Phase 2 Pond Farm Master Training Programme

Workshop Manual 2: Month 2 – Month 8 of mid production cycle: Pond Management practices towards profitable fish farming.

Figure 1 Test weighing fish

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. The authors take no responsibility for any health or other conditions caused by following procedures in this manual.

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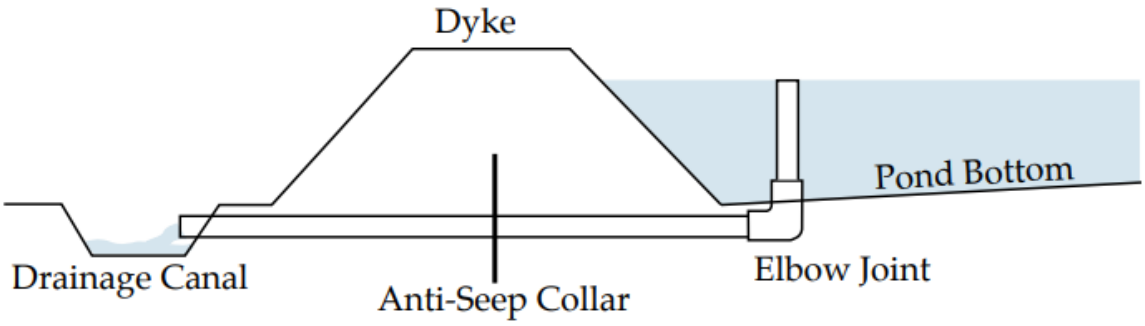

Figure 2 Pond outlets: 90-degree bend and standpipe. A must for each pond if you want to grow tilapia seriously to make a profit.

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
Urea	Fertiliser: Nitrogen based H_2NCONH_2
°C	Temperature: Degrees centigrade

Figure 3: Measures preventing predators birds in ponds – if you don't do this you can lose 10-50% of your stock between Months 2- 8 of your production cycle….. A lot of money…….

Introduction

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

Month 2 – Month 8 mid production cycle:
Pond Management practices towards profitable fish farming.

This publication is the 2nd of a 2 manual series covering an 8–10-month pond production cycle shown below. The first manual for Month 0/1- Pre and post stocking of ponds – the 1st month - is already available:

Two Manual Series	
Month 0/1	**Pre and post stocking of ponds – the 1st month**
M2-8	**Mid-production cycle up to end of cycle harvesting.**

Objectives of this manual

1. To serve as a farmer's step-by-step, technical guide to key, good day to day practice and farm management, following the first month post fingerling stocking up to M7-M8 when he/ she is ready to harvest.

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

3. From M2 to M8 forms the major part of the farmers ongrowing production cycle. Therefore, it is vital that key, day to day pond management activities, **regularly recording monthly fish growth and performance,** and planning for the future, are all clearly understood and practiced in order to end up in M8-9 with harvest/harvests which produce enough sales income to make a profit and towards standalone financial viability for the pond farmer.

4. The manual provides a **month-to-month activities plan** for pond fish farmers in which there are laid out specific activities, good management practices – daily, weekly and for each month M2 – M8 representing one full production cycle leading into harvesting.

Where this manual starts

The manual will now go on to describe best management practices for pond fish farmers from Month 2 onwards following the original fingerling stocking from M2 when the fish are in the grow out ponds, up to Months 8, 9, 10 when they are ready to harvest.

We are assuming by Month 2 M2 the fingerlings which were originally stocked on the farm into hapas, net enclosures, or a smaller nursery pond are now transferred into the larger, well fertilised green water production ponds; having been test weighed and carefully divided into the larger grow out ponds at the correct stocking densities, as described in the first manual. This should have been done when the fingerlings reached 10g, approximately 2-3 weeks after initial stocking at 1g. If the fish farmer leaves his/her fingerlings in hapas and nursery ponds any longer than this, then they are more than likely losing numbers of fish, having lower growth and losing money.

Therefore, depending on the performance of each fish farmer (especially feeding and pond fertilisation green water), some will of course be better than others. After fingerling stocking at 1g, their fish should have grown to minimum of 8-10g test weight within one month, and between 25- 35g after two months. With *niloticus* the best performing farmers with good quality feed and consistently green water ponds should reach an average test weight of 50g and above after two months from the initial farm stocking at 1g. This will depend on how well the fish farmer and Extension Officer EO have followed the key day to day management practices including **pond fertilisation, correct feeding, feeding frequency, predator control, keeping pond bottom clean and monthly test weighing and records keeping** amongst many others.

We now go on in the manual to provide a guide for **monthly farm activities** (From M2 – M8) for tasks the fish farmers must do if they wish to become standalone financially viable. At this point we emphasize that to farm fish successfully in ponds to make a profit involves time and work spent on the farm every single day. This involves a number of regular activities:

a. **Each day** including feeding the required numbers of times per day with the correct type and size of feed.

b. **Weekly** checking water quality and the bottom of the pond, where necessary adding replenishing new fertiliser and lime, and recording for each pond the amount of feed fed in kg.

c. **Monthly** – test weighing each pond – grading the fish if necessary.

These are **just some of the activities,** if the fish farmer wants to be successful, he/she should be spending a minimum of 4 hours per day on the farm every day. Anything less, then the farm is likely to fail. As stated in the previous manual a fish farm will not be successful if the owner lives far away, tries to run the farm over the telephone, and visits only once per week or less.

Monthly Tasks and Activities for Pond Fish Farmers from Month 2 of the production cycle.

