TILAPIA SEED PRODUCTION MANUAL

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Contents

Contents

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Preface

The purpose of the manual is to assist extension workers and fish farmers in applying Tilapia seed production technologies. These technologies apply to seed production in pond, tank and hapas. This manual has been developed based on results from on station at National Aquaculture Centre in Domasi and on farm trials from various fish farms across the country. It has been noted that availability of high quality Tilapia seed is one of conditions for sustainable commercial aquaculture operation. In order to produce high quality fish seed, fish farmers are urged to apply best management practices. This manual has been arranged in a step-by-step manner in the following sequence; source of broodstock, transportation of broodstock, broodstock management, broodstock selection, pairing and breeding, disease control and record keeping.

1. Introduction

Aquaculture in Malawi began in 1906, with the introduction of rainbow trout (*Onchorhynchus mykiss*) in the Mulunguzi Stream on the Zomba Plateau for angling. The use of indigenous species in fish farming began in 1956/57 with the culture of *Oreochromis shiranus*, Makumba and Chilinguni (*Tilapia rendalli*). Pond culture of these species increased with the establishment in 1957 of the Domasi Experimental Fish Farm for breeding and distribution to farmers. From the 1970s to date the sector received support from several development agencies and projects including the Food and Agriculture Organization of the United Nations (FAO), GTZ, WorldFish (then the International Center for Living Aquatic Organisms (ICLARM)), United States Aid for International Development (USAID), European Union (EU), Department for International Development (DFID), Japanese International Cooperation Agency (JICA), and the UK Department of International Development (DFID). The support from Non-Governmental Organizations (NGOs) encouraged wide adoption of fish farming in Malawi in the 1990s. Eight major NGOs have incorporated a fish farming component in their food security programmes. These NGOs include: Action Aid, World Vision International, CARD, COMPASS, OXFAM, Concern Universal, Christian Service Commission and US Peace Corps.

Despite the support from various NGOs and development partners, fish production volumes from aquaculture remain low. Intensification of aquaculture has been limited largely by lack of availability of quality fingerlings and lack of application of the best management practices in fish-rearing. In order to produce high quality seedlings, fish farmers are urged to maintain high-quality broodstock obtained from certified sources. Best management practices for sourcing and maintaining broodstock and producing high quality fry are outlined below.

2. Sources of broodstock

Broodstock should be collected from natural water bodies such as rivers and lakes. They can also be collected from selective breeding programmes. Broodstock should be selected by skilled personnel using selection criteria:

1 both males and females should range from 100 to 250g (above 15cm);

2 should be in good health;

3 without diseases, deformities and physical injuries or wounds;

4 bright in body colour, strong, swimming vigorously, and have clear side stripes.

3. Transportation of Tilapia Broodstock

Once broodstock is collected, it should be transported properly from source to the intended destination. This requires the use of appropriate equipment and competent personnel with relevant skills to ensure that fish are handled with minimum stress and injury to reduce mortalities.

Broodstock should be transported using either tanks or polyethylene (plastic) bags.

Figure 1: Packing tilapia broodstock in a truck

3.1. Broodstock conditioning before transporting

1 Keep broodstock in concrete tanks or hapas placed in pond, river or lake from where the fish is collected for 24 – 48 hours.

2 Stop feeding the fish to reduce metabolic activities. This reduces water contamination during transit.

3 Remove weak and dead fish from conditioning hapa or tank.

3.2. Transporting broodstock in tanks

1 Secure tightly the tank in the truck to avoid unnecessary movement of water when the vehicle is in motion so as to reduce fish stress.

2 Fill the tank with adequate clean water but not treated water. Use scoop nets when handling the fish to avoid injuring and stressing them.

3 Stock tank with broodstock (300-400 fish with an average weight of 150g in a 1000 litre tank) at appropriate densities depending on distance, size of fish and water temperature.

4 Cover the opening of the tank with a hessian sack tied with a rope to protect fish from direct exposure to the sun.

5 Regularly check for signs of fish stress (e.g. gasping for oxygen, erratic swimming) and replace water when travelling long distances.

