Government of Malawi

TILAPIA GROW-OUT MANUAL

ULIMI WA NSOMBA ZA CHAMBO

Contents

Acknowledgements

This technology manual was produced as an output of the Working in Partnership for Agricultural Technology Transfer (AgriTT) project. AgriTT was a partnership between the UK Department for International Development, the Governments of Malawi, Uganda and China. The manual was developed by Chinese technicians and tilapia system experts in collaboration with Malawian counterparts. Various people are thanked for their contributions towards the production of this manual and these include the Chinese experts: Mr Chen Zhong and Mr Lu Ya; the Director of Fisheries (Mr A. Bulirani), Senior Deputy Director of Fisheries, Dr Steve Donda; Assistant Directors of Fisheries, Mr O. Kachinjika and Dr F. Njaya; senior technical staff at Headquarters: B.B. Chirwa, A.D. Pulaizi and S.B. Unyolo; members of staff at the National Aquaculture Center, Dr H. Zidana, Messrs. J. Kandapo, D.G. Mbamba, H Sainani, W. Chirwa and Mrs U. Banda; staff at Lilongwe University of Agriculture and Natural Resources: Dr W. Jere, Dr D. Kassam and Dr D. Sikawa.

Preface

The purpose of the manual is to assist extension workers and fish farmers in applying tilapia grow-out production technologies. These technologies apply to grow-out production in ponds. This manual has been developed based on results from on station trials at National Aquaculture Centre in Domasi and on farm trials with various fish farms across the country. This manual has been arranged in a step-by-step manner in the following sequence; pond requirements, pond preparation, fingerling stocking, feeding, pond management, disease control, harvesting, disaster management and record keeping.

1. Introduction

Most production systems to date in Malawi have been low input and low output. Rearing technologies introduced by Chinese technical experts through the AgriTT project have been shown to increase yields significantly. This manual outlines the grow-out rearing technologies that have been developed.

There are several technologies for grow-out fish production; these include technologies for ponds, cages, tanks and raceways. However, this manual focuses on pond culture. Successful tilapia grow-out is dependent on use of quality seed, feed and application of best management practices. This manual therefore outlines step by step procedures for raising of tilapia production in ponds.

2. Pond requirement

- Pond sites should be accessible and convenient for transportation of inputs and products, well exposed to prevailing winds and sunward with no barriers such as big trees or high buildings around.
- Pond areas should be over 1,000m^2.
- Pond dikes should be solid and water-holding, can be cemented if conditions permit; should be at least 30cm higher than ground level or equipped with drainage ditches all around.
- Water sources should be underground springs or stream, rivers and lakes, stable, of good quality, flowing all year round and the water level should be maintained for at least 6 months per year.
- Ponds should be equipped with separate water inlet and outlet systems; water inlets and outlets should be covered with a 180μm sieve net for screening so as to avoid entry of wild fish into the culture pond.
- Water levels should not be less than 1.5 metres deep.

3. Preparations before stocking

3.1. Pond preparation

1 A month before fingerling stocking, drain the pond and expose it to sunlight;

2 Inspect the whole pond area and repair any damage in good time;

3 Clean up weeds at the bottom and around the dike;

4 Level the pond bottom;

5 Maintain the water inlet, outlet as well as the ditches and screens;

6 Set twine or net above the pond to prevent birds.

3.2. Pond disinfection

1 Disinfect the pond with either quicklime or chlorine;

2 Fill the pond with water to 6 – 10 cm deep;

3 Put quicklime lumps into the pond water to dissolve; these should all over the pond bottom before the lime cools down.

3.2.1. Dosage of quicklime

1 Pond with water about 0.5m depth: 200g/m^2.

2 Pond with little water about 10cm depth: 100 g/m^2.

3.2.2. Dosage of chlorine

Dosage for chlorine is 15-20 mg of chlorine per litre of water.

3.3. Pond filling

A day after pond disinfection, fill the pond with water to a depth of 1.2m.

