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Better management practices for tilapia hatcheries in Egypt

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FISH is developing the better management practices (BMP) guidelines at the global level and contextualized BMP resources at the country level to support sustainable and responsible tilapia farming in WorldFish focal and scaling countries. This country specific BMP instruction manual, produced as part of this approach, is hoped to enhance the capacity of grow-out farmers and extension service providers in Egypt to support scaling of WorldFish technologies (e.g. GIFT) and package of practices (e.g. BMPs).

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Introduction

Tilapia hatcheries are the most common type of fish hatchery in Egypt. They are nearly all private sector businesses, and their success in supplying fish farms with tilapia seed has contributed to the increase in national farmed fish production. There are three different hatchery systems used for Nile tilapia: (1) concrete tanks with a water-heating system, (2) hapas under plastic tunnels and (3) hapas in open ponds. The fish farming industry is growing quickly, and tilapia hatcheries have to improve the quality of seed production for fish farmers to maintain their profit margins. For this reason, these guidelines have been developed to document optimal, locally appropriate management practices.

Observing these better management practices (BMPs) will increase hatchery productivity and produce highly vigorous and uniform fry, free from diseases and malformations. In this way, the hatchery will be in a better position to meet fish farmers' demand for high quality tilapia fry.

BMPs emphasize the optimal use of production inputs such as good broodstock and appropriate feeds for each specific age stage. They also underscore the proper management of broodstock, collection of eggs and better nursing approaches for fry after egg hatching, including nutrition. Attending carefully to these better practices ensures that the available resources and operation elements are optimally used, without compromising the protection of the environment.

To draft the first version of this report, WorldFish Egypt organized a workshop in 2013 for private sector experts and entrepreneurs to discuss the BMPs for local tilapia hatcheries. Those BMPs are summarized in this guide.

Collecting newly hatched fry from hapas.

1. Site selection and hatchery design

Site selection

The hatchery site must be located in an area where it is legally permissible to establish the project, so as to facilitate licensing.

In addition, the following points need to be taken into account:

- The local regulation authority permits an aquaculture project to be established at this location and issues license for business when/ if needed.
- The site has access to a sustainable and sufficient source of water.
- The site is located close to fish farms for easy marketing.
- The site is accessible by paved road.
- The site has access to energy, either electricity or fuel.
- Water must be free from pollutants. Underground water is best-suited for use in fish hatcheries, if it is proven to be free from contamination.
- Make sure there is sufficient distance between the selected site and nearby fish farms to apply biosecurity measures.

Hatchery design

A hatchery should have a settling pond/basin for biological filtration/treatment of the incoming water to enrich the water source with oxygen and reduce the level of ammonia. The same pond/ basin can be used for recycling water within the hatchery if the quality of the water source deteriorates.

When designing a hatchery, the following points must be considered:

- Specify the spawning system using one of the three different hatchery systems used for Nile tilapia: (1) concrete tanks with a water-heating system, (2) hapas under plastic tunnels and (3) hapas in open ponds.
- Specify targeted annual production to define the number of brooders and fry units, as well as the required capacity of water pumps, water-heating and ventilation devices.
- Specify the number of tilapia broodstock (males and females) based on targeted annual production.
- Easy access to irrigation and drainage will facilitate operation and reduce costs.

Spawning units

I. Concrete tanks

- In Egypt, the most common design for tilapia hatcheries is the concrete tank: 8 m length x 3 m width x 1 m height.
- Each tank is supplied with an irrigation inlet (cold and warm water) and a drainage outlet at the opposite side.
- The tank's bottom slopes toward the drainage outlet and ends in a small basin (50 x 50 cm) for fry collection.
- Use an epoxy paint for the tank walls to make cleaning easier and to reduce pathogen build-up in the cracks of the cement. The epoxy paint is safe for fish.

Plate 1. Traditional concrete tanks for tilapia spawning.

- All tanks are equipped with an aeration system through hoses attached to an air blower. Narrow-meshed nets must be installed on both irrigation and drainage pipes to prevent undesirable eggs and/or fry from entering the tank.
- To facilitate tank servicing, place a wooden walkway in the middle of the tank for easy movement.

