FISH FARMING

Importance of fish farming

a) Source of good quality protein rich food

b) Source of income to farmers and revenue to government

c) Creates employment opportunities

d) Contributes to National food security

e) Optimizes use of water resources

Production Systems

Basically 3 production systems i.e intensive, semi intensive and extensive systems.

i). **Extensive systems**

- In these systems little or no input is used in the production.
- Fish are stocked in cages, still water earthen ponds and other water reservoirs and left to fend for themselves.
- Low stocking densities and thus low yields characterize the systems.
- major species are the tilapia and catfish.
- common in the small scale subsistence farming of the rural kenya.
- yields range between 500-1500 kg/ha/year.

ii). **Semi-intensive systems:**

- These systems form the bulk of aquaculture production in Kenya.
- In these systems still water earthen ponds and cages are used as holding units for fish culture.
- Still water pond culture uses the natural productivity of the water to sustain the species under culture. However to enhance productivity, the ponds are fertilized using both chemical and organic fertilizers at varying proportions to enhance natural productivity.
- Exogenous feeding using cereals bran and other locally available feeds is done to supplement pond productivity.

Earthen ponds in Kenya

- Commercial production in these systems range between 1 - 3 Kg/m^2/year depending on individual farmers management level.
- Some farmers in western Kenya have achieved production levels of between 6-10Kgs/m^2/year with tilapia and catfish.

iii). **Intensive systems:**

- In these systems water flows in and out continuously (flow through) allowing higher stocking densities. The systems require good supply of good quality water.
- Less land is required to produce the same quantity of fish as compared to extensive and semi intensive systems.
- The systems employ mainly raceways, various types of tanks and floating cages as holding units.
- Feeding is done by complementing or substituting the natural productivity in the culture units by exogenous feeding using complete feeds (the feeds are specifically manufactured for the species under culture) and water aeration. Such

operations require high initial capital investment and high operational cost. They are mainly suited for high value fish like the Rainbow trout.

- Production in such systems in Kenya range from 10 to 70 Kg/m^2/year. This depends on the management levels employed by individual producers. This production can go higher with better management and quality feeds.

successful fish production

The Concept of Commercial Fish Production

The objective of commercial fish farming is to produce fish to supply markets at a competitive price and make a profit. The market is therefore, the driving force for commercial fish farming. The key parameters that determine the levels of production and success in fish farming are water quality, feed quality and seed quality. How one manages these parameters vis-à-vis the prevailing market demand and prices determines the viability of a commercial fish farm. Figure 1.1: Hand Illustration of the Five Basic Components of Commercial Fish Farming. (Adapted from Schmittou et al., 19

i) Fish to be produced

Different fish require different ecological conditions and production techniques to grow.

The choice of what to produce will therefore be guided by:

a) Market preference

b) Ecological requirements of the fish

c) Production technology of the fish

d) Resources available to produce the fish

ii) Proposed farm site:

Fish farming is a long term investment and therefore it is important to know land tenure system of the site. Conflicts may arise regarding land ownership.

The topography of the land will determine whether it will be possible to construct fish production facilities and also the cost of construction. The accessibility of the site throughout the production period is very important. Availability of power and other essential infrastructure should also be considered. The location of the site in relation to the market is also important.