Month 2

1. When fish get to 8-10g in hapas or nursery pond, they are ready to be stocked directly into larger growout pond. Note the larger pond you are putting them into must have green water, be well fertilised and have netting/a sieve covering both inlet and outlet pipes from at least 2 weeks before.
2. The pond you are putting the fish into must have proper inlets and outlets – the outlet with a 90-degree u bend and standpipe in order that you can control and at any time lower the level of water.
3. This pond should be carefully netted 3-4 times with a seine net before stocking the fingerlings to remove any fish or other predators (frogs, snakes) still in the pond. If you don't do this then you risk losing large numbers of your fingerlings within one month. Then a low survival rate – no profit.
4. Starve fish minimum 12 hours before moving them from hapa or nursery pond. Test weigh first. Take 3 sample test weights & then average.
5. Count fish into pond, always keep in water, to correct stocking density 3, 3.5, or 4 fingerlings per m^3.
6. Leave fish to settle 6 hours, then feed small amount. If no feeding response, leave, come back later.
7. Throughout month ensure pond well fertilised & maintain green water as many days as you can.
8. Test pH of pond water using paper strips or other method once per week – if below 7.0 add more lime or burnt corn cobs to get water pH to 7.5-8.5.
9. When fish 12-15g start using 1.0 -1.2mm crumb feed. At this size feed to appetite a little but often.
10. The fish should be fed a minimum of 6 times per day - small amounts and often, by hand using scoop.
11. The person feeding the fish is the most important person on the farm. Make sure you have the right person feeding the fish.

Month 3

1. Maintain green water using fertiliser, chemical or animal manure, dosages in first and second manuals.
2. Once every 3 days for rest of production cycle, first thing in morning before any feeding, drag chain over pond bottom. Drain water level to 50cm to remove sediment- remember you must have sieve on outlet. Fill up with new water. Allow fish to settle before starting to feed.
3. Feed 4-6 times per day. Feed fish to their appetite no more.
4. Check pond mud where you are feeding regularly for uneaten feed. If you find uneaten food on bottom reduce feeding. If you don't find you can increase slightly.
5. Record feed used in kg & mortalities in numbers in each pond for the month. If you don't do this you cannot know your FCRs and therefore cannot be a financially viable fish farmer.
6. Make sure you have good security measures on your farms. The fish now getting bigger & more valuable. So, take measures against humans also birds and other predators. Again, if you don't you will lose money.
7. Clean farm inlet/outlet channels, ensure each have good slopes. Set up small weir system in inlet channel to aerate water.
8. Test weigh each pond at end of every month. Take 3 samples and then average.
9. Keep updating your pond record tables at end of each month. Look at growth of fish & FCR to see how you're doing.
10. By end of M3 when netting & test weighing, look carefully at size range of fish. If large size range i.e. bigger and smaller sizes, discuss with EO on methods for grading. If large variations in fingerlings, & you don't grade, you will lose many of smaller ones, & thereby have smaller kg harvest after 8-10 months.

Month 4

1. Keep maintaining green water in your ponds.
2. Test each ponds water pH weekly. If below 7.5, add lime or lime alternatives.
3. Try to maintain your pond water at pH 8.0-8.5.
4. Every 3 days drag chain over pond bottom. Lower outlet, drain water level to 50cm to remove sediment. Fill up with new water.
5. Feed 4 x per day. Feed fish to appetite no more. When fish 30g average weight use 3mm pellets. When they reach 70g average use 4mm pellets.
6. Check pond mud in places where you are feeding regularly to prevent overfeeding.
7. Record monthly feed used in kg for each pond. Record mortalities in each pond to get monthly total for each.
8. Other jobs: Plant hedges around perimeter of your farm. Put in lockable entrance gate.
9. Put in sharpened bamboo stakes below water level in all of your ponds. If you can afford buy security light with sensor.
10. Test weigh ponds end of every month. Keep updating your records table for each pond – Calculate Weight Gain & FCRs.

Month 5

1. Keep maintaining green water in your ponds.
2. Test pH pond water weekly. Maintain pH 8 -8.5 for pond water, add lime or lime alternatives.
3. By now fish getting bigger & you will be using more feed each day.
4. Keep dragging chain on pond bottoms & remove sediment through outlet every 3 days.
5. Don't run out of feed! Think at least 1 month ahead to ensure you have enough for following month.
6. Start making enquiries locally/further away about selling fish in 3 months' time? Price per kg? Per piece? Transport costs?
7. Plan ahead. Contact hatchery about ordering new batch of fingerlings in 2-3 months' time. Also feed company about next order of feed for new cycle.
8. Be careful who you talk to. Don't advertise to strangers that you have ponds full of large tilapia.
9. As your fish get bigger you need to open inlet more regularly each day, as they require more oxygen in water. Try doing this for one hour in the early morning and see how it affects feeding response.
10. It is balancing act to maintain good green water whilst also opening inlet to aerate water when necessary.
11. End of month, test weigh your fish. Look for variation in sizes? Do you need to grade? Generally, if you need to grade, it should only be only one time in 8–10-month cycle.
12. Watch carefully pattern of monthly figures in your tables e.g. average test weights of fish in g, monthly weight gain in pond kg, amount of feed you are using in month kg, & FCR figures for each pond. These tell you if you are managing each pond well or not. Why is one pond doing better than the others? The Feeding? Pond fertilisation? Water quality? The pond bottom? Other? Remember you can always improve.
13. If you don't have these records and figures, and can't regularly look and analyse them, then you are fish farming blind and you will not be successful.

Month 6

1. Keep maintaining green water in your ponds & keep feeding 4 X per day.
2. Test pH of pond water weekly. Maintain pH 8-8.5 for pond water, add lime or lime alternatives.
3. Keep dragging chain on pond bottoms & remove sediment through outlet every 3 days.
4. Watch fish carefully, particularly 6-7am each morning or last thing in evening before dark, for fish showing signs of being short of oxygen in water. If fish on surface "gaping" trying to suck in air, this means dissolved oxygen (DO) is too low, & fish are struggling. Also, can mean you are overfeeding. Also, your water quality not good.
5. In this case - Don't feed the fish, turn inlet on, leave on until fish no longer on surface. Wait another hour, then see if they are ready to feed. Only feed when fish show good feeding response.
6. Don't allow strangers on your farm. The fish are getting bigger and worth a lot of money.
7. Other jobs you can do: Put perforated metal sheet below each pond inlet to aerate water more. Improve security on your farm.
8. End of month, test weigh your fish. You will now have significant total weight kgs of fish in each pond. Therefore, the risk keeping them healthy, alive and not stolen is greater.
9. This means each day you have to be even more observant of fish behaviour, their feeding response, & careful to make sure water quality is ok, also water is well aerated. Be careful - don't overfeed.

