ThinkAqua: Phase 1 Pond Farm Master Training Programme

Workshop Manual: The beginning of a pond production cycle: Pond preparation, fingerling stocking, & the first month - getting a good start

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Enabel THINKAQUA RAB RWANDA RARICO Rwanda Animal Resources Improvement Cooperative

Disclaimer: The information and procedures described in this manual are standard and widely carried out by fish farmers all over Africa. There are certain procedures which involve the handling and use of potentially harmful chemicals. For carrying out these safely, specific health and safety measures are clearly indicated. We urge readers to take all necessary precautions for safe use of these chemicals. ThinkAqua take no responsibility for any health or other conditions caused by following procedures in this manual.

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Figure 1 Pond preparation

Acronyms including key *Kinyarwanda* translations

ABW	Actual body weight
Acidity	*Ubusharire*
Alkalinity	*Ikinyuranyo cy'ubusharire ku gipimo cya pH.*
Av body wt	Average body weight per fish from test weighing
C	Carbon
Ca	Calcium
Cbm / cu m	Cubic meter, meterokibe.
CP (%)	Crude Protein (as %)
cm	Length: centimetre
Cow dung	*Amase*
DAP	Fertiliser: Diammonium Phosphate
Fish production cycle	*Igihembwe cy'amafi*
FCR Food Conversion Rate	*Ingano y'ibiryo ifi iriye ngo ipime garama 100.*
g	Weight: grammes
H	Hydrogen
kg	Weight: kilogrammes
Lime	*Ishwagara*
m	Length: metres
m^2	Area: metres squared or sq m
m^3	Volume: metre cubed cu m
N	Nitrogen
Neutral (as in pH)	*Igipimo mberabyombi*
NPK	Fertiliser: Nitrogen Phosphorous Potassium
0	Oxygen
% percentage	*Ijanisha. Kinyarwanda*
pH	Measure and scale of acidity and alkalinity
SR (%)	Survival Rate (as %) of fingerlings/fish
TSP	Fertiliser: Triple Super Phosphate
Urea	Fertiliser: Nitrogen based H_2NCONH_2
°C	Temperature: Degrees centigrade

Figure 2 Productive Green pond water – this will make your tilapia grow!!

Introduction

This technical manual is an output of the Enabel funded Master Pond farmers training programme. The first phase being:

"The beginning of the pond production cycle for tilapia"

including site security, pond preparation, fingerling stocking, and the first month getting off to a good start.

This publication is the first of a 3 manuals series covering an 8–10-month production cycle shown below:

Month 0/1	**Pre and post stocking of ponds – the 1st month**
M4-5	**Mid-production cycle**
M8-9	**End of cycle pre and post harvesting**

Objectives of this manual

1. To serve as a farmers step-by-step technical guide following a previous harvest when a fish farmer wishes to restock his/her pond(s) and start into the first 4 weeks of production.

2. It is also a reference and technical guide for RARICO and other extension officers as they carry out their work in supporting and assisting pond farmers to be standalone successful and financially viable.

3. To stress to all, that good pond preparation, a successful fingerlings stocking, and then the first month of daily pond management is a most crucial time for the fish farmer to go on and be successful.

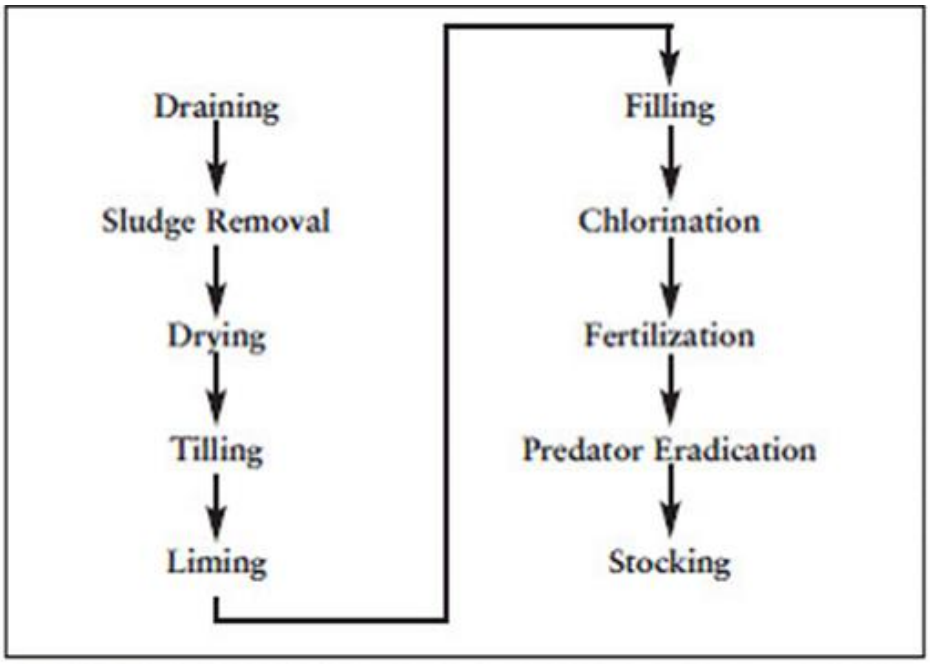


Figure 3 Summary of pond preparation to stocking

1.1 **Starting outside the fish farm site: Fish Farm security - Is your fish farm secure?**

Before describing how to prepare your ponds for fingerling stockings it is important to start with the fish farm itself, outside the site at its entrance. What are the important attributes it must have in order that your fish farm business and ponds are secure?

- It is important to remember when you first stock small fingerlings they are unlikely to be interesting for outside people to look at or steal when small.
- However, after 4-5 months, as your tilapia begin to get to 50-150g they begin to get more valuable to others outside, even your local neighbours.
- Then if you think that after 8-9 months before harvest the tilapia in your pond can be on average 250-300g (0.25-0.3kg or 4 or 3 pieces per kg) – **these fish are very valuable!!**

Sample calculation

What your fish are worth!!!

