of appetite • anemia • slow growth rate | <ul style="list-style-type: none"> • manual removal • 200ppm formalin bath until parasites detach from host • drying/liming of ponds for weeks • for <i>Lernaea</i>, 3-5% salt solution for the control of larval stages |
| <p>Infestation by monogenean flatworms (<i>Gyrodactylus</i>, <i>Dactylogyrus</i> etc.)</p> | <ul style="list-style-type: none"> • parasites attached on the gills, fins and body surface • affected fish have pale skin and gills with increased mucus production • frayed fins • opaque cornea | <ul style="list-style-type: none"> • maintain optimum stocking density and sufficient feeding • 5% salt solution for 5 minutes • freshwater bath for 1 hour for 3 days • 100ppm formalin for 1 hour for 3 days • 150ppm hydrogen peroxide for 30 min |

Many believe that tilapias are hardy and are not easily affected by disease causing agents. But in view of the foregoing, we have noted that there are several diseases that can affect tilapias at each growth phase. When ignored, many diseases may even cause mortalities. It is therefore important to manage the fish's rearing environment properly in order to ensure good growth and healthy conditions.

Agencies for tilapia R&D in the Philippines

- ✉ Southeast Asian Fisheries Development Center¹
Aquaculture Department (SEAFDEC/AQD)
Binangonan Freshwater Station
Tapao Point, Binangonan, 1940 Rizal
Philippines
☎ (02) 2893687
✉ bfs@aqd.seafdec.org.ph, mlcaralar@aqd.seafdec.org.ph
- ✉ Bureau of Fisheries and Aquatic Resources (BFAR)²
Department of Agriculture
3rd Flr. Philippine Coconut Authority Bldg.
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Philippines
☎ (02) 9298074, (02) 9299597
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- ✉ Philippine Council for Aquatic and Marine
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Los Baños, Laguna 4031
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¹ produces SEAFDEC-selected tilapia (SST);
 conducts training courses in tilapia breeding,
 hatchery, nursery and grow-out in tanks and
 lake cages

² produces GET-EXCEL Tilapia, conducts training
 courses in tilapia hatchery operations

³ produces FAST tilapia

⁴ produces GMT tilapia

⁵ promotes SRT (sex reversed tilapia) and
 the sex reversal method

⁶ produces red tilapia

⁷ produces GIFT tilapia

⁸ produces Jewel tilapia

⁹ produces Genomar Supreme Tilapia

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ABOUT SEAFDEC

The Southeast Asian Fisheries Development Center (SEAFDEC) is a regional treaty organization established in December 1967 to promote fisheries development in the region. The member countries are Brunei Darussalam, Cambodia, Indonesia, Japan, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. The policy-making body of SEAFDEC is the Council of Directors, made up of representatives of the member countries.



SEAFDEC conducts research on fisheries problems; generates appropriate fisheries technologies; trains researchers, technicians, fishers and aquafarmers, and managers; disseminates information on fisheries science and technologies; and recommends policies pertaining to the fisheries sector.

SEAFDEC has four departments that focus on different aspects of fisheries development:

- The Training Department (TD) in Samut Prakan, Thailand (1967) for training in marine capture fisheries
- The Marine Fisheries Research Department (MFRD) in Singapore (1967) for post-harvest technologies
- The Aquaculture Department (AQD) in Tigbauan, Iloilo, Philippines (1973) for aquaculture research and development, and

- The Marine Fishery Resources Development and Management Department (MFRDMD) in Kuala Terengganu, Malaysia (1992) for the development and management of fishery resources in the exclusive economic zones of SEAFDEC member countries.

SEAFDEC/AQD is mandated to:

- Conduct scientific research to generate aquaculture technologies appropriate for Southeast Asia
- Develop managerial, technical and skilled manpower for the aquaculture sector
- Produce, disseminate and exchange aquaculture information

SEAFDEC/AQD maintains four stations: the Tigbauan Main Station and Dumangas Brackishwater Station in Iloilo province; the Igang Marine Sub-station in Guimaras province; and the Binangonan Freshwater Station in Rizal province.

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