Month 7

1. Keep maintaining green water in your ponds.
2. Test pH of pond water weekly. Maintain pH 8-8.5 for pond water, add lime or lime alternatives if necessary.
3. Watch carefully fish carefully for gaping on surface, lack of feeding response. Open inlet to allow fresh water in.
4. Also, if this happens more regularly, start reducing kg & frequency of animal & chemical fertilisers in ponds.
5. It is balancing act to maintain good green water in pond, whilst also opening inlet to aerate water when necessary.
6. At this stage, even earlier in cycle, its good routine practice to open your inlet for 1 hour at 6-7am each morning before first feed, then again at 4-6pm in evening after you've finished feeding.
7. As your fish get bigger you need to open inlet more regularly each day as they require more oxygen in water.
8. Keep dragging chain on pond bottom & remove sediment through outlet every 3 days. Always do this early morning before you feed.
9. Don't run out of feed! Always think at least one month ahead to ensure you have enough feed.
10. Continue enquiries about selling fish in next month? Try to agree minimum Rwf 3500-4,000 per kg.
11. End of month, test weigh your fish. They should be now getting close to size/weight you can harvest.

Month 8

1. Keep maintaining green water in your ponds but start reducing frequency & kg of fertilisers put in.
2. Before - Get everything ready you need to harvest the fish.
3. This includes: scales, hand nets, plenty of clean buckets, plastic bags, cool boxes, tarpaulins, ice if you wish to use it, calculator, records book, receipt book.
4. From your test weights also from the demand/assurances you have from those who want to buy, you should have good idea if you're now ready to harvest or not.
5. You can partial harvest to remove larger fish – anything over 250g av wt is sellable at good price.
6. This is personal decision to harvest or not at this stage, but take advice of your Extension Officer.
7. If you do harvest – If you have plenty of water, open pond inlets and let run 24 hrs per day for 3 days before you harvest, allowing pond water colour to become clearer. This will improve condition and taste of fish before selling.
8. Then stop feeding the fish 24 hours minimum before your harvest day.
9. This will empty their intestines & make them easier to handle live at harvest. They will also stay fresher & in good condition for longer after harvest, thereby making them easier to sell.
10. Designate one person on harvest day you trust to keep written records of each customer sale, total kg, total numbers of fish, price sold per kg, total income from all sales at end of the day.
11. If you don't keep these records then you don't know if you're making a profit or not.

Month 9

1. Depending on whether or not you started harvesting the month before:
2. If not, assess your monthly test weights in each of ponds & make decision if you're ready to start harvesting.
3. Continue to watch your fish & their behaviour every day. At this stage up to 250-300g average weight per fish you will be feeding a lot of feed each day. Just feed to their appetite. Take care to not overfeed.
4. Watch for signs of "gaping" on surface and low feeding response – indicating low dissolved oxygen (DO) of the water.
5. Try to more regularly open inlets each day to let in fresh water, i.e. 1 hour in the early morning, one hour 4-5pm in late afternoon.
6. At this stage you can reduce kg and frequency using animal or chemical fertilisers. Each of these if over applied can reduce oxygen levels in ponds which now have 100's of kgs of larger fish.
7. If yes to 1. above think about harvesting & emptying 1-2 more? of your ponds, so you can then start preparing them for next fingerling stocking.
8. As a business, any time when ponds are sitting empty & not being used are losing you money. Minimising turnaround time to prepare & restock with new fingerlings is critical to you making more profit.
9. Also, once your fish reach a market size you can sell, the longer you leave them in the pond still feeding them, the slower they will grow, so keeping fish in ponds after M10 M11 M12 you are just wasting your money, better to harvest, sell and restock with fingerlings as soon as possible.
10. Plan ahead. Contact hatchery about ordering new batch of fingerlings. Also feed company about next order of feed for new cycle.
11. Think & plan carefully what you will do with the income/profit from your sales. Before anything else, make sure you use this money to cover cost of your feed and fingerlings for next cycle.

Month 10

1. **By M10 you should harvest & sell all fish remaining in your ponds, empty them & start preparing for next cycle.**
2. **It is not economical to carry on partially harvesting them M11, M12, M13 etc.**
3. **You will just be wasting your time & losing money.**
4. **When all your harvesting & sales finished carefully look through all your records, your income made against all your costs including feed, fertilisers, labour etc so that you know if or not you have made a profit.**
5. **Up to you, but if you want to succeed & become standalone profitable fish farmer, you must at least in first 2-3 years reinvest most if not all your income made from fish sales back into your fish farm, fish feed/ inputs & labour costs for next cycle, new equipment? renovating your ponds, making your site better.**
6. **Instead, if you spend this first income on things outside of your fish farm, e.g. distributing out to cooperative members, building new cow shed, school fees etc then you will never become a financially viable fish farmer.**
7. **Also, if you do show you are reinvesting your income from fish sales back into the fish farm, you have far better chance in future of being successful applying for loans or new financial partners to further develop your fish farm business.**

We will now go on to describe in more detail the key above activities and how to carry them out. But noting that a number of them i.e. pond fertilisation have already been covered in detail in the previous manual which you should refer to. For these we will summarise the main points.

Mixed sex or all male tilapia fingerlings?

Firstly a few important notes on how receiving and stocking all male or mixed sex tilapia fingerlings into your ponds can affect your final harvest and income/profit made:

- Normally to avoid excessive breeding and large numbers of much smaller fish in your ponds as the production cycle develops, it is better to buy all male tilapia fingerlings.
- Always try to choose and buy all male fingerlings from a good, well-run hatchery, who know how to produce all male fingerlings and have been doing this for a number of years.
- There are certain questions it is important that you ask the hatchery before you buy:
- What is the % male in each batch of all male tilapia that you are selling? They should know this – if they don't, then be very wary, look elsewhere.
- A minimum % of males in any batches sold to go into ponds is 95% males (97-98% is the standard acceptable in Thailand/south Asia) – anything less than this then you will after 2-3 months begin to see large numbers of tiny fry in your pond which will quickly start eating and wasting the feed meant to be going to the original fish stocked.
- As a result of this, the stocking densities in your pond will go up very high, the growth rates of your original fish will decline, and unless you do something about this quickly, you will end up after 8 months with a pond full of small size fish which are worth not much money.
- In the scenario you buy what you believe are all male fingerlings (a high % males) and then find after 2-3 months when the fish are only 30-50g, the fish in your pond start breeding and producing large numbers of tiny fry, then if you want to ensure your end harvest will still be good – i.e. the original

fish stocked go on to grow to an acceptable average wt i.e. 250 – 300g minimum, then you have to act immediately when you first see the tiny fry in your ponds:

- Once you see these tiny fry you have to start netting your pond to remove as many of these fry as possible and on a regular basis.
- To remove as many of these tiny fish as possible net your pond using a very fine mesh netting – many people use hapas, but be sure to do this first thing in the morning before you first start feeding.
- Net the pond 3-4 times to remove the majority of the small fry. Gently put the larger original fish stocked back into the pond each time.
- The best pond farmers also combine other routine pond management activities as described in this manual with this fry removal i.e. when test weighing the fish once a month.
- Removing fry from your pond should be done at least once a week for the whole rest of the production cycle i.e. 8 months. You will make more income in the end from doing this than trying to keep these fry in the same pond and trying to grow them on. If you don't remove them regularly with a net, they will quickly within a few months take over the pond, become stunted and stop growing.
- If you have spare empty ponds, you can use these 2nd generation fry to stock these, but be sure to stock at a proper stocking density 3 per m2, test weigh them, and stock at a regular size / no variation – so you might need to grade them first before you stock them. But it is always better to stock any other empty ponds you have with original hatchery produced all male fingerlings.
- If you don't have any spare ponds, you are best to humanely kill these small fry, dry them in the sun, and then grind up into a powder and add back into your feed for the original fish. Or you can sell them per kg weight to your neighbours to fry and eat.
- It cannot be emphasized how important it is to remove these small fry from your pond throughout the production cycle – if you don't then you will not make money.
- Also to add the better the hatchery is – the higher % males you will get in each batch over 95%. The higher the % males the less breeding and fry producing will happen in your pond, and the bigger your original fingerlings stock will grow to by the end of an 8-month cycle.

Pond fertilisation

- Successful pond fertilisation and obtaining green water in your ponds is one of the key activities which will determine if you get good growth of your tilapia or not. It should be taken very seriously as a key management activity throughout the production cycle.
- Crucial to fertilising ponds properly is to regularly sample and know the pH of your pond water on a weekly basis.
- This can be done by using relatively low-cost pH papers or strips which are available for sale in certain outlets in Kigali – ask your EO.

Figure 4 Different methods of measuring pond soil and water pH on your farm

- To obtain good green water blooms in your ponds the water should have pH of between 7.5- 8.5. If any lower then you need to add lime or burnt maize cob ash to your pond.
- Methods of application and doses can vary depending on many factors. Different ponds have different substrates and conditions. See table below.
- When adding lime to a pond with fish in this should be done first thing in the morning before the fish are fed. Then wait for at least 1 hour after liming to start feeding the fish.
- There are different methods of application. You should experiment and find out which one works best for your ponds in raising the pH.
- Standard method: Mix calculated dose of lime into 3 buckets of water, make sure that all the powder is dissolved, then with a 500ml or 1 litre measuring jug or cup walk around the whole pond carefully throwing/ spreading the liquid over the whole surface of the pond.
- The burnt maize cob ash is less alkali, less strong so you will have to add more kg and again experiment each time you use by gradually increasing the dose until in a period of 24 hours after treating, you see pond water pH becoming more alkali and also green colour.

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.

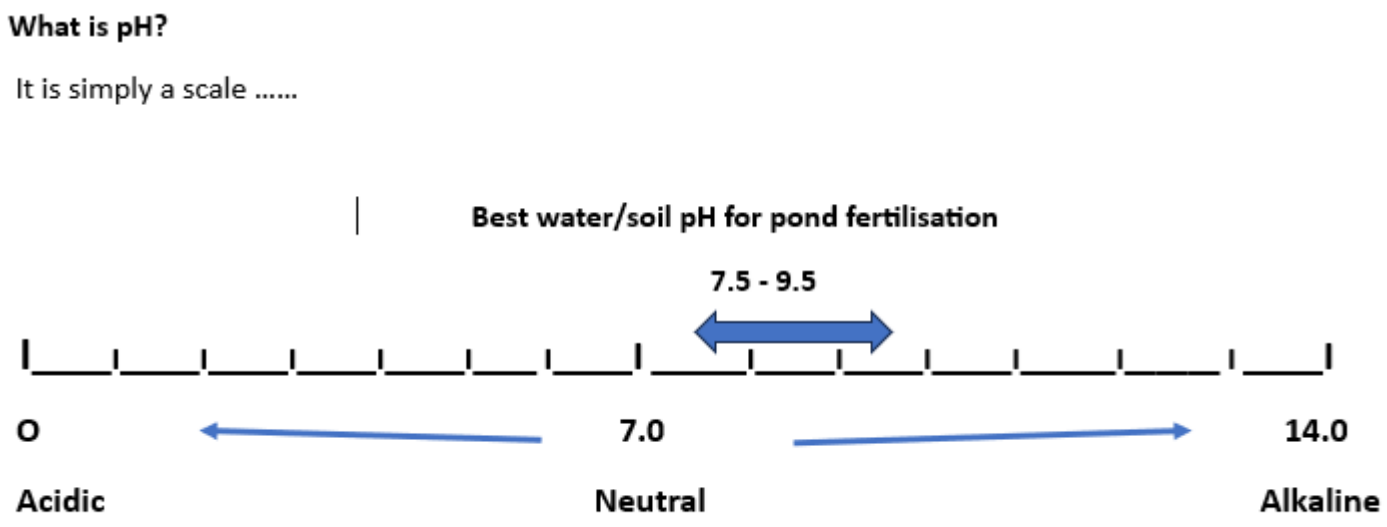

Figure 5 pH Scale Optimum pH for pond fertilisation

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

Fertilisation and maintaining green water throughout the cycle

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 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

- These livestock wastes can be applied in three ways when there are fish in the pond:
- 1. Mix the waste well **into 3 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 4 or more tied, **empty plastic feed or fertiliser bags** which have a number of small holes in - Either put these bags in the water in the four corners of the pond or better suspend bags in the water at equal distance along a rope which goes right along the middle of the pond from the inlet to outlet end of the pond. Make sure the rope is tied tightly at each end so that the top of each bag is clearly visible at the surface of the water. You can also use wooden stakes into the bottom of the pond to take the weight of each bag.
- Depending on the water colour **you should change these bags adding fresh manure at least once every two weeks.**
- 3. Place the livestock manure in a circular wickerwork woven basket approximately 50cm in width and 30cm deep. Put this inside an inflated car or lorry innertube so when on water it will float.