6 In some cases use an oxygen cylinder fitted with a compression release valve to supply water in the tank through air stones.

7 Make sure spare oxygen cylinders and compression release valves are available in case oxygen gets depleted in the cylinder or the valve gets damaged.

Figure 2: Plastic tank (1000 litres for transporting fish)

3.3. Transporting broodstock in oxygenated polyethylene bags

1 Check for holes in the plastic bags before pouring in water.

2 Double the bags by covering one on top of the other.

3 Fill the bag with water (approximately 7 – 10 litres) (refer to Figure 3).

4 Put 10 to 15 broodstock, each weighing about 150 – 200g, in each bag.

5 Remove air from the bag by pressing the top of the bag over the water.

6 Fill the bag with oxygen from the cylinder (refer to Figure 3b).

7 Tie the bag tightly with a rubber band to trap the oxygen it has been filled with.

8 Put bags on a surface free of sand and other sharp objects before

loading into truck.

9 Count the number of bags to tally with the collected number of broodstock.

10 Clean the floor of the truck with water and use a wet sack or hapa material to act as a cushion for the bags during transit.

11 Pack the bags with fish in the truck in an orderly manner.

12 Transport the fish when it is cool, preferably early in the morning or in the evening.

13 Ensuring proper and speedy handling of the fish will result in successful live fish transfer.

Figure 3: Filling water in plastic

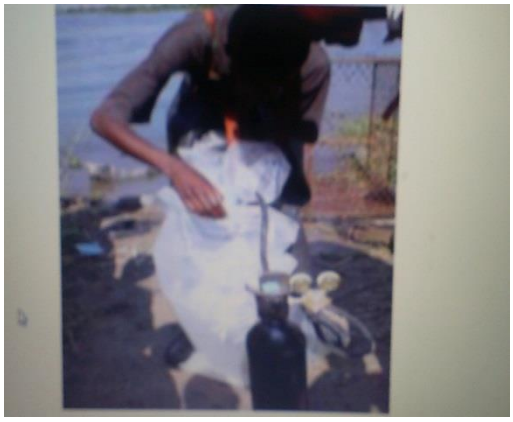

Figure 4: Filling oxygen in plastic

4. Broodstock management

4.1. Pond conditions

1 The pond water source should be stable, with good quality water flowing all year round.

2 The pond water level should be maintained at a depth of 1.2 metres.

3 The pond area should be between 400 and 1000m^2.

4 The pond dikes should be solid, without leakage, and if possible, be reinforced with cement. The dike should be at least 30cm above the ground, with draining ditches all around to prevent rainwater pouring into the pond which may ruin the dike and cause changes in water quality.

4.2. Water inlet and outlet system

1 The pond should have separate water inlets and outlets.

2 Water inlets should be covered with sieve nets of at least 180µm for screening, to prevent wild fish, frogs and other predators from entering the pond.

4.3. Predation control

Fish predation by birds is a serious problem. Therefore twine or nets should be set above the pond. Broodstock ponds should be fenced to prevent other predators such as otters, monitor lizards and frogs.

4.4. Pond preparation

4.4.1. Pond rehabilitation

1 A month before broodstock stocking, pond should be drained and exposed to sunlight to enhance pond bottom cracking, aeration and decomposition. This will also kill eggs and unwanted parasites.

2 The pond bottom and the area around the dike should be cleaned up to remove any weeds.

3 The pond bottom should be leveled for easy collection of broodstock and easy draining of the pond.

4 The whole pond area should be inspected and damages repaired, as needed.

5 Maintain the water inlet and outlet as well as the ditches, and change the screen.

4.4.2. Pond disinfection

1 The pond should be disinfected with either quicklime or chlorine.

2 Before disinfecting, the pond should be filled with water 6～10cm deep.

3 Quicklime lumps should be put into pond water using a dosage of 120g/m^2 in and allowed to dissolve and spread over the pond bottom, before the lime cools down.