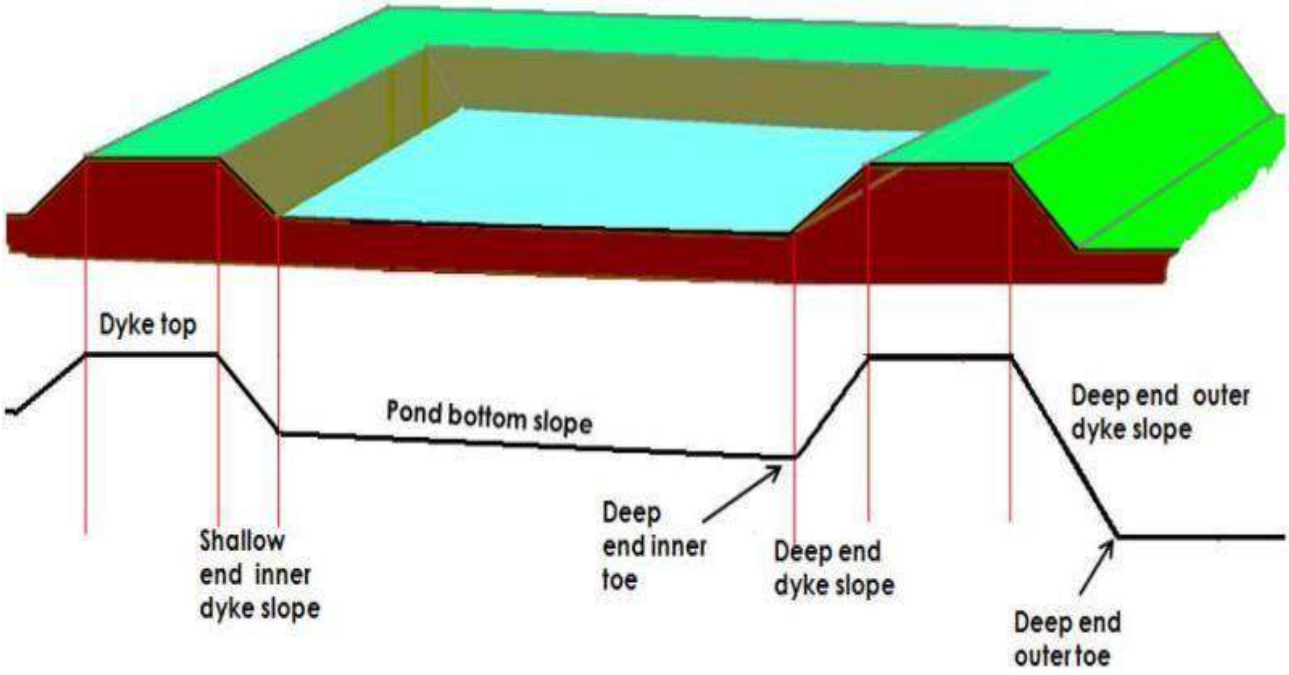
iii) Water:

Fish are aquatic animals. Enough clean water is required throughout the growing period. Will the water be enough to last the entire growing period? Is it of good quality? Water quality refers to consideration for salinity, temperature, dissolve oxygen, acidity/alkalinity (pH) suspended particulate matter. Water that is good for livestock and human beings is good for fish farming. It must not contain excessive disso

iv) Soil

During the process of designing ponds, decisions on the following should be made:

- Total area of the pond water surface (this is the actual pond size)
- The length and the width of the pond water surface
- The water depth and the total pond depth at the deep end
- The slope of the dykes and the pond bottom
- The size of the free board (height of dyke above water level)
- The width of dykes



Steps in the construction

Step 1. Mark out the area that the pond will occupy using wooden pegs and strings and then remove all the vegetation.

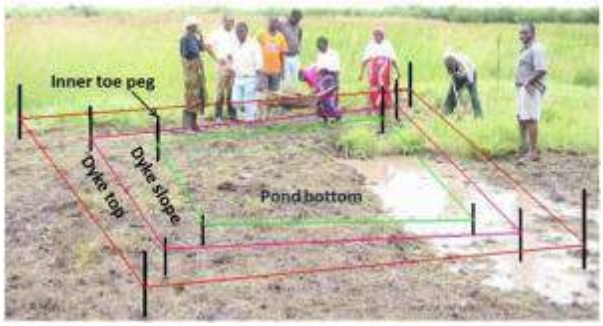
Clearing vegetation from the pond site

Step 2. Remove the top soil and keep it in a good location close to the site. It will be used to cover the pond bottom and the dyke tops to enhance fertility. Remember that if the soil is kept far away, this will increase the cost of pond construction since the soil will need to be brought back.

Step 3. Clear the area within the pond limit of all vegetation including the area within 10 m of dykes and pond structures and any access, water supply or drainage area.

Step 4. Establish a Temporary Bench Mark (TBM). A bench mark is a mark on the ground that establishes the elevation of a place and is used as a reference point for all other elevation. This will allow you to determine and check by use of levelling equipment (e.g. spirit level) the elevations of the dykes, canals and other structures. The TBM should be set and permanently fixed in a protected location during the whole construction period.

Step 5. Using spirit level, measuring tape, pegs and strings, mark out:



A site pegged ready for digging and filling

- The dykes
- Dyke slopes
- Inner and outer toes
- The pond bottom

Step 6. Using the determined pond depths and the actual elevations of the site, determine which areas need digging and which need filling. This is very important because it eliminates unnecessary movements of soil and thus keeps the construction cost at a minimum.