- Tie 2 equal lengths of rope on either side of the basket so that for your pond two people stationed on opposite sides of the pond, can slowly walk and drag the basket inside the inner tube with livestock waste in it up and down the pond 2-3 times each morning and then 2-3 times each evening. When finished tie the rope so that the basket stays in the middle of the pond floating near the surface.

Figure 6 Type of Basket that can be used with innertube to distribute lime, fertiliser also feed in pond

- Note that this method can also be used to dispense other inorganic fertilisers (see below) throughout the pond, also in south Asia such baskets with slightly bigger holes are also suspended in the middle of ponds filled with different types of subsidiary feeds i.e. rice bran, Colocasia leaves etc so that the fish can come and help themselves if they are hungry.
- Again, experiment to see which methods of administering fertilisers and or lime work the best for your pond in order to get and keep green water. Noting carefully **how often you have to refill the bags or basket in order to get and maintain green water.** This should be done throughout the production cycle.

Inorganic Fertilisers

Figure 7 Different types of fertilisers, also Travertine (tradename in Rwanda) a type of agricultural lime

- 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
DAP (Diammonium Phosphate)	0.15kg or 150g	15g
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

Sample Calculations For 600m² pond

1.Lime Dose: 10kg for 100m²

For 600m² pond = 6 X10kg = 60kg lime

2.DAP Dose: 0.15kg or 150g for 100m²

For 600² pond = 6 X 0.15 = 0.9kg or 900g DAP 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

- Mix thoroughly these fertilisers into 3 buckets 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. Or as above you can use the basket and ropes method to distribute the fertiliser equally throughout the pond.
- Applying 140g of urea, and 150g per 100m² of DAP per 100m² provides approximately the same nutrient input as 30g NPK per 100m² (depending on NPK ratio).

Maintaining green water in your pond

It is very important that you 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

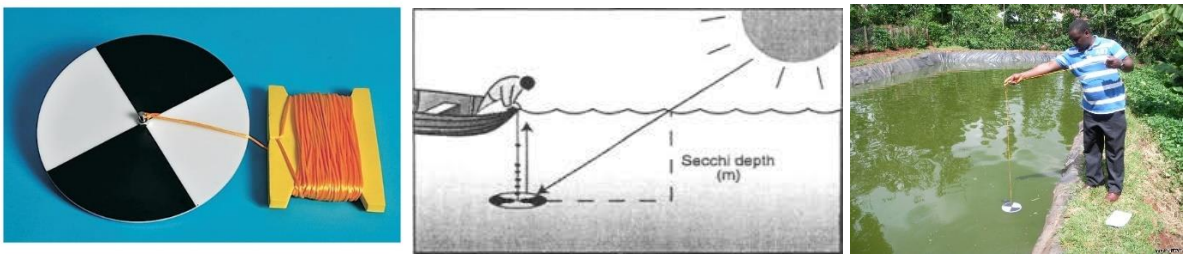

Figure 8 Secchi disc for measuring good pond fertilisation

- 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 be 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:
-

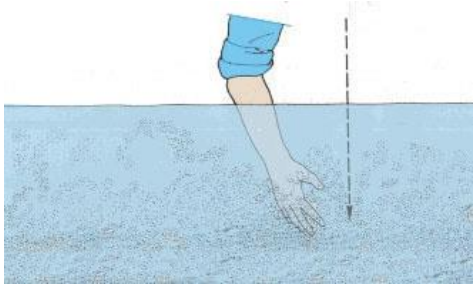

Figure 9 Testing Pond water fertilisation using your arm

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 7.0 or lower then you need to add some more agricultural lime – **at 15-20kg per 100m² pond area**. Dissolve this in 3 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 2-4 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.

Feeds and Feeding

Table 4 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. This will quickly reduce the water quality, reduce the fish growth and then can cause fish disease problems.

- Feed is your most expensive input! – Feed carefully!! And make sure the person feeding the fish does it properly even when you are not there. This person is the most important person on your farm.

- Noting as you go through the production cycle from M2-M8, each following month you must be feeding more feed to each pond as the fish are growing and will require more feed per day as they grow bigger.

- As above, best on the farm to feed each day to appetite of the fish and no more. Only feed (more) when you still see a feeding response. The daily feeding rate % of body weight for different sizes of fish should be used as a guide not kept to strictly. Feed to appetite.

- From M2 onwards try to feed the frequencies per day shown in the table, using a bucket and scoop to spread the feed. When the fish are still smaller feed little and often.

- Where to stand and feed on a pond is a matter of preference. Some people like to feed in just one place - normally near the inlet. Others will slowly walk around the pond throwing in feed in different places, noting where they get the best feeding responses.

- It is good practice to take your time when feeding, making sure you throw some of the feed to the smaller fish which may not be in main feeding mass, the smaller fish can get pushed out of the way.

- Every 3 days before feeding first thing in the morning one should get in the pond in the places where the fish are normally fed and collect a handful of mud from the bottom of the pond. Look carefully to see if any uneaten feed. Also note the smell. If a bad smell the bottom mud of your pond is becoming anoxic/anaerobic and will quickly cause problems. Note later below the simple method of regularly cleaning the bottom of your ponds with a rope and heavy chain. This will make a big difference in how your fish feed, their health and their growth.