Say you have a 20m X 30m pond Total area 600m²

Stocked with 1.5 g fingerlings at 3 per m²

Total fingerlings = 1,800 pieces

Say after 8-9 months you have survival rate of 70%

Therefore 1800 X 70/100 = 1,260 fish at harvest

Say these fish at harvest average 250g (0.25kg) each

Therefore, the total weight of fish in the pond at harvest

= 1260 X 0.25 = 315kg total harvest

Total Income – What your fish are worth

315kg at 2000 RFr = Rwf 630,000

315kg at 2500 RFr = Rwf 787,500

315kg at 3000 RFr = Rwf 945,000

315kg at 3500 RFr = Rwf 1,102,500

- Therefore, at harvest you have potentially **1,102,500 Rwf** worth of fish in just **one of your ponds**
- **For 5 ponds** that is 1,102,500 X 5 = **5,512,500 Rwf**
- That is a lot of money!!!!!!!
- Enough for you to buy:
- 5,512,500/1,200 per kg = **4,593 kg or 4.5 MT of fish feed**

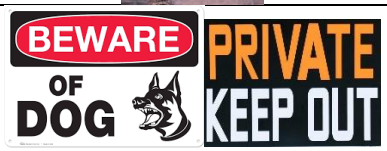
At your farm gate/entrance – some questions-how to improve your farm security …

- When your fish are this valuable **5,512,500 Rwf** you have to protect them
- But you have to do this at cost you can afford
- Starting at beginning:
- Is your farm by or alongside and close to a (major) road?
- Can people in cars, motorbikes bicycles or walking easily see your fish ponds?
- Is it obvious to people walking or driving past there is a fish farm there?
- Do you let local people have access to and walk around your ponds daily? School children? Local workers? Others?
- Do you have a fish farm sign beside the road or outside the farm?
- Is it open access to your ponds from the road? Or do you have some form of fence or hedge along with one entrance gate that can be locked?
- Do you have a night watch person there on the ponds between 6pm- 6am every night? Or someone of your farm living on the farm – 50m from the ponds? If not ….?
- All of these are risks to your farm and your business.
- If only one out of 10,000 people driving past your farm every day come back at night and steal your fish
- They can easily steal 50 – 100kg of fish in one night without you even knowing – that is worth **175,000 – 350,000 Rwf of your money gone in one night**
- A local person or small schoolboy who walks past your ponds every day can come at night without you even knowing and remove 5 fish in one night – 35 fish in one week - At 250g each fish, that is 8.75kg and worth **30,600 Rwf of your money** each week.

Improving farm security & protecting your stock at an affordable cost?

Outside the farm

ACTION/DESCRIPTION	COST	PICTURE/ILLUSTRATION
Don't Put up a sign outside your farm showing to everyone including strangers that there is a fish farm cooperative/business there	***No cost***	-
Do put up a fence, wall or grow a hedge along the road adjacent to the ponds	***Medium cost***	
Do plant a series of trees along the road adjacent to the ponds - in 5 years.	***Low cost***	

Do Make one lockable gate /door be the main and only access to the farm.	***Medium cost***	
Do put up sign on gate saying **Private Keep Out!! Or Beware dog inside!**	***Low cost***	

Inside the farm

ACTION/DESCRIPTION	COST	PICTURE/ILLUSTRATION
Ensure there is one farm staff who lives on or v close to the ponds -within 50m.	***Medium cost***	
If not then you must have night watchman by the ponds between 6pm – 6am especially when fish are over 100g.	***Medium cost***	
Inside the farm have a dog tethered up - geese also make very good security animals at night – make a lot of noise.	***Medium cost***	 
Put trip wires at major points of access around ponds – connect these to bells.	***Low cost***	
In ponds put in series of sharpened bamboo stakes below level of water – this prevents people netting ponds.	***Low cost***	
Solar powered floodlight with movement sensor.	***High Cost***	

As your farm progresses and you are growing bigger fish and getting bigger harvests then security is a must and something you have to put some of the farm's profits into. As seen above many of the security measures above are either low or medium cost.

Now your fish are safer - we are moving on to pond preparation for your next fingerling stocking.

After the last harvest:

Pond Preparation

- The pond should be completely emptied of water and the bottom and sides of the pond left to dry for a minimum period of **7 days.** Leave the outlet pipe open for if it rains.
- Then by walking from the inlet to outlet end of the pond, assess the bottom of the pond. If your feet sink into the pond bottom over 1 inch or 2 centimetres then the sediment/mud on the pond bottom must be removed.
- Sediment can be removed using a shovel, hoe and wheelbarrow, stretcher *(ihene*), or large tub or container. It can either be put back onto the top walls of the pond dikes and allowed to dry and compressed. Or spread onto any crops or fruit trees close to the pond as a good fertiliser.
- Removal of pond sediment is crucial to the success of the next production cycle.
- If one thinks of our own houses and how we live and eat – The bottom of the fish pond is **both the floor and also the dining table for the fish** who live above it.
- If it is allowed to get dirty, covered in sediment/mud/uneaten feed then this will make the water (quality) bad – low levels of Dissolved Oxygen (DO), high levels of toxic ammonia (NH_3), and bad smelling Hydrogen sulphide H_2S.
- If you allow these substances to build up on the bottom of your ponds your fish will firstly stop feeding and growing, then become sick and start dying.
- Cleaning the pond bottom properly in-between production cycles will help to maintain a healthy and good environment for next cycle fish to grow well in. It will also make fertilising your pond to get good green water far easier.
- If your pond needs some further maintenance this is the time to do it!!
- Repair dike walls of any holes or breaches.
- Ensure you have a good slope on dike walls and the soil is properly compacted.
- Ensure your pond outlet pipe is at the lowest point to allow proper drainage.
- For your outlet pipe, if you don't have one already, fit a 90-degree outlet bend and up pipe on all pond outlets and cover with sieve netting to prevent any fish escaping. **This very important**, as it allows you to control the height/depth of the water throughout the production cycle. This makes good pond fertilisation and regularly cleaning out the sediment on the pond bottom far easier.
- This also is an overflow pipe for your pond – If it rains heavily or floods – You don't want your valuable fish to get washed away.
- Farmers who don't have these 90°outlets will make less money.