3.4. Pond fertilization

Five days before stocking seed, fertilize the pond with chicken manure at 200g/m2.

3.5. 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 seed should be stocked.

3.6. Checking for predators

Use a 380µm sieve net to screen the pond for frogs and tadpoles. This should be repeated two or three times.

4. Fingerling stocking

4.1. Selection of stocking size

Stocking size of the fingerling is closely related to the water source, planned output target, culture period and market size. It also relates to climate of the culture area, growth period, stocking density and mode of fish farming. In principle, it is better to stock bigger fingerlings, but the cost, transportation and survival rate must be considered. In one pond, tilapia fingerlings to be stocked must be of uniform size (individual difference should be controlled within 10 per cent). It is recommended to stock fingerlings which are bigger than 5g/piece.

4.2. Stocking density

Stocking density can be calculated from the following formula: N=W/ (G ×a)

Where: N = Density (no. of fish/m2)

W = Expected weight per unit area at harvest (Kg/m2)

a = Survival rate (%)

G = Expected average individual body weight at harvest (Kg)

Example on Stocking Density

W=0.5 Kg/ m^2 (i.e. 5 tonnes/Ha)

a=90% (i.e. 0.9)

G=0.1 Kg

N=W/ (G ×a) =0.5/ (0.1×0.9) =5.55 (individuals/m^2)

Examples of number to be stocked in a pond

Number to be stocked in a pond = Pond area (m^2) * N

1) When pond area = 1000 m^2

Therefore, number to be stocked = 1000×5.55=5500 individuals

2) When pond area = 500 m^2

Therefore, number to be stocked = 500×5.55=2750 individuals

Notes

The following points should receive special attention during stocking:

1 Handle the fingerling carefully and gently to avoid injuring them;

2 Fingerlings to be stocked in the same pond should be of uniform size, healthy and with no injuries or diseases;

3 Stock in the morning and at the windward side of the pond.

4.3. Fingerling conditioning

When fingerlings arrive at the destination and if tight oxygenated plastic bags were used for transportation:

- Unload the bags and put them in the shade for about 15 minutes;
- Put the bag into pond water and keep spraying it with water;
- Open the bag after 10 min and gradually let pond water into the bag until the water temperature is basically the same;
- Release the fingerlings into the pond.

If canvas bags or cans were used during transportation:

- let them stand still for 10 to 15 minutes;
- then gradually add water into the can with artificial or mechanical method;

When the water temperature in the can becomes similar to the pond water temperature, release the fingerlings into the pond.

5. Feeding

5.1. Calculation of feeding amount

Annual feeding amount calculation

The following formula can be used: Q=PrKA,

Where：

Q= Annual amount of a certain feed (kg)

P= Yield of the feeding fish in the pond (kg/m^2)

R= Proportion of this feed (%)

K= FCR of this feed

A=Total area of the pond (m^2)

For example, two feed types will be fed in the pond (i.e. Maldeco feed & maize bran)

P=0.5 kg i.e. 5 Tonnes/ha

r Maldeco=80%

K Maldeco=1.5

A=1000 m2

r bran=20%

K bran=8

The “Q” should be calculated as following:

Q Maldeco=0.5×0.8×1.5×1000=600kg

Q bran = 0.5×0.2×8×1000=800 kg

Distribution of monthly feeding amount

During one culture cycle, the monthly feeding plan is made based on the temperature, growth performance and feed supply for each month. Table 1 is a reference monthly feeding rate.

Table 1: Reference feeding rate

Month	Dec	Jan	Feb	Mar	Apr	May	June
Monthly amount/ yearly amount (%)	5	10	15	20	20	20	10
Daily feeding times	3-4	3-4	2-3	2-3	2-3	2-3	2-3

Daily feeding amount

Fish should be fed 4 to 6 per cent of the fish body weight up to 2 months, and 1.5 to 3 per cent for the rest of the grow-out period.