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

Average test wt of fish in M2 = 35g

Total Nos of fish in pond = 1000

Total body wt of fish in pond = 35 X 1000 = 35,000g or 35kg

Example calculation of amount of feed to feed per day

35g fish are fed at 2.5% body wt per day (Table above)

So, for 1000 fingerlings at 35g they should be fed:

35kg x 2.5/100 = 0.87kg or 870g per day

These fish are fed 4 times per day so

870 /4 = 217g say 220g for each feed

Note – this calculation is a guide for you – You can weigh out as in this example 870g of feed each morning as a guide for the day for one pond. But when you are actually feeding you should feed the fish to their appetite – i.e. only the amount of feed they will comfortably eat with none left over.

- With this size of fish (35g), you can start feeding from 7 or 8am and then feed 4 times per day finishing around 5.30-6.00pm.
- In a normal day - but not always! - the fish will feed better and eat more for the first and second feeds in the morning. By the third and fourth feed of the day they will tend to take less.
- With fish this size the golden rule is feed a little each time but often. As they get bigger you will be able to feed them bigger amounts.
- 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 fish 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.
- One other useful trick especially when the fish get bigger 50g 100g etc and you are feeding them larger size pellets i.e. 2mm or 3mm or 4mm. Throw in a small amount of the pellets and watch carefully the fish when they come to take them into their mouths. If the pellet size is too big for them, they will spit the pellet out and you are wasting your feed. Feed smaller size pellet. Watch carefully!
- The best fish farmers when the fish grow to a size/weight where they are ready to move on to the next size of pellet, they will for a period of a week or so, mix the two sizes of feed together in the bucket to feed. Inevitably there will still be some smaller fish in the pond, and for them they can continue to take the smaller feed and keep growing.

Figure 10 Different feed sizes on the left a 1mm micro floating pellet which can be fed to fish of 5 – 10g, this in comparison with the "starter" powder used for 1 – 5g fingerlings.

Keeping the bottom of your ponds clean using chain

- This is a low cost but important, regular task that should be carried out for each of your ponds **every 3 days.**
- Its objective is to keep the pond bottom clean and free of suspended sediment, not allowing **anaerobic mud** to build up and **adversely affect water quality.**
- For this you require a minimum length of **10m of heavy-duty metal chain** tied at each end with equal lengths of rope, so that the total length of the chain and ropes easily reaches across the width of your pond.
- This activity should be carried out **early morning** before first feeding, but before doing carefully check that all the fish in the pond are ok, none are gaping up on the surface or are short of oxygen.
- If ok, this requires **two people starting at inlet end.** Place the heavy chain in the middle of the pond then each person very slowly, keeping level with each other, walk down their side of the pond dragging the ropes and chain along the pond bottom down to the outlet end.
- Once at the outlet end **open the outlet**, ie drop the level of the 90-degree bend so as to start draining the water + removing the suspended sediments down to **50cm pond level**. Make sure you have a proper sieve on your outlet pipe.
- Then the two persons go back to inlet end and repeat this procedure - slowly dragging the chain along the pond bottom down to the outlet end.
- Repeat this procedure a third time.
- When doing this it's good to have a person standing next to the outlet pipe to **keep cleaning the sieve** so it doesn't block and the level of water continues to drop. Thereby flushing all of the suspended sediment out through the outlet pipe.
- After dragging the chain three times, keep cleaning the outlet sieve until the water level drops to 50cm, and most of the sediment cloudy water is removed from the pond.
- Then **open inlet pipe** and fill the pond up to normal level.
- Wait **30 minutes – 1 hour** and then try giving fish their first feed of the day.
- If this procedure is carried out regularly **once every three days** the pond water quality will be better, the fish will feed and grow better, and you will make more profit.

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 11 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 12 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**
- For fish between 1-20g from your hand net count 100 fingerlings into the small bucket – make sure you are not adding excess water into the bucket.

- For larger fish you can use smaller sample size ie 20-100g use 50 fish, 100 –200g use 20 fish, and when they are over 200g then a 10 fish sample is sufficient.
- 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 further 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 other 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: 50 fish weigh 1500g or 1.5kg**
   So, 1 fish weighs 1500/50 = 30g
2. **2nd test weight: 50 fish weigh 1550g**
   So, 1 fish weighs 1550/50 = 31g
3. **3rd test weight:50 fish weigh 1600g**
   So, 1 fish weighs 1600/50 = 32g

Final Average wt (g) of one fish = (30 + 31 + 32)/ 3 = 31g

Grading your fish. When? How?

- Most pond fish farmers in Rwanda do not grade their fish. By not doing this they are potentially losing 20% or more of the original fingerlings / fish stocked, thereby losing money.
- It is good practice to grade your fish once during an 8-month production cycle.
- This allows the smaller fish in the pond to be separated out and put into another pond where they will feed and grow better.
- Whilst the bigger fish from the grade will grow even more quickly if they are separated out into a pond on their own.
- When to grade depends on a number of factors:
- To start with when you receive original fingerlings from the hatchery look at them carefully – they should be fairly uniform in size, most good hatcheries will grade their fingerlings before selling.
- If they have a wide size variation on arrival then you cannot grade them straight away as this will cause too much stress and they can die.
- Once they have been put into hapas or into a nursery pond let them settle and feed for 3 weeks. Then these fish can be graded.
- Often it can be a good time to grade these fish around this time one month after arrival when you are also then moving and stocking them into the bigger grow out ponds eg when they reach 10g or above. The two operations can be done at the same time if the fish are handled carefully.

- If the fingerlings are fairly uniform in size on arrival, then you can each month follow their progress as you test weigh each grow out pond at the end of every month.
- When you are test weighing the fish observe closely their sizes and see if there is any variation.
- Normally in this case by Month 3-4 this can be a good time to grade your fish.
- We now go on to describe how this is done.
- **Equipment: you will need:**
- A box grader – there are different types of these see photos below. The grader should have different bar or mesh sizes to allow you to grade different sizes of fish
- These graders can be bought ready made from aquaculture equipment shop in Kigali – the best are plastic imported ones from Thailand or China – ask your EO.

Figure 13 Rectangular and circular plastic fish graders

- Or as in photo below you can get local basket weavers to make very nice hand box graders of different bar/mesh sizes. It is also possible to find plastic kitchen ware larger sieves, plastic bowls/ bins with holes in supermarkets in Kigali which you can also use for grading.
- A seine net with mesh size allowing you to net out all the fish in a nursery pond or in a grow out pond.
- Hand nets again of mesh sizes that will be ok for the size of the fish.
- Scales for test weighing and weighing the fish when moving them
- One or more relatively large plastic bin or rectangular plastic water tank which you will use to grade the smaller fish into.
- At least three hapas of minimum 4m² of mesh size to hold the fish
- 3 or more plastic bucket or bowls. Metal head pans also very useful.