4 Chlorine should be applied using a dosage of 15-20 mg/litre of water.

5 These dose ranges depend on agro-ecological zone.

4.4.3. Pond filling

A day after disinfection, pond should be filled with water to a depth of 1.2m.

4.4.4. Water testing

Seven days after filling the pond, check if the water is conducive for fish survival.

Water testing method: Put a small hapa into the pond and stock about 10 fish in the hapa; after 24 hours, if the fish survive, then broodstock should be stocked.

4.5. Stocking density

Stock 3 fish/m^2

Before stocking, bathe the broodstock in 3~5 per cent salt solution (5g of salt in 1 litre of water) for 10~15 minutes to remove parasites.

4.6. Feeding

Broodstock should be fed twice a day at 8:00 - 9:00 am and 3:00 - 4:00 pm. The feed should contain between 25 per cent crude protein (CP) and 28 per cent CP, and the daily feeding rate should be 3 per cent of the total body weight.

4.7. Daily management

4.7.1. Pond Monitoring

1. The pond should be monitored every morning and afternoon to check the following: water colour and activity levels of the broodstock.
2. During monitoring, pay attention to water quality and broodstock activity, and record the following parameters, temperature, dissolved oxygen and pH.

3 If broodstock are gasping for air on the pond surface, add fresh water.

4 Chase birds or other potential predators away until there are no fish gasping for air.

4.8. Record keeping

During the whole rearing period for broodstock, records should be kept including broodstock source, species name, stocking density and date, feeding amounts and times, medication usage, water temperature, dissolved oxygen and pH.

Table 1: Record sheet for seed production in pond/tank/hapas

Date	Pond/ Tank /Hapa No.	Water Condition				Stocking		Mortality (No.)	Feeding amount (kg)	Medication used	Remarks
		Temp	pH	D.O.	Level (cm)	Species	Density				

5. Selecting Broodstock for Breeding

1 Select the fast growers with no injuries, free of diseases, bright in body colour, healthy and strong in appearance, swimming vigorously, and having clear side stripes.

2 Separate the males and females into different ponds for conditioning. The number of males and females reserved should be 1.5 times the amount needed for breeding.

3 A total of 150 tilapias should be selected at random, their weight and length measured to get average values; then the average value should be used to select the broodstock.

6. Pairing and breeding

6.1. Pond requirement and preparation

The requirements and preparation methods for breeding pond is the same as for conditioning pond (refer to 4.1).

Protection facilities

1 Prepare reed mat 100cm high,

2 Bury 20cm of mat tightly into the pond dike;

3 Use wooden stakes as poles for holding the fence,

4 Set up a polyethylene net over the pond to prevent bird predators.

Figure 5: Fencing around the pond dike

6.2. Set-up breeding hapas

Set hapas in the pond parallel to each other, east-west direction to maximize utilization of sunlight. The hapas should be 2 metres away from the pond edge. Hapas should be 20m×6m×1m in size with 250µm mesh size. The total area of hapas should not be more than 50 per cent of the pond area. When setting up more than one hapa, make sure the space between every two hapas is more than 1.5m.

6.3. Pairing

Only one species of tilapia should be bred in one pond to avoid cross breeding.

During the peak breeding season (September to December) every year, broodstock should be paired by stocking two females for every single male (2:1 ratio). After this period change the pairing to three females for every two males (3:2 ratio).

Three stage method for pairing of broodstock

Stage one: separate males and females, species, clear out eggs and fry. Several people can do this step.

Stage 2: Check the brooders again to ensure that they have a bright colour, clear stripes, are swimming vigourously and have a healthy appearance. Two to three technicians should do this. Repeat the separation of males and females.

Stage 3: Repeat as above on the brooders selected from Stage 2. Repeat selection by fish characteristics, sex and species. This stage should be managed by one experienced technician. The breeders selected can then be put in the pond or hapa for fry production.

Note: do not put pressure on or injure the fish while handling them. This approach will help ensure purity when breeding and accurate crosses if using interspecies crosses.

For the third stage it is very important that the technician is very competent and can be sure not to make mistakes.