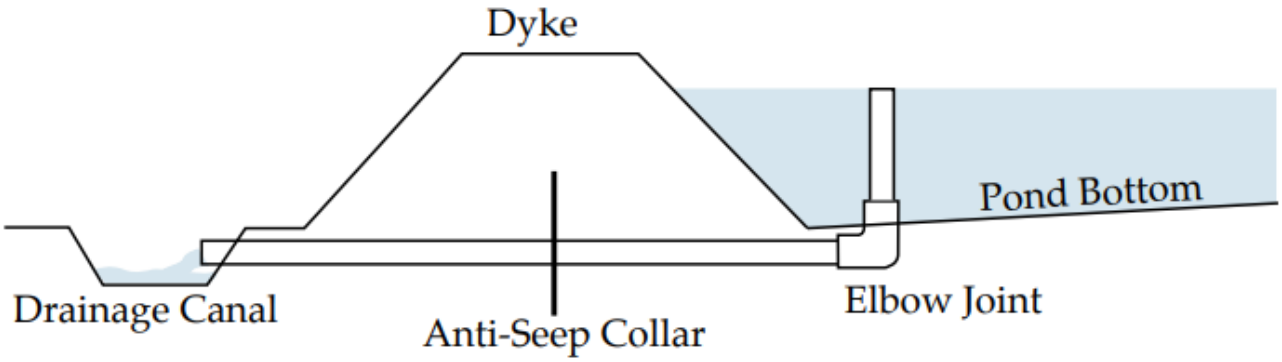


Figure 4: Cross section of pond with 90 °outlet pipe. Allowing pond water level to be controlled by rotating the pipe throughout the 6–8-month cycle. This very important in regularly removing silt from pond bottom, maintaining good water quality and pond fertilisation - green water throughout the production cycle.

- Once you have removed the sediment/mud then you should be able to walk on the pond bottom which is firm and your feed do not sink into it.
- Finally, with a hoe or rake break up/till the flat bottom and sides of the pond and close off the outlet
- You are now ready to lime your pond

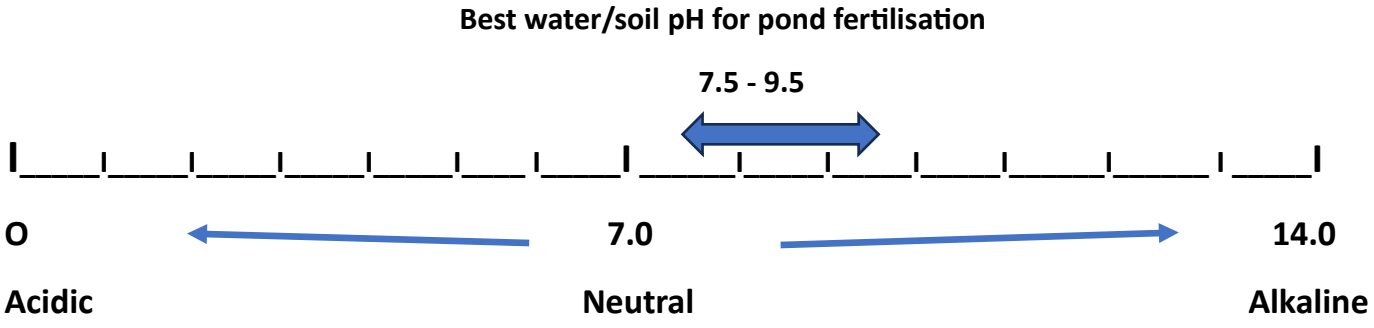
Liming your pond

Why? Liming of a fish pond is done in between production cycles to clean/sterilise the pond bottom to control disease causing organisms and others. Also to correct the pH and improve alkalinity of the pond bottom and water above it making it easier to fertilise the pond and get regular green water to make the fish grow faster.

Before doing this, it is important to understand **what is meant by pH – acidic – and alkaline?** - and how this relates to the water in your pond being ready for fertilising to obtain green water to make the fish grow well.

What is pH?

It is simply a scale ……



Lime is a strong alkali and can be purchased from most agrodealers in district towns **in 25 or 50kg bags.** Care should be taken handling it from the shop back to the farm keeping it away from any water. It should be stored indoors the bags sealed, off the ground in a cool dry place.

Types of Lime

• **Limestone - $CaCO_3$** - is also known as: Agricultural lime, Ag-lime, Crushed limestone, and Calcium Carbonate. Best one to use.

• **Quicklime- CaO** – is also known as Calcium Oxide, Burnt lime, and Active lime. This product normally the most pure.

• **Hydrated Lime (Powder) $Ca(OH)_2$**- is also known as Calcium Hydroxide, Powdered lime, Builders lime, and Slaked Lime.

Figure 5 Liming ponds Note he is wearing gloves, a mask and boots for safety.

Liming Frequency

The effects of liming during production cycles will usually last several years in ponds with little or no outflow. However, ponds that frequently discharge water may have to be more frequently limed based on water quality and pond bottom soil type. We recommend in Rwandan context ponds are limed at a minimum after two production cycles. The ponds should not be left filled with water (and empty or with some fish) for over 12 months. This likely to adversely affect the fish growth and money made in the next production cycle when it happens.

Determining amount of lime to apply to your pond

- You need to first find out what the pH is of your pond bottom soil.
- Using a 1 litre graduated plastic jug – fill it up to 500ml with top soil from the centre of your pond – then fill up to 1 litre mark with collected rain water – important not to use water from tap or local stream as it may have other chemicals in it.
- Mix thoroughly until all the soil has been dissolved/suspended in the water – Then allow to settle for 5 minutes.

- After which mix thoroughly again – and use what you have on the farm to measure the pH. The most costly is a pH meter - But you can also buy simple water test kits with liquids – or the cheapest to use is a roll of pH indicator paper or strips. Repeat test 3 times using soil from different parts of the pond bottom – Take an average.