Daily feeding amount＝total weight of all pond fish × feeding rate

The feeding amount is appropriate if the feed can be eaten up within 15 to 20 minutes and about 80 to 85 per cent of all the fish can have enough. Refer to Table 2 for daily feeding times.

5.2. Feeding method

Feeding should start from the second day of stocking. Use special compound feed for seed with 35 per cent crude protein or higher, or use grow-out fish feed after grinding or soaking.

Apply four “fixed” principles which include:

i) Fixed quality: the compound feed used should be nutritionally comprehensive, with suitable pellet size, good palatability and should be stable in water; decayed feed should be avoided;

ii) Fixed quantity: daily feeding rate is usually around 5 ~ 8 per cent of total fish weight, and should be eaten up within 30 minutes;

iii) Fixed time: feed twice every day, between 8:00~9:00 and 15:00~16:00;

iv) Fixed site: select a relatively central site near the pond edge where passage is convenient, as the fixed feeding site.

Three “observation” principles include:

i. Observing weather: when it is sunny and the dissolved oxygen (DO) is favourable in the pond water, feed more; while when it is cloudy and rainy, DO condition is not favorable, feed less; when it's stuffy without wind and a thunder shower is expected, stop feeding. When the weather changes suddenly, the appetite of the fish will decrease and feeding should also be decreased.

ii. Observing water quality: feed more if the water quality is good, moderately fertilized, brown or glossy dark green in color and the fish feed vigorously; if the water is over fertilized, too thick, and water quality is poor such as when water color turns black, feed less and add or change water in time. Stop feeding when water deteriorates and fish come to the surface gasping for air.

iii. Observing fish conditions: check the feeding place when monitoring the pond every morning and evening, and find out the feeding situation of the fish. If the feed is eaten up soon after feeding, then feeding amount should be increased appropriately; if the feed is not eaten up for a long time after feeding, then the amount should be reduced accordingly.

5.3. Feeding techniques

Use a "slow-fast-slow" and "little-more-little" feeding technique when feeding. This means, at the beginning of feeding when only a few fish have gathered at the feeding place, one should feed little and slowly, but when most fish come to the site, one should feed fast and more, and scatter the feeds to a larger area to satisfy the feeding needs of all fish. After a while when about 50 per cent to 60 per cent of fish have eaten enough, one should slow down and reduce feeding gradually until feeding is stopped totally when 80 per cent to 85 per cent of fish have had enough. With this method, one can save the feed cost, promote the balanced growth of all fish, avoid big fish suppressing small fish, reduce injuries from smashing with each other, prevent disease outbreaks, and finally obtain higher economic benefits.

5.4. Acclimatization

5.4.1. Selection of feeding site

Feeding sites should be fixed at the relative central, deep, and windward place where it's convenient for access with feed.

5.4.2. Feeding platform

Set a feeding platform about 3m long from pond edge toward the pond centre, so that the fish can access feed from a broad area. This reduces the chances of hypoxia caused by fish competing for feed and avoids over-crowding during feeding which might damage pond dikes.

Figure 1: Feeding platform

5.4.3. Training fish to feed

A few days before normal feeding, use a semi-starvation method to domesticate the fish. Before feeding, first make sounds by splashing water or knocking barrels to stimulate the fish schools, then give a handful of feed, repeat this at about a dozen seconds intervals, and altogether take about 20 to 30 minutes as one training session. Fish domestication requires patience and diligence, and should be insisted on whether fish are feeding or not. After one week of acclimatization, the fish are very likely to have a conditioned reflex, and gradually develop the habit of clustering to the fixed point to feed.

6. Daily pond management

6.1. Water management

The time and volume for water to be added depends on the water fertility, fish growth rate and weather conditions. Pond water depth should be maintained between 1 to 1.5 metres during the culture period.

6.2. Pond monitoring

1 Monitor the pond in the morning to measure DO, water colour, water quality, fish activity, and thus determine the feeding amount, fertilizer amount and the need to add water, and also to check if there is any water leakage or if fish have escaped.