Figure 14 Local made wicker basket fish graders – origin Malawi

- **The process of grading fish from one or more hapas into grow out ponds**
- Don't feed the fish for at least 24 hours before grading. Make sure the hapa mesh is well cleaned to allow proper water exchange
- The hapa/ hapas should be located next to the pond inlet. If they are not then carefully move them 24 hours before next to inlet pipe. Turn inlet pipe on and allow slow but steady trickle of water overnight.
- Also, the night before install your two other hapas next to hapa(s) with fish in. Make sure none of the hapas have any holes in them.
- The next morning turn the inlet pipe on to full flow.
- Two people carefully crowd the fish in the hapa up to one end ensuring they have plenty of water, plenty of space, and the inlet pipe flow is flowing directly through them.
- By crowding them up into one corner - by raising the hapa net you effectively make two sections in this hapa, one with the fish in in water, the other empty also with water.
- In the empty section of the hapa this is where one person will hold the box grader gently lifting it up and down in and out of the water.
- Whilst another person will carefully take a hand net and net out a sample of fish from the other section of the hapa i.e. the fish to be graded. This sample should not be too many - perhaps 3 kg at most. These he /she will then carefully put into the box grader. The other person will then gently lift up and down the grader in the other section of the hapa doing this perhaps for 20 or seconds to allow all of the smaller fish to drop through the bars / mesh into the water in the other section. With the larger fish remaining in the box grader.
- After 20 – 30 seconds all of the larger fish in the grader are netted out using the hand net and carefully put into one of the other empty hapas nearby.
- This procedure is repeated – perhaps it will take 20 or 30 times - until all the fish from the original section of the hapa have been graded.
- You then have two separate populations of fish in two separate hapas – the larger and smaller
- After you've finished grading let the two hapas of fish settle and recover for 30 minutes.
- Then as in the procedure described earlier you test weigh the fish in each hapa taking 3 samples from each and then getting an average test weight for the larger fish and also one for the smaller ones.
- You next take a hand net and net out net by net the larger fish from their hapa, each time emptying your hand net into a plastic bucket with water on your scales and record the nos of kg.
- Then taking that bucket with water carefully and emptying the fish into their new grow out pond.
- Make sure you let them swim out of the bucket under their own steam into the new pond - don't drop them from a height.
- This might take 10 – 20 hand net samples to weigh all the large fish but once completed you will know the total number of kg of fish gone into the new pond and also their average test weight. From these two figures you can simply calculate the total number of larger fish gone into that pond:
- E.g. 98.3 kg (98,300g) total weight of fish at 32 g av wt = 98,300/32 = 3072 fish.
- This same procedure should be repeated with the smaller graded fish in the other hapa. Test weigh – then weigh out total number of kg into another new pond.
- Some people instead of total weighing the graded fish will count one by one the fish emptying them into their new ponds. Whilst this is ok, for thousands of fish this can take a much longer time and can unduly stress the fish more.
- Once in their 2 new ponds you should let the fish settle for 1 hour then see if they will start to feed. Only feed them when they are ready.

Figure 15 Air pump and airstones can be used to aerate water in hapas or tanks below whilst grading

The process of grading fish from one larger grow out pond into two other new ponds

- If you decide to grade your fish when they are already in the grow out pond when they are 30 50 70 g av wt i.e. best to grade around M2 – M4.
- Then the actual procedure is very similar to what is described above so we will not repeat - but with some obvious differences:
- Starve fish the same overnight, in early morning open grow out pond inlet pipe full, seine net pond carefully from outlet to inlet end, hold fish in big bag in water in the seine net directly next to inflowing water.
- Set up on the bank near to the inlet two large plastic rectangular water tank /bins. Into both of these tanks place an empty hapa inside each tank so it lines them – fill both tanks with clean water from the inlet, and place box grader in one tank. Also, if you have electricity or battery powered aerator with air stones as above you can use this to aerate tank water.

Figure 16 Rectangular plastic water tanks used for grading

- Then using same procedure as above but this time hand netting 3-4 kg at a time from the seine net carefully into a bucket of water, hand the bucket up to the person grading, carefully empty bucket with fish into the grader. Grade as above.

- The smaller fish will fall through bars and mesh into the plastic tank- the larger fish carefully net out and place into the other rectangular tank lined with a hapa.
- Repeat this procedure with small bucketfuls until either you have emptied the seine net or before the fish in the two rectangular tanks get too many in number and start to get short of oxygen.
- At this stage same as above – firstly test weigh each tank the smaller and larger fish – then batch weigh each tank 2-3 kg at a time and put the small fish into one new grow out pond and the large fish into another.
- Once your seine net in the original pond is empty, seine net the pond again 2nd time and repeat. After 2nd seine netting, drop the level of the water in the pond to 50 cm and seine net again.
- By now you will be getting smaller and smaller numbers of fish in each seine net.
- When you get very few fish after seine netting then completely drain the pond and remove and grade all the remaining fish.
- With this procedure you need to be careful not to overload the two rectangular tanks when you are grading i.e. too many fish in each so they start to suffer from lack of oxygen. So, from time to time stop the grading and test weigh and total weigh out from each box putting the fish into the two new ponds.
- Some people use a slightly different method to grade grow out ponds- if they have a full earthpond next to the one they are grading from. Instead of using rectangular tanks on the bank to grade into they set up 2 hapas in the adjacent pond and grade the fish into these two hapas - similar to the process described first above.
- Again, the best way is to experiment trying the different methods and see which works best for you.
- Some other points:
- Some fish farmers may have smaller concrete raceways or other tanks on their farm – If these are relatively close to the pond you are grading from you can use these to grade – again lining them with hapas so it is easy and quick to net out the graded fish and weigh them.
- Such tanks if you don't have them are a worthwhile investment for the future as very easy and quick to grade fish into them, also they can have dual use of holding market size fish when you are harvesting ready for sale. A good design is to build two in a block 5m long 1 m wide 1m depth with proper inlets and outlets and screens. Discuss with your EO.