II. Hapas

- Hapas can be used for spawning or as fry rearing units. The dimensions are 6–8 m length x 2–3 m width x 1 m height.
- Hapas are fixed inside an earthen pond with wooden sticks.
- Cover the pond with a plastic sheet forming a greenhouse to raise water temperatures early in the season, making them suitable for spawning.
- At times, pond water needs to be changed, especially on hot or sunny days.
- If the water temperature is low, warm it up to the appropriate level.
- Keep dissolved oxygen levels adequate by operating a blower as needed.
- If there are predatory birds in the surrounding area, cover the hapa pond with a bird net.

Plate 2. Hapas fixed in open ponds for spawning.

Egg incubation unit (egg hatching lab)

Some hatcheries depend on collecting eggs from brooders, with a view to obtaining the largest possible number of fry during the season. In this case, the hatchery will include egg incubation vessels connected to a source of running water from bottom to top to ensure the eggs are regularly stirred until hatching takes place. Fry are then moved to the rearing units for feeding.

Plate 3. Egg incubation vessels in tilapia hatcheries.

Water heater

Most tilapia hatcheries in Egypt start operating in mid-January or early February. This allows enough time to produce seed that are ready for sale by the beginning of April, which is when the growing season begins in the farms. To stimulate spawning,

the water needs to be warmed up to 26°C. This is why a heater must be in place to produce seed at this time of the year.

Some hatcheries are equipped with automatic built-in thermostats to control water temperature. But most hatcheries use a water heater to heat water up and add it into the spawning tanks/units at night or during the day when the temperature is lower than needed.

Plastic tunnels (greenhouses)

Plastic tunnels are used in winter and spring. The plastic sheets are removed in summer. When covered with plastic sheets, the hatchery's water temperature rises by 3°C–4°C. They also help maintain water temperature in hatcheries that use water boilers. Covering with a plastic sheet is mainly done to warm up the water and enable early spawning.

Air blower

High stocking densities for fry during rearing require an aeration source, such as an air blower, especially as the fry get bigger. It is imperative to maintain a dissolved oxygen level higher than 4:5 mg/L to guarantee the highest possible growth rate during the nursing period.

Electric generator

An electric generator is necessary as a backup source of electricity to replace the main supply in case of an electricity failure. It is necessary for operating pumps and other electric appliances at the hatchery.

Plate 4. Tilapia hatcheries under plastic tunnels.

2. Broodstock selection and management

A major key to the success of any hatchery is selecting and replacing broodstock. This is done based on overall appearance, health condition and vigor. However, farmers must also take in account the following factors:

- Nile tilapia is characterized by transverse and longitudinal dark lines on the tail and back fins, starting from the beginning to the end of the fin. The fewer the number of lines or the absence thereof on the tail fin, the more probable that the fish is a hybrid with other species.
- Establishing a broodstock population with high reproductive efficiency and prolonged life requires selecting younger brooders (1–1.5 years old). Brooders should weigh 300 g on average. It is also advisable to renew the broodstock every 3 years or at the age of 4–5 years old.
- Select highly vigorous, well-fed brooders and avoid feeble or diseased brooders.
- Replace broodstock periodically to maintain their reproductive performance.
- The replacement and renovation program must outsource broodstock from different areas to avoid inbreeding, which may result in problems in fry development, such as low growth rates and malformation.

Plate 5. Nile tilapia.

Managing genetically improved tilapia brooders

When spawning a genetically improved strain of Nile tilapia, the hatchery operator must have adequate management knowledge and skills to avoid inbreeding and to maintain the genetically improved traits, such as rapid growth.

Inbreeding results from mating among closely related brooders. When a limited number of brooders is used in spawning, the chances of inbreeding increase. Inbreeding reduces the quality and immune response of fry, making them more susceptible to disease, which can lead to a higher mortality rate in seed. In addition, the reproductive performance of the brooders is reduced and subsequently their ability to produce genetically improved seed.

Good management of the broodstock requires the following:

- Regularly replace brooders (males and females) from specialized multiplication centers.
- Keep records for each batch of broodstock, including all relevant information and place of storage (tank, pond, hapa). Maintain each brooder age category separately.
- Renew the broodstock population every 3 years (i.e. generations) from the multiplication center.
- Increase the effective size of the broodstock population to minimize inbreeding.
- Breeders must recommend a female to male sex ratio of 1:1 to minimize inbreeding, especially in production strains.
- Regular communication with the strain improvement center is necessary to keep abreast of developments in the genetic improvement program of Nile tilapia.