2 Remove frog eggs, tadpoles and weeds as soon as they are seen.

3 During the rainy season, pay attention to the water level and inspect the fish and remove any materials that may block the water outlet.

4 Add fresh water when it is necessary. Use a 180 µm sieve net to ensure that no wild fish or other predators enter the pond when water is being added.

7. Disease control

Disease control is one of the important aspects in pond fish culture, which determines the success or failure of aquaculture. Thus we should follow the principle of “comprehensive prevention, active treatment and prevention first”.

The following are some of the common diseases and their treatment.

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

Epidemic situation

The disease usually becomes common during the rainy season when water temperatures are between 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. The stimulation from the parasites will cause the fish to surface and their gills to secrete a lot of mucus, and when it’s severe, a layer of white nebula (white spot) can be seen on the body surface of fingerlings. Sometimes fish groups will swim along the pond edges. When the parasite occurs on the body surface of fry, the fish head and mouth will turn slightly white.

Prevention measures

1 Soak in 8mg/L copper sulphate solution for 20 to 30 minutes;

2 or soak in 3%~5% salt solution for 10 to 15 minutes;

3 or a dipping bath with 80mg/L formalin for one hour.

Treatment methods

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

7.2. Dactylogyriasis (Dactylogyrus spp.)

Epidemic situation

The disease spreads through eggs and larvae, and is common during the rainy season when temperatures are around 20 ℃~ 25 ℃.

Dactylogyrus 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, gill lamella becomes 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 gill lamella and gill raker surface due to heavy infestation of the parasites.

Prevention measures

1 Clean the pond thoroughly and maintain good water quality.

2 Before stocking, soak the fingerlings in 20mg/L potassium permanganate for 15 ~ 30 minutes.

3 Use a dipping bath with 80mg/L formalin for one hour.

Treatment methods

1 Add a 0.7mg/L mixture of copper sulphate and ferrous sulphate (5: 2) evenly to the pond.

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

7.3. Gyrodactyliasis（Gyrodactylus spp.）

Epidemic situation

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

Prevention measures

1 Clean the pond thoroughly and maintain good water quality.

2 Before stocking, soak the fingerling into 20mg/L potassium permanganate for 15 ~ 30 minutes.

3 Use a dipping bath with 80mg/L formalin for one hour.

Treatment methods

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

2 Add 0.7mg/L mixture of copper sulphate and ferrous sulphate (5:2) evenly to the whole pond.

7.4. Saprolegniasis（Saprolegnia spp.）

Epidemic situation

At the early stage of the disease, symptoms such as inflammation and white mucus discharge on the skin 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 mainly in the rainy season when water temperatures are 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.

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 is cold, disinfect the pond with quicklime using a dosage of 15～30g/m2 before stocking.

Treatment methods

400mg/L salt solution and 400mg/L sodium bicarbonate (baking soda) should be mixed add evenly to the pond.

7.5. Calculation of drug dosage

Calculation of pond water volume

When adding drugs to the pond, the pond water volume must be accurately calculated. Thus the length, width, water depth of a rectangular pond, and the radius of a round pond should be measured to calculate the volume with the following formulae.

Water volume of a rectangle pond (m3) = Length (m) × Width (m) × Mean water depth (m)

Water volume of a round pond (m3) = 3.14×r2×Mean water depth (m)

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

Calculation of drug dosage

Drug dosage for spreading the whole pond (mg) =Pond water volume (m3) × Drug concentration (mg/L) ×1000

Drug dosage for dipping bath (mg) = Volume of water used (m3) × Drug concentration (mg/L) ×1000

8. Daily recording

Keep daily records on tilapia grow out

Table 2: Water management

Date	Pond #	Pond size (m^2)	Species	Lime application (kg)	Fertilizers		Water Colour	Seicchi Disk visibility (cm)	Remarks
					Type	Wt (kg)			