Figure 6 Different methods of measuring pond soil and water pH on your farm

The amount of lime needed in a particular pond depends on the acidity of the pond soil, the type of liming material to be used, and the quality of the liming product that is available. Once you have done the simple pH test above you will know from Table 1 below the approximate amounts of agricultural lime to use:

Table 1: Dose rates of lime for your pond depending on soil pH – per 100m², per 10m²

If the soil pH is	**If the total alkalinity (mg CaCO per litre is**	**Apply this amount of lime (kg) per 100m² pond**	**Apply this amount of lime kg per 10m²**
Less than 5.0	Less than 5	30	3.0
Between 5.0 - 5.5	5-10	25	2.5
5.5 – 6.0	10-20	20	2.0
6.0 – 6.5	20-30	15	1.5
6.5 - 7.0	30-40	10	1.0

How do I apply lime to my pond?

- Best lime to use is $CaCO_3$ agricultural lime.

- Firstly, it is important before spreading any lime, you have the **necessary protective clothing**: Long sleeved gloves, a face mask, googles for your eyes, and you ensure your feet, arms and head are covered. Lime if allowed onto the skin can cause burns and scarring.
- Do not lime ponds **on a windy day or during rain.**
- If the grass around the edges of the ponds is overgrown cut this first down to short level.
- Ensure there are **no other humans or animals** in the vicinity of the pond.
- Before starting, **close both inlet and outlet** of the pond
- Start spreading the powder using a shovel. Start at inlet end and work your way down towards outlet ensuring you also evenly cover the sides of the pond up to grass level.
- When applying lime take care to keep powder away from the operators' eyes and face.

- Leave the pond for minimum **of 7 days** – It is preferable pond remains dry but it is ok if it rains -make sure outlet pipe is still closed
- After 7 days **open inlet pipe and allow pond to fill to 30cm depth** or the height of your wellington boot.
- Now leave the pond like this. Depending on local weather and sunshine, you should start to see the pond water turning **a green colour within 3-7 days.**
- When this happens then open inlet and allow water level to go up **to 50cm**.
- Again, leave at this level and wait a further 2-3 days for green colour to further develop.
- And then top up water from your inlet to take **water level to 100cm or 1.0 metre**
- Then turn off inlet
- At this stage you can now **add fertiliser to your pond**:

First pond fertiliser: Inorganic or Organic

- There are two general types of fertilisers for ponds: **Organic and Inorganic**
- Depending on what is available locally and what you can afford you can use one or the other – or both

Organic Fertilisers

- These are basically animal / livestock faeces or wastes and should be applied at this stage in the following rates:

Table 2 Dosage rates for semi dry livestock waste fertilisers for 100m² fish pond

Type of waste	***kg per 100m² pond***	***Notes***
Chicken / poultry waste including litter	*1.5*	*Poultry waste the best to use if you can get it*
Cow waste	*8.0*	*Try to use semi dried to remove any urine*
Pig waste	*10.0*	*As above*
Rabbit waste	*10.0*	
Goat waste	*12.0*	

Note: These dosages are standard but may vary depending on individual ponds and pond soils

- Note you should have a set of scales which weigh 1-5kg. They should also be used to weigh daily amounts of fish feed
- These livestock wastes can be applied in two ways:
- 1. Mix the waste well **into 2 X buckets of water** ensuring that most has dissolved to form a cloudy looking liquid
- Then with a scoop or jug spread/ distribute the liquid evenly over the whole surface of the pond.
- 2. Or put the livestock waste into two tied, **empty plastic feed or fertiliser bags** which have a number of small holes in - Tie these onto a wooden stake one in the middle of the pond and the other at the outlet end.

Inorganic Fertilisers

- These are the chemical fertilisers in powder/granular form you can buy from a local agrodealers and should be used at the below dosages in your pond.
- The 3 important components that encourage green water in your ponds are Nitrogen (N), Phosphorous (P), and Potassium (K).

Table 3 Dose rates for Inorganic chemical fertilisers for 100m² pond

Chemical Fertiliser	kg/g per 100m² pond	g per 10m²
Triple Super Phosphate (TSP)	0.065kg or 65g	6.5g
NPK (Nitrogen Phosphate Potassium) mix	0.30kg or 300g	30g
Urea Nitrogen based)	0.14kg or 140g	14g

Note: These dosages are standard but may vary depending on individual ponds and pond soils

- Mix thoroughly these fertilisers into a bucket of water until they are dissolved
- Apply the liquid similarly with a scoop/jug all over the surface of the pond remembering to keep inlet closed.
- Applying 140g of urea, and 65g per 100m² of triple superphosphate per 100m² provides the same nutrient input as 30g NPK per 100m² (depending on NPK ratio).
- Within 2-3 days the pond water should become green
- **Your pond is now ready for stocking.**

Maintaining green water in your pond

It is very important that you try to maintain green water in your pond for as many days and weeks you can throughout the whole production cycle. This is because the green water is made up of millions of tiny plants (phytoplankton) and animals (zooplankton) which the tilapia, especially between 1- 150g average weight, feed on. Therefore, the more days you keep your pond water green during a whole production cycle the more your tilapia will grow, and the more money you will make.

What is the ideal/optimum level of green water in your pond to achieve most growth of the tilapia?