3. Hatchery pre-spawning preparation

Before the start of the spawning season, hatcheries must make the following preparations:

- Clean brooder units and prepare to receive the broodstock before filling the units with water. Make sure that a narrow-meshed net is tightly fixed to the irrigation and drainage pipes and that the plastic sheet of the tunnel is free from any punctures or cracks.
- If the hatchery uses hapas, clean and examine them to confirm that there are no defects. Make sure that aeration hoses have been placed into the units. Prepare barrels to be used for moving female broodstock from the earthen ponds to the hapas.
- Check the efficiency of water pumps, ventilators, boilers and egg incubators. Make necessary maintenance if the need arises.
- Make sure that spawning inputs and instruments, such as nets, scoop nets and utensils, are available
- Make sure that laboratory requirements, including chemicals and disinfectants, are available.
- Procure feeds for broodstock and fry, and then store them in a well-ventilated, rodent-proof warehouse.
- Ensure easy access to fuel for operating the hatchery equipment, such as heaters, pumps and generators.

Stocking brooders

Normally, brooders are stocked into the spawning units (tanks or hapas) about 15 days before the spawning season. They are collected during the daytime when the temperature is warm, and males and females are moved separately into the hatchery. Keep males and females in separate tanks or hapas for feeding before spawning. Feeding starts as on the day following stocking. The water temperature should be raised gradually up to 26°C.

Specialized feeds must be used to compensate for weight loss during the wintering period in the earthen ponds and to accelerate ovulation and spawning.

After confirming that females are ready to ovulate, both sexes are stocked into the spawning units at a rate of 2 females to 1 male. The average weight of broodstock in each spawning unit must be kept almost equal.

Feeding brooders

Tilapia females incubate eggs in their mouth, so brooders should stop feeding them during the incubation period. The fish exhaust their internal food reserve 10–12 days from the start of egg incubation until hatching takes place. This explains why spawning is so stressful for female fish. It also justifies the need for balanced feeds to improve their reproductive capacity and to produce highly vigorous fry that are free from malformations.

The crude protein content of feed for brooders should not be less than 30%–35%. Floating feeds are currently used to reduce feed loss and maintain water quality. Feeding takes place twice a day at rate of 1%–2% of bodyweight. As the female fish start to spawn, their appetite is reduced remarkably due to egg incubation in the mouth before hatching. Such a loss of appetite is indicative of the number of brooders carrying eggs in each unit.

Plate 6. Nile tilapia, male (left) and female (right).

4. Water quality management

The hatchery's water must be appropriate for fish growth and reproduction (Annex 1). Because of this, it is advisable to analyze water from the source to detect any physical characteristics (such as clearness, turbidity, odor, temperature) or chemical properties (such as dissolved oxygen, salinity, alkalinity, pH, ammonia, nitrite, nitrate, phosphorus, potassium, pollutants).

The hatchery operator must determine the amount of water needed daily to secure the equipment necessary for replacing the water. A regular water analysis determines the most suitable approach to water quality management in the hatchery. It also helps to define when to replace the hatchery's water and use aeration equipment.

It can be useful to use underground water, where legally permissible, to make up for surface water shortage. However, the quality of the groundwater must be checked before use (Annex 1). Groundwater is preferred for tilapia spawning because the temperature is close to the optimal level for spawning. During water scarcity, operators may resort to reusing water after filtration. Water use, or reuse, must be rationalized to reflect required needs.

Water replacement

Water replacement is a function of the following:

- stocking rate (fish or fry) in ponds/tanks (fish biomass)
- quantity of fish feeds added to the rearing unit
- dissolved oxygen level in the water
- quantity of organic waste and settled solids in the pond
- water temperature.

Deteriorating water quality exposes brooders to stress and reduces their appetite. Fish held in low quality water are more susceptible to disease, which has a negative impact on their reproductive capacity.

At the fry nursery units, low quality water can lead to the following:

- low appetite and incomplete sex inversion to all male populations
- poor growth rate, production of malformed fry and declining survival rates
- sharp shortages in the level of dissolved oxygen, which can lead to higher mortality and reduced sales revenue, even financial loss of the hatchery.

Photo credit: Ahmed Nasr Allah/WorldFish

Fish tank aeration.