Dig the soil from the dig areas and move it to the fill areas

Step 7. Dig out the soil at the 'dig' areas and place it on the 'fill' areas. Most of the fill areas will be on the dyke position.

Remove boulders and tree stumps from the pond area.

Make sure to remove boulders and tree stumps from the pond area.

Compact the soil properly

Step 8. Once the soil is placed on the fill area, make sure that this soil is properly compacted. To achieve good compaction, place soil in layers not exceeding 15 cm in

height and compact back to at least 10 cm. When constructing dykes, soil layers are place 20 cm inside on top of each other to reduce amount of work during dyke cutting.

Good dykes should:

- Be able to resist water pressure resulting from the pond water depth
- Be impervious
- Be high enough to keep the pond water from overflowing

Shape the dike slope and the pond bottom

To determine the height of the dyke to be built, take into account:

- The water depth you want in the pond
- The freeboard (upper part of a dyke that is never under water). It varies from 0.25 m for very small ponds to 1 m for very large ponds
- Dyke height that will be lost during soil settlement. This varies from 5 to 20 percent of the construction height of the dyke
- Dyke width depending on the water depth and the role the dyke will play for example transportation in the farm

- It should be at least equal to the water depth, but not less than 0.60 m in clay soil or 1 m in somewhat sandy soil
- It should be wider as the amount of sand in the soil increases

Getting the desired slope and uniformity

Dyke slopes should be determined bearing in mind that:

- Steeper slopes erode easily
- The more the soil becomes sandy, its strength decreases, and slopes should be more gentle
- The bigger the pond size, the stronger is the erosive power of the water waves
- As the slope ratio increases, the volume of earthwork increases, and the overall construction cost and the land area required for the ponds increases

Note that the more gentle the slope, the more solid the pond, but very gentle slopes make ponds more expensive and make rooted weeds control difficult. A slope of 50% is the minimum recommended

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The ability of the dykes to hold water can be enhanced by:

- Using good soil that contains enough clay (about 25% clay is best)
- Building a core trench (clayey core) within the dyke where the soil is pervious
- Building a cut-off trench when the foundation is permeable
- Proper compacting of the soil
- Ensuring that the thickness of the dyke is appropriate

Newly built dykes should be protected against erosion by planting a grass cover on the crest of the dykes, on outer slope and on the free board.

The pond bottom should be constructed such that water drains towards a harvesting sump at the deepest part of the pond, in front of the outlet, where all the fish can be concentrated during complete draining of the pond.

Water intakes

Water intake weir for a trout farm

Mbugu Mwangi, Kenya

Main water intakes are used for the overall regulation and transportation of water to the fish farm. They ensure constant supply of water and allow regulation of the amount of water to the farm allowing for diversion of what is not needed.

When setting up main the intake, consider:

- The levels of the water source (river, stream, etc.) in relation to the elevations of the water supply structure and the ponds themselves and where the water will eventually leave the farm.
- The depth from which you want to take the water (surface, lower levels or the complete depth of the water supply source) at the intake

An open water supply canal lined with concrete slabs.

There are several types of canals depending on their use:

- Feeder canals to supply water from the main water intake to the fish ponds
- Drainage canals to take away water from the fish ponds
- Diversion canals to divert excess water away from ponds
- Protection canals to divert water runoff/floods away from the fish farm

All canals should be well designed to have the required water carrying capacity at the required rate. If the water quantity is low and the rate of delivery is slow, pond will take too long to fill.

Pond inlets

There are two common types of inlet structures used in Kenya:

- Pipe inlets
- Open inlets

When designing and constructing an inlet:

a) Place the inlet at the shallow end of the pond

b) Make sure that the bottom level of the inlet is at the same level as the bottom of the water feeder canal and at least 10 cm above the maximum level of the water in the pond

c) Design the inlet structure to be horizontal, without a slope.

d) Make it wide enough to fill the pond completely in reasonable time

e) Make it such that water splashes and mixes as much as possible when entering the pond.

f) Provide a screen to keep unwanted fish and other organisms out

g) Control mechanism e.g. gate valves

Water inlet for a trout raceway

Pond Outlets

Pond outlets are built to:

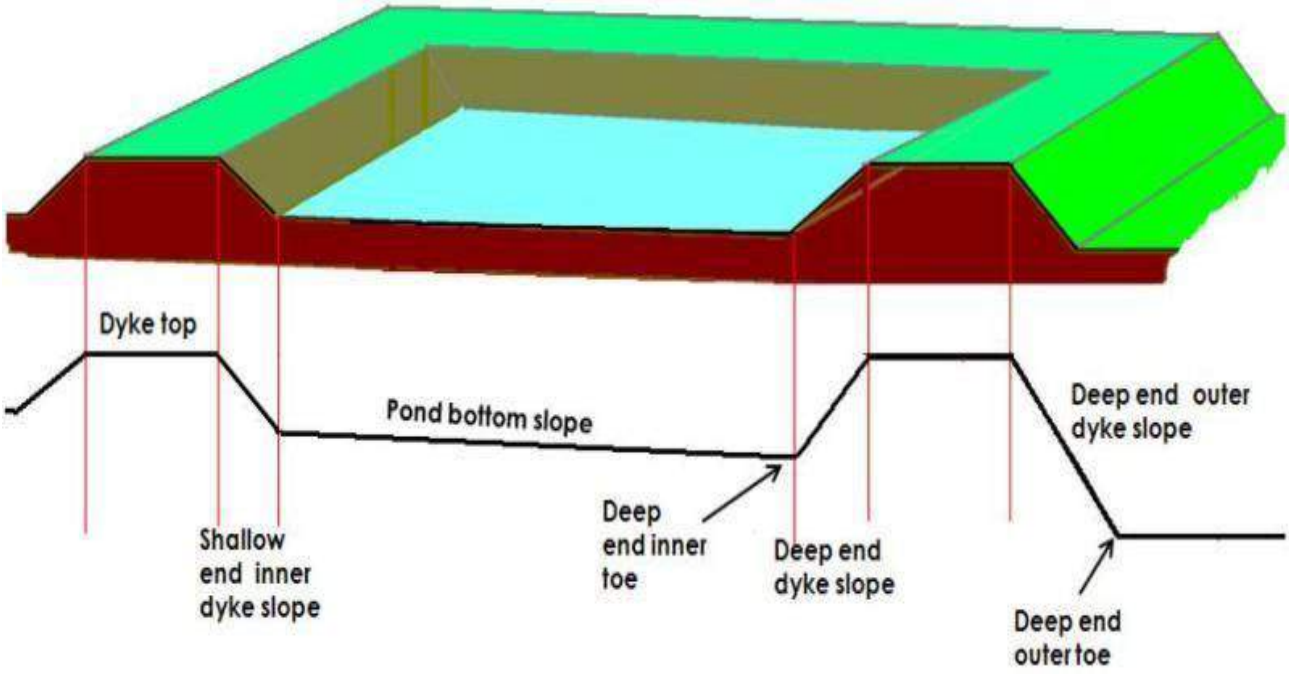
- Keep the water in the pond at its optimum level, which should be the maximum water level designed for the pond
- Allow for the complete draining of the pond and harvesting of the fish when necessary

A good outlet should ensure that:

- The time needed to drain the pond completely is reasonable
- The flow of the draining water is as uniform as possible to avoid disturbing the fish excessively
- Fish are not lost even during the draining period
- Water can be drained from any pond levels
- Allow for overflow of excess water
- Can be cleaned and serviced easily
- Construction and maintenance costs are kept at a minimum

In most cases, outlets have three main elements:

- Water control plugs, valves, control boards, screens or gates
- A collecting sump inside the pond, from which the water drains and into which the fish is harvested
- A conduit through the dyke through which the water flows out without damaging the dykes or the drainage canal



Recommendations for Preparing Ponds for Stocking :

1. Remove excess pond bottom mud and dry pond bottom.

2. Ensure pond is not leaking and is deep enough. Undertake the necessary repairs.

3. Screen the inlet and outlet.

4. Treat the bottom of the pond with lime, if needed such as if pond cannot drain completely.

5. Ensure there are no live fish left in the pond.

6. Fill the pond.

7. Maintain pond record sheets with the details of any management treatments.

8. Check pond water quality before stocking

source of fingerlings

source from reputable organisations that :

1. Can guarantee the good quality of fingerlings or stockers it supplies.

2.Has a good reputation among other farmers (check with other farmers)

3. Follows the stipulated BMPs for hatcheries . The manner in which fish are reared and handled within the hatchery directly affects their health status, survival and potential to perform.