6.4. Feeding

Feed broodstock twice a day at 8:00 - 9:00am and 3:00 - 4:00pm. The feed should contain 25 – 28 per cent crude protein. The daily feeding rate is 2 per cent of the total

body weight. Fresh feed (sweet potatoes, tender maize leaves, tender banana leaves and cabbages) should be fed once every 15 days.

6.5. Daily management

6.5.1. Water quality management

The pH of the pond water should be maintained between 6.5 and 8.5. If the pH is outside this range apply quicklime using a dosage of 10g/$m^3$and change 10 per cent of the pond water every week.

6.5.2. Pond monitoring

Pond monitoring should be done as in 4.7.1.

6.6. Fry collection

6.6.1. Fry collecting time and methods

1 Collect fry after they start to appear. Thereafter, collect fry once every 7 days in the morning to avoid disturbing egg incubation.

2 Drive the broodstock and fry to one end of the hapa;

3 Leave them for 3 minutes;

4 Use a 250µm mesh size net to collect the fry on the water surface;

5 Use a 4,000µm mesh size net to move the broodstock to the original hapa, and finally collect all the fry that are left.

Figure 6: Collecting fry from a hapa

6.6.2. Fry handling

1 Put all the collected fry into a small hapa with a 250µm mesh;

2 Remove the debris from the hapa;

3 Grade them using small nets to rear different sizes separately;

4 Disinfect the fry with copper sulphate solution at 8 mg/litre for 20 – 30 minutes 3~5 per cent salt solution (5g of salt in 1 litre of water) for 10 ~ 15 minutes to prevent and treat trichodiniasis.

5 Count the number of fry using a beaker or cup as follows:

- Collect fry using a beaker three times
- Count fry at each time of collection
- Find the average number of fry per beaker or cup
- Count number of beakers or cups
- Calculate the total number of fry by multiplying total number of beakers with average number of fry per beaker or cup.
- After counting, stock fry in the ponds, hapas or tanks for

rearing.

7. Disease control

The following section covers some of the common diseases and parasites found on fish farms, and how to prevent and treat outbreaks.

7.1. Trichodiniasis（Trichodina spp. &Trichodinella spp.）

7.1.1. Epidemic situation

The disease usually becomes when water temperature is around 18℃ - 22℃. It often occurs in fry and fingerling rearing ponds. The higher the density, the faster the infection. The infected fish will turn black in colour and thinner in appearance, and will not feed. Stimulation from parasites will cause the fish to surface and their gills to secrete a lot of mucus, when the condition is severe, a layer of white nebula (white spot) can be seen on the body surface of fingerlings. Sometimes the fish group will swim along the pond edge. When parasites occur on the body surface of fry, the fish head and mouth will turn slightly white.

7.1.2. Prevention measures

1 Soak fish in 8mg/litre of copper sulphate solution for 20 to 30 minutes.

2 Soak in 3 - 5 per cent salt solution for 10 to 15 minutes.

7.1.3. Treatment methods

Add 0.8mg - 1.0mg/litre mixture of copper sulphate and ferrous sulphate (5: 2) to the whole pond, once every day or once every two days.

7.2. Dactylogyriasis (Dactylogyrus spp.)

7.2.1. Epidemic situation

The disease spreads through eggs and larvae, and is common when temperature is around 20℃ - 25℃.

Dactylogyrus usually can destroy fish gill filaments, causing mechanical damage to the filament tissue and increased mucus. When being intensively parasitized, the fish will swim slowly, the operculum opens, mucus increases, gilllamella become all or partially pale, there is difficulty in breathing, obvious gill swelling, fish weight loss, sunken eyes, gills partially congested and ulcerated, with white or colourful spots on gilllamella and gill raker surface due to heavy infestation of the parasites.

7.2.2. Prevention measures

1 Clean the pond thoroughly and maintain good water quality.

2 Before stocking, soak the fingerlings into 20mg/litre potassium permanganate for 5 – 30 minutes.

7.2.3. Treatment methods

1 Mix 0.5 mg of copper sulphate with 0.2 mg of ferrous sulphate and dissolve in 1 litre of water (0.7mg/L), and spread through the whole pond.