5. Spawning management

Spawning management starts immediately after stocking brooders into spawning units. After stocking, feeding starts along with regular cleaning of the rearing units. Water temperatures in greenhouses must be maintained around 26°C.

It is important for hatcheries to follow these measures:

- Lower consumption of feed by brooders indicates spawning and incubating eggs in the mouth of females.
- After 10–12 days have elapsed (according to temperature), collect fry from brooder basins and move them into fry rearing units. When collecting eggs from brooders, transfer the eggs into the hatching jars, where the incubation period is completed until hatching occurs. Keep the water temperature between 25°C and 28°C. After hatching, move the fry into the nursery units for hormonal treatment after absorbing their yolk sac.
- It is preferable to replace brooders after the release of eggs with similarly prepared ones for subsequent spawning. Brooders need intensive feeding to compensate for the loss of feeding during egg incubation, whereas the previously prepared brooders need only 10–12 days for spawning. Replacing brooders is intended to increase fry output at the beginning of the season and for the earlier sale of the largest possible quantity to meet the high demand at the start of season.
- When the number of fry collected from a specific spawning unit declines, replace the males in the tank with rested males.

Fry before delivery.

6. Fry nursery and monosex fry production

Larvae hatch in their first phase. They carry their with them yolk sacs and continue to feed on them for 2–3 days according to the ambient temperature. After they completely consume their yolk sacs, fry are stocked into the treatment units at a rate of 2000–3000 fry per m^2. The holding capacity of each unit is completed within no more than 1 day to avoid discrepancy in fry sizes after treatment. Any increase over this density could reduce the effectiveness of the hormonal treatment, which is calculated from the day following stocking the nursery unit.

Plate 7. Recently hatched tilapia fry during collection (top) and stocking (bottom).

Fry feed preparation

The level of protein in fry feed should not be less than 40%. Fry feed must also be rich in fats, vitamins, minerals and immunity-enhancing ingredients to feed the fry during the nursing period.

Sex reversal

Most tilapia hatcheries in Egypt produce monosex fry by applying the masculine hormone 17 α-Methyltestosterone (MT). The process of monosex production using MT hormone is not prohibited, as the European Union and United States markets allow tilapia to be imported from countries producing monosex tilapia. The ministerial decree organizing this issue states that mixing hormone with feed should be done with caution in feed mills.

The following steps describe what hatcheries must do for mixing MT hormone with fry feed:

- Train dedicated staff on health safety and wearing masks and gloves before starting feed preparation and mixing fry feed with hormone (section 13).
- Dissolve 10 g of the MT hormone in 1 L of 95% ethyl alcohol, and keep the solution in the fridge. It is good for use within 3 months.
- Grind the feed well. Particles should be fine with the diameter ranging between 400 and 1000 micrometers to suit feeding by the early hatched fry. Use a narrow screen sieve to remove the larger feed particles.
- Add the hormone at a rate of 60 mg for each kilogram of feed. Six milliliters of the standard solution is added to 0.5 L of pure alcohol. The mixture is then added to 1 kg of the prepared feed to ensure regular dispersion of the hormone throughout the feed. The feed is then spread over a clean plastic sheet in a well-ventilated place, without direct exposure to the sun. The feed layer's thickness should not exceed 2 cm to facilitate alcohol evaporation within 24 hours. By this time, the feed is ready for fry nutrition.

Feeding fry

Fry are fed with a previously prepared ration that is rich in protein and the added hormone. Fry are fed 5–6 times a day until the end of the treatment or the primary nursery period. The feed must be spread on the surface of the water of the rearing unit to give all fry equal access to the hormone-treated feed. Feeding continues for 21 days to ensure successful sexual inversion where the male ratio reaches 98%.

Fry harvest

Fry are harvested at the end of the nursing period. They are either moved to clean basins as a preliminary step before they are sold or to rearing units for growth into the fingerlings phase. When selling the fry directly from the nursing units, the hatchery operator must make sure that no waste or precipitates are found in the nursery units.