- You can simply measure this using two simple methods:
- 1. A Secchi disc

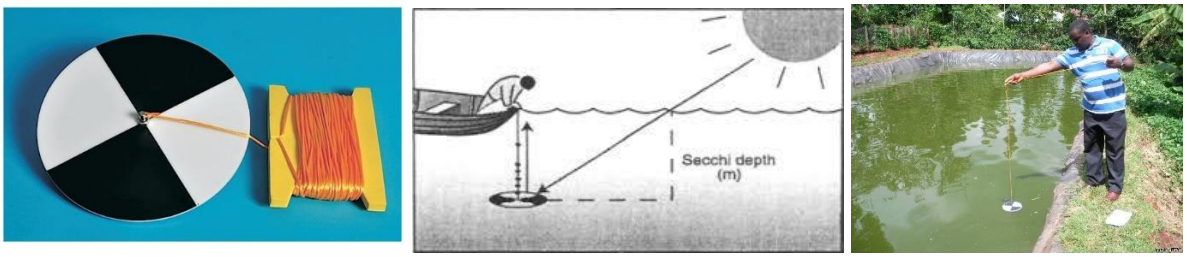


Figure 7 Secchi disc for measuring good pond fertilisation

- You can make one of these yourself or get from your extension officer. Tie knots in the string every 10cm to show the depth.
- Carefully lower the disc on the string near the pond outlet into the water and note the depth of water where you can only just see the disc – ie if you lower the disc any further you can no longer see it.
- Repeat this at 2 other locations around the pond – in the middle of the pond and at inlet end.
- The ideal depth for green water is at between 30-40cm. At this depth you do not need to add further lime or fertiliser.

- 2. The same test can simply done using your arm lowered into the water – the ideal water quality is when you can just see your fingers when your arm is up to your elbow in the water:
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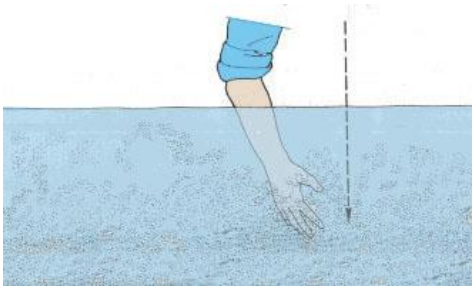

Figure 8 Testing Pond water fertilisation using your arm

Maintaining green water in your ponds – A balancing act and a real skill!!

- **A**. **If you can still see** the Secchi disc **at 50cm or more** ie the water is too clear – then you need to:
- Add more fertiliser – either the organic (livestock waste) or inorganic (chemical fertilisers) at same doses as above.
- Check your pond water pH (as above) – if it is 6.5 or lower then you need to add some more agricultural lime – **at 15-20kg per 100m² pond area**. Dissolve this in 2 X buckets of water and spread evenly over the pond surface.
- Remember also in this case to keep your inlet closed.
- **B**. **If you cannot see** the Secchi disk **at 30-40cm** ie the water colour is too thick, too green, then you need to:
- Open the inlet pipe – let it run for 4-6 hours
- Watch carefully the colour of the water to see if it changes
- After 4-6 hours test again using the Secchi disc – if the Secchi disc water depth **is now 30-40cm** – then stop the inlet - pond water now is at ideal state of green water.
- If the water colour still too thick keep the inlet flowing a further two hours – then test again with Secchi disc
- Repeat this until you get **a 30-40cm Secchi disc reading** then turn off inlet water.

Sample Calculations For 600m² pond

1.Lime Dose: 10kg for 100m²

For 600m² pond = 6 X10kg = 60kg lime

2.TSP Triple Superphosphate Dose: 0.065kg or 65g for 100m²

For 600² pond = 6 X 0.065 = 0.39kg or 390g TSP

3.Urea Dose: 0.14kg or 140g for 100 m²

For 600 m² pond = 6 X 0.14 = 0.84kg or 840g Urea

4. NPK Dose 0.30kg or 300g for 100 m²

For 600m² pond = 6 X 0.3 = 1.8kg NPK

5. Cow faeces/waste Dose 8kg for 100m²

For 600m² pond = 6 X 8 = 48kg Cow waste

Table 4 Advantages & Disadvantages of Organic/Inorganic Fertilisers

Fertiliser type	Advantages	Disadvantages
Organic Fertilisers: Livestock waste	- Locally available - Cheaper - Algal blooms green water tends to last longer - Recycling on farm nutrients	- Slower acting - Require livestock nearby - Odour and some health risk - More difficult to store
Inorganic Fertilisers: Chemicals	- Faster acting - Once bought can be stored on site - Easier application	- Can be more expensive - Costs will increase in future - Algal blooms green water tends to last shorter time - Need to buy in nearby town - Less sustainable

Last preparations for fingerling stocking

- Ensure pond(s) have correct green colour water.
- Also, that you have the necessary feed - correct sizes already there on the farm
- Stock fingerlings at recommended stocking density:
- For Higher level fish farmers **4 per m²,**
- For Mid-Level fish farmers **3.5 per m²,**
- And for Low Starter Level Fish Farmers **3.0 per m²**
- If fingerlings are **3.0g average weight or above** they can be stocked directly into the pond
- If smaller **0.5g – 2.5g** the fingerlings should be stocked first into a net hapa in the pond to allow them to grow up to 5g when they are big enough to be released into the pond.
- The hapa or hapas should be located close to the pond inlet to allow fresh water to flow through them if needed.
- The bottom of the hapa should be at least 50cm or 0.5m off the bottom of the pond.
- The hapa(s) should have a netting covering them to prevent birds taking the small fish
- Every fish you lose at this stage comes out of your profits
- For 1.0 – 1.5g fingerlings you should stock **200 pieces for every 1m³ of hapa**
- Therefore, for **1,000 fingerlings** you will need **5m³ hapa eg one of 5 X 1 X 1m**
- **If you stock too many fingerlings into too small a hapa, you risk killing them all**

The day of fingerling stocking

- The fingerlings should be stocked early in the morning when it is cooler
- Normally they will arrive in oxygenated bags from the hatchery
- Carefully carry them from the vehicle and allow them to float in the pond or in the hapa
- If the fingerlings inside the bags are showing no sign of stress or discomfort, allow the bags to float on the surface of the water again close to the pond's inlet for 5-10 minutes, this is to equalise the water temperatures
- Then after turning on the pond inlet - one bag at a time, untie the top and gently allow some of the pond water to enter and mix with the water in the bags, watching the fingerlings closely. You can also gently splash the water with your hand to aerate it.
- Do this for about 5 minutes to allow the pond and bag water to mix completely and acclimatise the fish. Then slowly, without tipping the bag, allow the fingerlings to swim out of the bag into the pond or hapa using their own effort.