Figure 17: Block of 2 small concrete tanks used for grading also growing on fingerlings – Source Malawi

- Also, if you decide to grade your grow out ponds at M2 M3 rather than your original nursery pond or your hapas – then from one grow out pond you will be approximately halving the numbers you stock into the two new grow out ponds. So, you well might have much lower stocking densities than required in each of these two ponds which is not ideal
- Therefore, it is best to try and grade at least 2 grow out ponds in M2 M3 so that when you grade/divide into bigger and smaller fish you will then be able to stock the two new grow out ponds at good stocking densities – 3 per m^2 3.5per m^2 etc. Thereby you will be getting the most efficient and best growth and production from all of your grow out ponds.
- Please discuss all above about grading with your EO – Together you can best decide for your farm – when to do it? And how best to do it on your farm.
- Grading your fish once in a pond production cycle will make a big difference to your end harvest and overall income and profit.

Sample calculation

What your fish are worth!!!

Say you have a 20m X 30m pond Total area 600m^2

Stocked with 1.5 g fingerlings at 3 per m^2

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**

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.

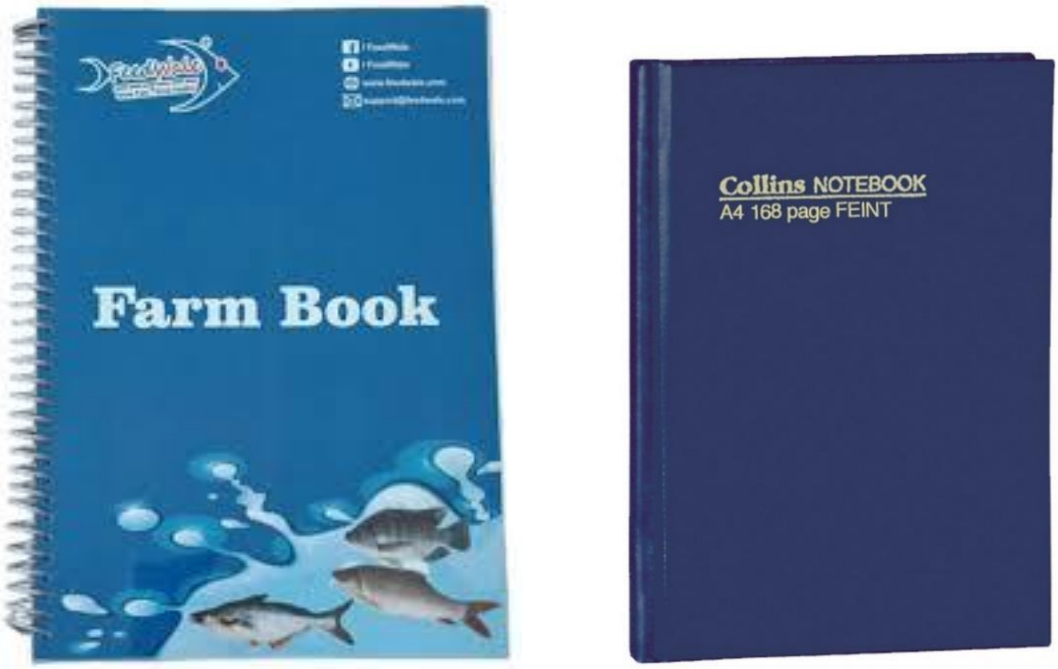

Figure 18 Farm records books.

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 4* to calculate and know how well your pond is doing every month.

Table 4 Example: One Fish Pond production performance each month – This from a Malawian fish farmer who kept these records for her 600m² pond. This Table a must to be kept!! Will show you clearly how well each of your ponds are performing over whole production cycle.

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 Rwf 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 Rwf cost

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

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……..

Photo gallery

Figure 19 Using chains to drag earthponds to remove sediment

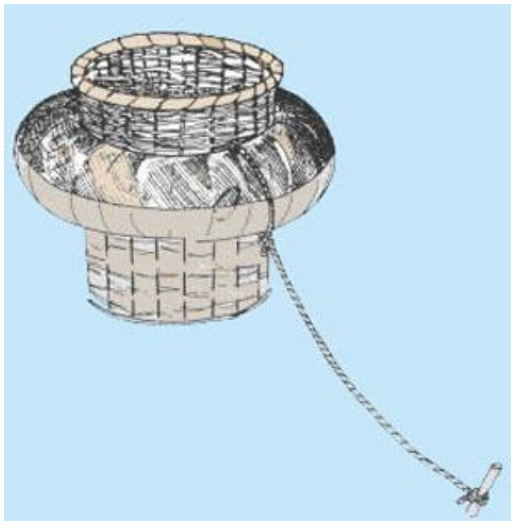

Figure 20 Woven basket inside lorry / car inner tube to distribute fertiliser, lime, even feed in a pond

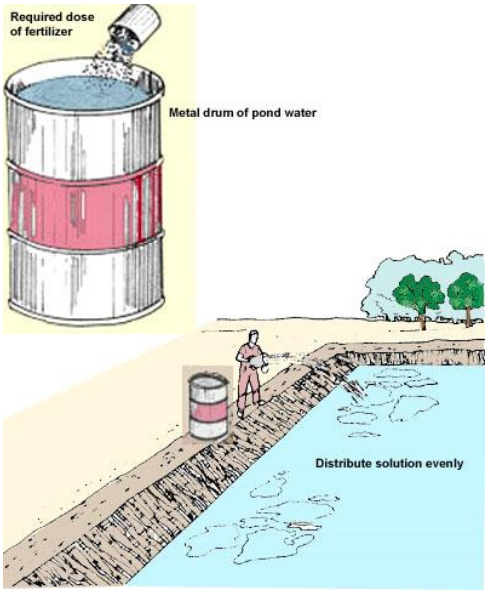

Figure 21 Method for applying fertiliser or lime to ponds

Figure 22 Concrete block tanks showing wooden screens for partitioning and farmer holding Thai mesh basket fingerling grader – Malawi