Hatcheries must carefully observe the following conditions at fry harvesting:

- Avoid harvesting/handling the fry at noon or during high temperatures.
- Grade the fry at harvest to accurately determine their numbers before sale or transportation. Avoid size discrepancies that could occur at the rearing units.
- Move the fry to the storage units in barrels or plastic basins, and avoid overcrowding to reduce stress or loss of part of the harvest during transfer.
- The size of the counting scoop net at sale varies with the size of the fry. Count a scoop sample before packaging the fry for sale. The number of fry per bag varies according to fry size and distance traveled.

Plate 8 Preparing fry feed (spread for alcohol evaporation).

7. Fry rearing for fingerling production

Larger operations with adequate areas of earthen ponds use the ponds for rearing fry into fingerlings, especially in July and August when demand is low. Fingerlings reared in this way are to be sold at the beginning of the following season when they can fetch a premium price.

Hatcheries should apply the following steps for successfully rearing fry:

- Prepare rearing units for overwintering by digging a ditch in the middle of the earthen ponds. The ditches are used by the fry when temperatures drop.
- The fry stocking rate per feddan[1] during rearing ranges between 100,000 and 300,000 fry, according to the targeted fry size and the duration of rearing.
- When stocking fry in ponds, stock them in the direction of the wind across the pond.
- At the beginning of rearing, fry are fed powdered feeds, with 30% protein, at a rate of 10% of their bodyweight. The amount of feed is gradually reduced to 5% of bodyweight by the end of the rearing period. To reduce the cost of rearing, make sure to fertilize the rearing ponds.
- Before the start of winter, increase the water in the nursery ponds or overwintering ponds to the highest level to reduce the effect of lower air temperatures on fry reared in the ponds.
- Harvest fingerlings at the end of winter/early spring to sell them at a premium price.

Photo credit: Shady Hamdy/AgriEsheeh

Putting the fry in bags.

8. Marketing

As an important hatchery management element, marketing requires knowledge of the whereabouts of fish farmers and their requirements throughout the year. The marketing function is affected by the track record and reputation of the hatchery and the results achieved at the farms that bought their seeds from the hatchery in previous years.

A successful marketing strategy requires the following:

- Avoid selling fry in hot weather.
- The number of fry per plastic bag is a function of fry size and distance to destination. When transporting to remote distances, reduce the number of fry per bag.
- Use clean water and avoid turbidity inside the plastic bags.
- Load the fry packages on the vehicle. Make sure that no protrusions exist to avoid any possible punctures.
- Fill each plastic bag with one-third of clean water. The other two-thirds are filled with oxygen. Do not use air from a blower to fill the plastic bags.
- Cover the plastic bags in the car with a sheet to protect the fry from the sun.
- In hot weather, place crushed ice around the bags to help keep them cool and avoid fry stress.
- Transfer fry or fingerlings in fridge cars during hot weather.

Source: private hatchery in Kafr El-Sheikh.

Plate 9. Marketing tilapia fry: Hapa for fry collection before sale (left) and scope fry (right).

9. Recordkeeping

Bookkeeping is an important day-to-day function at any hatchery. The basic processes at the hatchery must be recorded, together with other spawning unit data. All technical operations of brooder and fry units need to be recorded as well as the start and completion dates of hormone treatments and nursing for all units. Likewise, the tentative date of fry delivery along with the survival and feeding rates at every nursing unit should be included as well.

Hatchery records are often consulted for rapidly assessing any operational problems that could emerge at the hatchery. Records are particularly useful when new brooders are introduced from outside the hatchery to determine where to stock them and for monitoring their seed production.

Hatcheries should keep the following records:

a. Broodstock record

Year: _____ Month: _____

Unit #	Brooders			Mean Wt.		Mortality		Total	Remarks
	M	F	Total	M	F	M	F		

b. Nursery unit record for Nile tilapia fry

Batch number: _____

Hatching season: _____

Unit #	Start date	Number of fry	End date	Number harvested	M. Wt. (g)	Survival %	Remarks
Total							

c. Feeding records of brooders for each unit

Unit number: _____

Stocking date: _____

Expected date of spawning: _____

Number of broodstock (male and female): _____

Average weight of broodstock (male and female): _____

Date	Feed/day/kg	Temperature	Remarks
Feed total			

d. Fry feeding record for each unit

Unit number: _____

Date of rearing: _____

Expected date of completion: _____

Total number of fry: _____

Number harvested: _____

Average weight (g): _____

Date	Feed/day/kg	Temperature	Remarks
Feed total			

10. Biosecurity and health management

Health management of brooders and seed is another key to the success of any hatchery operation. Good health management leads to the production of highly vigorous fry that are free from disease.