Table 3: Fish stocking

Date	Pond #	Pond size (m^2)	No. of fish stocked	Total wt (kg)	Species	Mortality	Replacement	Remarks

Table 4: Amount of feed used in Kg

Week # since stocking	1	2	3	4	5		6	7	8	9	10	11	12	13	14	15	16
Kg																	

Table 5: Fish harvest

Date	Pond #	Pond size (m2)	No of fish harvested	Total wt (kg)	Fish consumed	Fish sold (kg)	Remarks

Table 6: Fish diseases

Date	Tank /Hapa No.	Species (Strain)	Production (Stocking Date)	Name of Disease	Name of drug	Consistence	Dosage (g,ml)	Person Resp.	Remark

9. Harvesting

In staggered stocking and harvesting, according to individual size, select the seines with appropriate mesh size, harvest the bigger fish and leave behind the smaller ones. If the mesh is small, after gathering the fish, one should add the small fish gently back to the pond, avoiding fish mortalities caused by crowding fish together for too long.

Tilapia harvesting should follow the principle of "market-oriented and balanced marketing". Malawi has a warm climate, with annual average water temperatures above 20 ℃, thus as long as water sources are guaranteed, tilapia farming can be done all the year round. Yet in May and August, it is relatively cold and dry. Ponds without water sources will gradually dry up, thus it is imperative harvest these ponds, this can result in over-supply of tilapia on the market, lower prices and less profit for farmers. Therefore, if conditions allow, farmers should avoid harvesting during this period.

10. Managing natural disasters and extreme weather events

In Malawi, aquaculture can easily be affected by natural disasters or extreme weather events. There is the risk of flood during rainy seasons and risk of drought during the dry season, and when severe, farmers might make nothing from aquaculture. Nevertheless, preparations can be made to reduce risks and economic losses.

10.1. Precautionary measures before natural disasters

i) Pay attention to the weather forecast, and keep abreast of extreme weather information and alerts;

ii) Before extreme weather, the marketable size fish in the pond should be harvested and sold at the right time, to avoid losses when disaster strikes;

iii) Aquaculture buildings and infrastructure should be reinforced and leakage avoided;

iv) Before extreme weather events, the DO in the pond water is generally low, thus close attention should be paid to water quality changes to avoid tilapia gasping for air due to hypoxia;

v) Before extreme weather events, appropriately lower the water level in tilapia ponds, because heavy rains will cause the water level to rise. Lowering the water level at the right time can effectively prevent tilapia from escaping when the water level becomes too high;

vi) Reinforce the pond dikes. Before disaster, inspect the pond dikes, heighten or reinforce those dikes which are too low or too thin to avoid breakages, and thereby prevent dikes bursting and leaking when water levels rise;

vii) Before extreme weather events, add nutrients such as vitamin-C complex into the feed, to enhance the anti-stress capacities of the farmed species;

viii) When a disaster is coming, monitor ponds more frequently, so as to find and solve problems in good time.

10.2.Timely recover the production after extreme events

After a disaster, inspect the farm in time to find out the impact and make efforts to recover production:

i) If there is any pond damage, clean up the debris in good time and remove dead fish to avoid environmental pollution or disease. Repair the damaged pond in time so as to resume production as soon as possible;

ii) For those ponds without damage, the primary task is to control the reproduction of pathogens. Disinfectants such as quicklime should be spread at the right time to improve the water quality.

iii) Disinfect fish with drugs in good time, to prevent secondary diseases such as skin ulcers and fungal infections caused by abrasion of fish bodies.

iv) For the disinfected pond, proper DO levels should be ensured. If it is convenient for filling and draining, replace part of the pond water with fresh water, and add fertilizer in timely fashion to the pond to stimulate natural food production in the pond which in turn enhances fish growth.

v) Nutrients such as vitamin C complex can be added to feed so as to enhance the anti-stress capacities and resilience of tilapia after disaster or extreme weather events.