2 Or disperse 3mg/L potassium permanganate through the whole pond.

7.3. Gyrodactyliasis（*Gyrodactylus spp.*）

7.3.1. Epidemic situation

There is no obvious symptoms of this disease during the early stage; when severe, gill tissues and skin will be damaged, there will be bleeding, and the infected fish become restless and swim slowly, with mucus discharge on the gills and skin. The fish eventually die of dyspnea (difficulty in breathing). This disease usually cause mortality on a large scale. *Gyrodactylus* reproduce optimally when temperature is around 20℃, usually when the rainy season begins. The gills, skin, fins, sometimes even the mouth and nostrils are mostly affected by this parasite.

7.3.2. Prevention measures

1 Clean the pond thoroughly and maintain good water quality.

2 Before stocking, soak the fingerling into 20mg/litre of potassium permanganate for 15 - 30min.

7.3.3. Treatment methods

1 Add 3mg/L potassium permanganate to the whole pond.

2 Mix 0.5 mg of copper sulphate with 0.2 mg of ferrous sulphate and dissolve in 1 litre of water (0.7mg/L), and spread through the whole pond.

7.4. Saprolegniasis（Saprolegnia spp.）

7.4.1. Epidemic situation

At the early stage of the disease, symptoms such as inflammation and white mucus discharge on the skin and can be seen with the naked eye. The growth of hyphae will

cover the lesions with a lot of white or off-white mycelium, like cotton wool. When it is severe, the mycelium can cover the whole body within 24 hours, causing swimming disorders, loss of appetite, even no feeding at all and death from emaciation (excessive loss of weight) and weakness. The disease occurs when water temperature is about 20℃; the severity is related to the extent of the injury and fish physique, and usually it occurs selectively rather than to all the fish.

7.4.2. Prevention measures

1 Be cautious during aquaculture management, harvesting, carrying and transporting, and avoid fish injuries.

2 When stocking, bath the fry with 2 to 4 per cent sodium chloride for 5-10 minutes.

3 When it's cold, disinfect the pond with quicklime at 15-30g/m^2 before stocking or salt solution (5g of salt in 1 litre of water) for 10~15 minutes.

7.4.3. Treatment methods

Mix 400mg of salt solution with 400mg sodium bicarbonate (baking soda) and dissolve in 1 litre of water (1:1 ratio) and spread to the whole pond.

7.4.4. Calculation of pond water volume

Before calculating drug dosage, one needs to know the pond water volume using the following formulae.

i. Rectangular pond

$$V = L * W * D$$

$$where\ V = Volume\ of\ water\ in\ pond\ (m3)$$

$$L = Length\ of\ pond\ (m)$$

$$W = Width\ of\ pond\ (m\ )$$

$$D = Depth\ of\ water\ in\ pond$$

ii. Circular Tank/Pond

$$V = \pi r^2 \mathrm{d}$$

$$where: V = Volume\ of\ water\ in\ \ pond\ (m3)$$

$$\pi = 3.14 \text{ or } 22/7$$

$$r = Radius\ of\ pond\ (m)$$

$$d = Depth\ of\ water\ in\ pond\ (m)$$

The mean water depth is the average of the water depths of several different sites in the pond.

7.4.5. Calculation of drug dosage

1 Drug dosage for spreading the whole pond (mg) =Pond water volume (m^3) × Drug concentration (mg/L) ×1000

2 Drug dosage for dipping bath (mg) = Volume of water used (m^3) × Drug concentration (mg/L) ×1000

8. Record keeping

Keep records during the whole breeding period, including brooder source, surviving species name, stocking, feeding amounts and times, drug use, water temperature, dissolved oxygen levels, pH, and pond patrol observations.

Table 2: Record sheet for seed production pond/tank/hapa

Date	Pond/ Tank/Hapa No.	Water Condition				Stocking		Mortality (No.)	Feeding Amount (kg)	Medication use	Remarks
		Temp	pH	D.O.	Level (cm)	Species	Density				