Hatcheries should take the following biosecurity measures for hatchery design, management and equipment maintenance:

Design

- Consider using a wheel dip with disinfectant at the entrance to the hatchery.
- Make a footbath and hand wash available for workers and visitors before entering any hatchery unit.
- Each tank is a separate unit (each tank has its own water inlet and outlet) to avoid cross contamination.
- Build the quarantine unit away from other hatchery units.

Management

- Avoid unnecessary movement of fish or rough handling, and maintain appropriate stocking density.
- At the beginning of the season, place brooders in a 3% saline water bath for 30 seconds before being stocked.
- After collecting fry or eggs, disinfect brooders with potassium permanganate before transferring them to other units.
- Remove any dead fish immediately and dispose them properly, as they could be a source of infection.
- Send moribund or recently dead fish to a health lab for proper diagnosis and to determine appropriate treatment.
- Keep accurate records for health monitoring. These include introducing new fish, observing abnormal behavior, onset of mortalities, number of affected fish, clinical signs, applied treatment and any other factors that likely contributed to disease occurrence.
- Whenever brooders are brought in from outside the hatchery, rear them in separate rearing units (quarantined) for 1 month before stocking with the hatchery's brooders. This will help avoid introducing new disease causing agents into the hatchery. During the quarantine period, carefully monitor the health of the new stock. Handle quarantine as a separate unit. Treat drainage water coming out of quarantine and disinfect it before discharging it out of the unit.
- If brooders are imported, be sure to get a health certificate that ensures the brooders are free from pathogens of major concern.
- Maintain water quality at optimal levels to avoid stress for brooders or fry.
- Use high quality feeds for both brooders and fry. Immunity-enhancing substances can be added to the feeds to improve health and prevent malnutrition.
- Store feeds in an appropriate storehouse away from high temperatures, humidity and rodents.
- The order of movement for hatchery staff is important. Visit the youngest batch first and then the oldest batch. In addition, be sure to handle asymptomatic or apparently healthy stock first and then infected or diseased stock afterward.

Equipment

- Clean all hatchery equipment, such as plates, buckets and nets, prior to use, and then disinfect them for 60 seconds using potassium permanganate at a dose of 1 g/L.
- Keep equipment separate for each unit. If possible, each tank should have its own equipment. Also, keep specific equipment used for collecting dead fish.
- Annex 2 includes a list of common disinfectants used in a freshwater hatchery. Note that the duration of treatment varies according to dose.

11. Quality assurance

Producing good seeds is an important factor in building a good reputation for a hatchery.

The following procedures must be carefully observed to produce highly vigorous uniform-size seeds that are free from disease:

- Secure brooders from a trusted source. The strain has to meet the morphological characteristics of Nile tilapia. It is, however, advisable to procure brooders from a multiplication center for genetically improved strains.
- Replace brooders with new ones of the same species every 3 years.
- Procure hormone from a reliable source and keep it in a refrigerator.
- Use pure alcohol when preparing the standard solution for solubility of the hormone.
- Feed brooders with balanced diets to produce highly vigorous fry and to reduce loss.
- During the nursing/treatment duration, feed fry with specialized high quality and proper-sized artificial feeds to safeguard the production of highly vigorous fry.
- Prepare feeds (section 6) and keep them in the fridge until they are used to feed the fry.
- Abide by the hormone concentration (60 mg/kg of feed) to produce a monosex fry population (98% males). Note that higher concentrations of hormone could reduce sex reversal efficiency.
- Start feeding the fry with a hormone-treated feed immediately after they finish consuming their yolk sacs. Delaying feeding could entice fry to feed on natural food, which reduces the potential success of the sex reversal process.
- Feed fry on the hormone-treated feed for no less than 21 days and no more than 28.

Remarks

- A higher concentration of hormone does not reduce the period of treatment. Doing so could even reduce the efficiency of the sex reversal process for the fry.
- Reduce fry density in plastic bags, especially when they are transported to remote areas. Inject an adequate quantity of oxygen to reduce fry losses.
- Rear a sample of the fry production in units annexed to the hatchery, and examine them to confirm the percentage of males. This is a good practice for any hatchery to build its reputation and credibility.
- Good hatcheries should consider applying for certification by complying with all the requirements of either a public or private third party to get their hatchery certified.