- Carefully watch the fish afterwards for another 5-10 minutes that they have settled ok.
- Then leave the pond alone for 6-12 hours to let the fingerlings settle.

Figure 9 Stocking and acclimatising fingerlings from bags into the pond

First feeding the fingerlings

- Then **after 6 hours** try with a very small amount of feed – just a pinch between your fingers – try to see if the fish are interested in feeding – be sure you are using the correct size of feed for the size of the fingerlings – see Table 5 below
- At 1- 1.5g average weight of fingerlings you should be using a **0.3 – 0.5mm feed preferably floating**
- If they are not interested and there is no feeding response, leave them and come back again in 6 hours and try again
- If and when they start to show interest and a feeding response when you put small amount of feed into the pond or hapa, then feed them a small amount slowly watching carefully. Come back 10 minutes later to see if all the feed has been eaten.
- **Be very careful at this stage not to overfeed the fish** since some of the uneaten feed can sink to the bottom and cause bad water quality. Also, the fish can gorge themselves and end up dying from over eating
- As with pond fertilisation, **feeding the fish correctly is a real skill** and should be taken very seriously. It is often said that **the most important person on any fish farm …. Is the person who feeds the fish**.
- Feed the fish in the hapas from the bank using the long pole and cup (in Figure 9) to ensure all the feed goes into the hapa and not on the grass or in the water outside the hapa.
- **Feed is expensive Don't waste it!!**

Figure 10 Use long pole and tied on cup to feed hapas correctly – A little amount and regularly

Table 5 Guide to feed sizes and feeding frequency throughout the production cycle

Average weight of fish (g)	***Size of feed particle / pellet (mm)***	***% Crude protein***	***Daily feeding rate (% of body weight*)***	***Nos of feeds per day (Feed to appetite)***
1.0 – 5.0	*0.5-0.8 Starter*	*40 -45%*	*6-10%*	*6-8*
5.0 – 8.0	*1.0 -1.2 Crumb*	*32 %*	*3-5%*	*4-6*
8.0 – 30	*2.0-2.5 Small Pellet*	*32%*	*3%*	*4*
30 - 120	*3mm Grower Pellet*	*30%*	*2.5*	*4*
70g upwards	*4mm Grower Pellet*	*28%*	*2.3-1.1%*	*4*

**Fed as % of the body weight of the fish -This calculated through sample test weighing fish every 4 weeks*
Note: These figures are a guide – and can vary depending on many factors including the feed company's feed, the temperature, water quality, quality of fingerlings.

Feeding should always be done carefully, watching the reaction of the fish. The fish should be fed to their own appetite and no feed should be left on surface or bottom of the pond after feeding.
Feed is your most expensive input! – Feed carefully!!

The first month – Starting off the right way

- The 1st month is critical to the success of your whole production cycle – the fish are still small - take care of them.
- You can calculate very easily the total body weight of all the fish in your pond when they arrive as fingerlings and then once monthly afterwards when you sample test weigh the fish – and from this the approximate amount of feed you need to feed them each day.

Example Calculation of total body weight/biomass (kg) in the pond

At fingerling stocking ….

Average wt of fingerlings = 1.0g

Total Nos of fingerlings = 1000

Total body wt of fish in pond = 1.0 X 1000 = 1,000g or 1.0kg

Example calculation of amount of feed to feed per day

1.0g fish are fed at 8% body wt per day (Table 5 above)

So for 1000 fingerlings at 1.0g they should be fed:

1.0kg x 8/100 = 0.08kg or 80g per day

These fish are fed 8 times per day so

80 /8 = 10g per feed for each feed

Note – this calculation is a guide for you – You can weigh out as in this example 80g of feed each morning as a guide. But when you are actually feeding you should feed the fish to their appetite – ie only the amount of feed they will comfortably eat with none left over.

- With this size of fish (1.0 -1.5g), you can start feeding from 7am and try to feed 6-8 times per day finishing around 5.30-6.00pm.
- With small fingerlings this size the golden rule is feed a little each time but often.
- If when you come to feed first thing in the morning there is absolutely no response – then don't feed any more – leave the fish – Check the pond to see everything else ok – come back later.
- If early morning you see the fingerlings up on the surface of the water "gaping" / trying to suck in air - don't feed them.
- This means the dissolved oxygen (DO) levels in the pond are low – You should in response open the inlet allowing fresh water in. Then watch the fish carefully until they stop gaping – and then 1 hour after this turn the inlet off. And then see if the fish are ready to feed or not.
- On farms that get coloured, dirty water in their inlet channels after heavy rain – be careful!! – Only turn on your inlet after the dirty coloured water has cleared.

The fingerlings in the hapa

- As mentioned earlier, if you receive fingerlings any smaller than 2.5g for stocking these should be carefully stocked into one or more hapas of the right size and the fingerlings then grown on to reach 5g when they can be first be test weighed and then carefully counted and stocked into the main pond.
- The hapa netting must be cleaned every 3 days to ensure good water exchange. So, first thing in morning don't feed the fish - open the inlet allow fresh water in - and with a soft brush clean the hapa net.
- At same time count and remove any dead fish – these can be floating on the surface – or can be on the bottom of the hapa.
- Whilst gently lifting the hapa look carefully at the bottom of it – There should be no uneaten or rotting feed at the bottom of the net. If there is then you are feeding too much – cut down on your feeding.
- With careful management, good feeding, and also good green pond water, you should be able to get the fingerlings from 1.0g to 5.0g in 2 weeks - fourteen days – to then release into the main pond.

Fingerlings in the main pond

- Try where possible to use bird deterrents for each pond – Birds can take hundreds of fingerlings this size from your pond unless you protect them.
- Whilst buying netting to cover your whole pond may be too expensive, there are other lower cost methods to deter birds:
- White flashing tape - used by rice farmers - can be stretched over the ponds – Also strong nylon twine or fishing line can be stretched over the pond at regular intervals from posts on the pond banks.
- Put a scarecrow next to ponds
- Having a dog and or geese near your ponds will scare birds away.