12. General considerations for environmental protection

Any attempt to produce an all-male population through hormone treatment of tilapia fry can have negative environmental effects. The hatchery's drainage water can contain residues of the hormone, and fish in the surrounding water streams could be affected directly or indirectly, by feeding on microfauna or microflora, which increase the hormone concentration in natural fish populations. Likewise, disinfectants used at the hatchery could end up in the surrounding waterways through the drainage water.

To mitigate the environmental impact around the hatchery, the following precautions must be implemented:

- To break down hormone residues, drain the hatchery water into specially designed sedimentation basins.
- Apply disinfectants at the recommended concentrations to minimize their impact on fish and living microorganisms in the drains.
- Bury dead fish immediately. Do not dispose of them in adjacent drains.
- Manage fry feeds well to reduce feed losses and maintain the hatchery's water quality. Notice that lowering the fry feeding rate reduces the efficiency of producing monosex fry.
- Ration water use at the hatchery and apply aeration to minimize water replacement. Do not overuse water in washing the rearing units.

Collecting fry from hapas.

13. Social responsibility

Social responsibility here means strengthening the relationship between the hatchery operators and the surrounding community, including individuals, residential areas and other activities in the area.

Hatcheries should consider doing the following to strengthen their reputation within the community:

- Participate alongside the community in emergency situations that could happen in surrounding areas, and support the activities of community development associations.
- Work in hatcheries requires getting down into the water. This can negatively affect staff health, so meeting their social needs and health care requirements is imperative, not only for the laborers but also for their family members. This will undoubtedly increase their sense of belonging to the workplace.
- Train staff in the proper use of disinfectants for their own personal safety.
- Ensure that masks and gloves are readily available at the hatchery, and train staff on how to use them when dealing with or handling chemicals.
- Contribute to community development and charitable projects in the community.
- Employ labor/staff from people living around the hatchery, especially seasonal labor.
- Cooperate with other nearby hatcheries in abiding by the recommended hormone concentration.
- Dispose of waste safely to protect the surrounding environment.

Photo credit: Ahmed Nasr-Allah/WorldFish

Tilapia egg incubation in hatchery.

Notes

[1] One feddan is 4200 m2 (0.42 ha).

Annex 1. Water quality parameters

	Optimal limit
Dissolved oxygen	5–15 mg/L
TAN	< 0.4 mg/L
NH_3	< 0.1 mg/L
NO_2	< 0.3 mg/L
pH	7–9
Phosphorus	0.005–0.2 mg/L
Calcium	5–100 mg/L
Sodium	2–100 mg/L

Source: Boyd 1998.

Table 1. Optimum water quality parameters for freshwater fish farming.

Annex 2. Disinfection

Disinfectant*	**Dose and use**		
	Dipping	**Water bath**	**Indefinite**
	30–60 seconds	**60 minutes**	
Copper sulphate	500 mg/L	4 mg/L	Alkalinity level/100
Formalin	400 mg/L	250 mg/L	15–25 mg/L
Potassium permanganate	1000 mg/L	20 mg/L	2 mg/L
Madeline blue	1000 mg/L	20 mg/L	2 mg/L
Salt	3% (30 g/L)	1% (10 g/L)	0.02% (0.2 g/L)

** Always consult the local authority as permission of use of disinfectants can vary from country to country.*

Source: Noga EJ. 2010. Fish Disease: Diagnosis and Treatment (2nd ed.) New Jersey, US: John Wiley & Sons.

Table 2. Doses and use of disinfectants for treating fish in tilapia hatchery.

CGIAR

RESEARCH PROGRAM ON Fish

Led by WorldFish

About FISH

The CGIAR Research Program on Fish Agri-Food Systems (FISH) is a multidisciplinary research program. Designed in collaboration with research partners, beneficiaries and stakeholders, FISH develops and implements research innovations that optimize the individual and joint contributions of aquaculture and small-scale fisheries to reducing poverty, improving food and nutrition security and sustaining the underlying natural resources and ecosystems services upon which both depend. The program is led by WorldFish, a member of the CGIAR Consortium. CGIAR is a global research partnership for a food secure future.

For more information, please visit fish.cgiar.org