Figure 11 Different bird deterrents for fish ponds – Protect your fish!!

Sample Test Weighing your fish

- This is one of **the most important management tasks** you must do at the end of every month throughout your whole production cycle.
- This tells you how well (or not) your fish are growing. It also allows you to calculate the approximate amount of feed you need to feed each day/month.
- It also importantly allows you to calculate every month your **Food Conversion Ratio (FCR)** – Which is basically how well the feed you are feeding is converting into weight gain of the fish.
- Knowing your FCR for each of your ponds and also the whole farm is key to you either making a profit … or if you don't know – making a loss.

Figure 12 Test weighing your fish – But note this should be done in a small bucket with water – Kitchen digital scale good for smaller fingerlings.

Procedure for test weighing fish in ponds

- The fish should be test weighed first thing in the morning when still cool weather
- The pond should be fed up to 4pm the day before **and starved before** the test weighing the next morning.
- On the morning first **turn on the inlet for 30 minutes** before carefully seine netting the pond starting from the outlet end. Go up to inlet end and gather fish in the bag of the net keeping them all the time in the water next to the inlet.

Figure 13 Seine net your pond to hold your fish safely in water in a bag in your seine net close to the inlet

- Prepare your scales on a flat surface on the pond bank close to the inlet – Scales can **be digital or spring balance** in the photo – For smaller 1-5g fingerlings small digital scales are better.
- Place a small bucket on the scale with 10cm water in it – **Tare or zero the scale.**
- With a hand net randomly net out for the seine net approximately 100 fingerlings.
- Very important you do this randomly. **Don't just pick out the bigger/ biggest fish**
- From your hand net count 100 fingerlings into the small bucket – make sure you are not adding excess water into the bucket.
- Whenever you are handling live fish **ensure your hands are wet first**. Dry hands can cause injury and disease problems.
- Take the reading in g or kg.
- Carefully put weighed fish back into the pond – **Don't throw them** – Allow them to gently swim out of the bucket into the pond water themselves.
- Repeat this test weighing with 2 X 100 fish samples from the seine net.
- Then take an **average from the 3 samples**. This will be your average test weight (g) for that pond for that month.
- When completed gently release all the fish in the seine net and allow them to swim back over the pond.
- One hour later try feeding the pond – If good feeding response, then feed as normal – If no feeding response come back one hour later and try feeding again.

Example Sample Test Weighing Calculation

1. **First test weight: 100 fish weigh 500g or 0.5kg**
   So, 1 fish weighs 500/100 = 5.0g
2. **2nd test weight: 100 fish weigh 460g**
   So, 1 fish weighs 460/100 = 4.6g
3. **3rd test weight: 100 fish weigh 520g**
   So, 1 fish weighs 530/100 = 5.2g

Final Average wt (g) of one fish = (5.0 + 4.6 + 5.2)/ 3 = 4.93g

Importance of Records keeping

- Firstly, ensure you have a **proper hard cover notebook** for keeping farm records.
- If you are a cooperative - you must make your farm records available for **all of your members** – It is a legal requirement.
- Recommend you have one person on the farm who is solely responsible for updating the records book
- The records book must be kept in a safe place **on the farm**, not miles away in someone's house.
- **Don't** keep records on pieces of paper or in your head - You will fail in fish farming if you do this.
- You cannot be a financially viable, successful fish farmer without keeping proper records
- In this project if you don't keep records…. And / or when we come to visit you, you do not have your record book available - we will not work with you in the following year of the project.

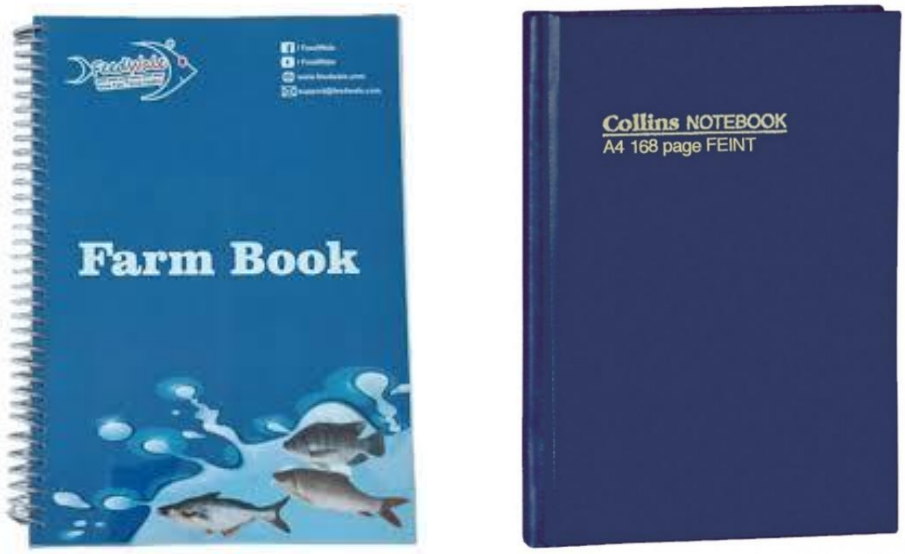

Figure 14 Farm records book – If you don't keep one… we will not work with you in following year of project.

If you want to be successful - Records you must keep:

Feed

- How much feed (kg/g) per day you use on each pond
- From this you know:
- How much feed (kg /g) you use on each pond per month
- How much feed (kg) you use on the whole farm per month
- How much feed you use on farm throughout whole production cycle.

Test weighing / Mortalities/ Harvesting

- The average weight per fish (g) in each pond at the end of every month.
- The number of dead fish you removed from each pond every month.
- The total kg harvested – and count the number of fish at harvest coming from original fingerlings.
- From this you can then calculate:
- The total weight of fish in the pond (kg) at the end of every month.
- The weight gain (kg) of all the fish in the pond at the end of every month.
- The FCR Food Conversion Ratio for each month and also for the whole production cycle.
- The % Survival rate of your fish from fingerling stocking to harvest.

From these what are simple records to keep you can then use the below *Table 6* to calculate and know how well your pond is doing every month.

Table 6 Example: Fish Pond production performance each month – This from a Malawian fish farmer who kept these records for her 600m² pond

Month	Average Test weight per fish (g)	Nos of fish in pond (estimated)	Total wt. in pond (kg)	Total weight gain in pond in month (kg)	Feed (kg) used in month	FCR (Food Conversion Ratio)
M0 First stocking	**2.0**	**1,800** were stocked	**3600g or 3.6kg**	-	-	-
M1. 30 days later	**8.5**	**1750** (50 mortalities)	**14.8**	**11.2** (14.8-3.6)	**10.5**	**0.93** (10.5/11.2)
M2	**22.3**	**1700**	**37.9**	**23.1**	**25.0**	**1.08**
M3	**57.7**	**1680**	**96.9**	**59.0**	**65**	**1.10**
M4	**80.3**	**1660**	**133.3**	**36.4**	**63**	**1.73**
M5	**124.3**	**1560**	**193.9**	**60.0**	**100**	**1.66**
M6	**170.0**	**1550**	**263.5**	**69.6**	**125**	**1.79**
M7	**212.0**	**1500**	**318.0**	**54.5**	**100**	**1.83**
M8	**254.0**	**1460**	**370.8**	**52.8**	**100**	**1.89**
Totals	**254g av wt per fish at harvest**	**1460/1800 X100 = 81% survival rate**	**370kg harvested**	**-**	**588.8kg feed used**	**Overall FCR = 1.59**

She harvested 370kg tilapia of av size 254g in 8 months from 600m² pond

She sold all these live/fresh in water for equivalent of 3,500 Rfr per kg

She made 370 X 3,500 = 1,295,000 Rfr Total income

She used 589kg feed x 1,150 Rfr per kg = 677,350 Rfr cost

Her margin was 1,295,000 – 677,350 = 617,650 Rfr

- If you can keep such a records table for each of your ponds over a production cycle this will be a major step towards success! And you becoming a standalone, financially viable fish farmer.

Appendix

Some useful further information

1000g = 1kg, 1000kg =1 Metric Tonne (MT)	1 hectare = 10,000m²	1mg per litre = 1 part per million ppm
1kg = 2.205 pounds (lbs)	1 hectare =2.47 acres	1mg per kg = 1 part per million ppm
100cm = 1metre	1cm = 0.39 inches	3.785 litres = 1 gallon
FCR for a pond = Weight of feed fed to pond per month (kg) / Weight gain in fish in pond over 1 month (kg)		

Example calculation

How much fish feed you need to produce 315kg tilapia at av wt 250g?

In this calculation we are assuming:

It will take 200g feed to produce 100g weight gain for each fish

This is what is called a FCR or Feed Conversion Ratio

Here FCR is 2:1

Very important to know & understand what FCR is – since fish feed is so expensive….

That by improved management practices on your farm …

You can reduce your FCR on your farm … say from 2.0 to 1.6 or lower

Therefore, you spend less money on feed to produce same harvest weight

So, to produce your harvest of 315kg from one pond

If we assume an FCR of 2.0 …

Then it will take 315 X 2.0 = 630kg fish feed to produce this 315kg harvest

630kg of feed at 1,200 Rwf per kg = 756,000 Rwf

Total harvest 315kg sold @3,500Rwf per kg

Total income = 1,102,500 Rwf

Margin = 1,102500 – 756,000 = 346,500 Rwf

Note: If through better pond management practices, you can lower your FCR of 2.0 to 1.6 then:

315 X 1.6 = 504kg fish feed to produce this 315kg harvest

504kg of feed at 1,200 Rwf per kg = 604,800 Rwf

Margin then becomes = 1,102,500 – 604,800 = 497,700 Rwf

This shows importance of your FCR and getting it as low as possible……..

Alternatives to using lime

There are some lower cost alternatives you can use to lime that are readily available on or near most farms in rural areas. And whilst they do not have the same strength and effect as agricultural lime, they are strongly alkali and can be used to control the pH level of pond soils and water.

Ash from burnt maize cobs

Used/stripped maize cobs should be kept and dried. Then when you have a good pile of them, burn down to ash. Let the ash cool and then break it down to small particles and powder. This can either be stored in a sealed bag, or used directly on the pond bottoms or pond water to increase the pH to 7.5-9.5. This will then further encourage green water in your ponds.

Wood ash – also used for sealing ponds

Although not as strong alkali as maize cob ash, wood ash can also be used as a lime substitute on the bottom of ponds or in the water. In Israel, they also use it for sealing leaking ponds eg around an outlet pipe where if mixed in with the pond water it acts like a cement sealing small gaps around the outlet pipe. Israelis also spread cut grass or green vegetation plus cow, pig, or goat dung all over the bottom and sides of brand new earthponds in areas where soil types are not good for fish ponds. They let it dry and go yellow colour, before then burning it down to a fine ash. They then open the inlet and allow water level to go up to 15cm depth then close inlet. The ash/manure mixture then seeps into the soil of the pond and begins to seal it. They repeat this procedure 2-3 times after which the pond bottom & sides hold water well without leaking.

Photo gallery

Figure 15 Scarecrows and plastic herons to deter birds

Figure 16 Colocasia (Cocoyam) leaves and rice bran can be used as supplementary feeds for tilapias.

Stay safe and work well on the farm: Equipment

Gumboots / bote.	
Overall, with long arms / isarubeti / igisarubeti.	
Protective gloves / uturindantoki twa plastic.	
Protective coat / itaburiya	
Goggles / amadarubindi / amataratara	
Face mask / agapfukamunwa	
Head cover / ingofero	

This manual was developed by ThinkAqua for expanding the knowledge of pond fish farmers in Rwanda in order to become standalone, financially viable, and treating aquaculture as a business. It is supported by Enabel, the Belgian Development Agency, in collaboration with the Rwanda Agriculture Board RAB.

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