4. The hatchery should have adequate facilities to hold and condition fish before live transportation.

5. Keeps good hatchery records. The hatchery should have a proper record system that enables them as well as the buyer to trace the lot of fish purchased down to the batch in case of any questions.

6. Provide fingerlings above 10cm esp for catfish.

Source of fingerlings:

a) Government fish multiplication centers e.g.

i) Sagana at Sagana in Kirinyaga County

ii) Kiganjo trout centre in Nyeri County

iii) Chwele fish farm at Chwele in Bungoma County

iv) Wakhungu fish farm at Bumala in Busia County

v) Kisii fish farm in Kisii town

b) Lake basin development authority fish farms e.g.

i) Kibos fish farm in Kisumu County

ii) LBDA Chwele fish farm Chwele in Bungoma County

iii) Yala fish farm in Siaya County

iv) Alupe fish farm in Busia County

c) Selected and certified fish farmers .(a list is to be found at Ministry of fisheries Development offices at County levels)

d) Farmers can produce own fingerlings (They need to work with seed production experts for advice)

Transport of fingerlings and stocking:

Factors that affect live fish transportation include:

- Distance and mode of transportation
- Age, size and weight of fish,
- Temperature of the water and nature of transport container.

Prior to fish transportation, fish require to be starved for two days to reduce water fouling while in transit. During transportation it might be necessary to change the water often and even aerate the water. It is also very important to maintain low temperatures during transportation.

When stocking fingerlings into a new pond, it is important to acclimatize the fingerlings first. This is done as follows:

a) Placing the container with fingerlings into the pond and leaving it for about 15-20 minutes.

b) Then allowing the pond water slowly into the container and allowing the young fish to swim out slowly

Fish Diseases

Fish diseases can either be:

(i) Bacterial - which causes diseases like fin rot and tail rot

(ii) Fungal infections - wooly or cottony patches on the surface of fish, and gill rot causing asphyxia.

(iii) Parasitic

- Ectoparasites- Those that occur outside the fish body for example those that cause Black spot, white spot, fish louse and Nematode.
- Endoparasites - Those that get into the body of the fish like the Contraceacum, and the Ligula intestinalis.

(iv) Dietary - High carbohydrate levels in trout feeds, lack of proteins and lipids will result to liver tumour.

Disease prevention in farms

i). Ensure quality and sufficient water supply, with adequate dissolved oxygen and free of pollution.

ii). Maintain clean pond environment by controlling silting, plants and proper phytoplankton and zooplankton balance. Regular pond disinfection is recommended.

iii). Keep the fish in stress free conditions by controlling stocking density, keeping different sizes separate to reduce fighting, providing proper food supply, handling the fish properly etc

iv). Prevent the entry of disease organisms by:

. Preventing entry of wild fish by using screens and eradication them from canals and ponds

. Ensuring that all fish got from outside to the farm are clean without parasites or diseases

. Always use good quality feeds

.Regular monitoring of the water entering the farm to ensure its of quality

v. Prevent the spread of disease within the farm by:

. Controlling predators, particularly birds and mammals

.Disinfect ponds regularly to kill both the disease organisms and their intermediate hosts

. Avoiding water sharing among ponds

vi. In case of disease outbreak,

.Remove sick fish.

. Bury diseased fish with quicklime away from the ponds

. carefully treat infected ponds and disinfect all dead fish from the ponds immediately

vii.. Always disinfect pond and fish handling equipment.This is done by putting LIME before you water the pond and washing the equipment in chlorinated water.

Harvesting Fish

Fish produced for consumption should be harvested when they reach market size.

In Kenya, tilapia are ready for harvesting within six to nine months depending on the :

1. Size at stocking,
2. Target harvest size,
3. Water temperature
4. Level of management employed.

The time of harvesting is determined through regular sampling which should be done monthly.

A day or two before harvesting, feeding and fertilizer application should be stopped.

During harvesting:

- Fish should be checked for off flavours
- Fish should be harvested during cool weather (early morning or late evening)
- Harvesting and transportation equipment should be set up well in advance to ensure reduced stress and minimal fish mortality.

Pond harvesting can be partial or complete.

Tilapias are best harvested by seining for partial harvesting and complete drainage for complete harvesting.

This can be done by either draining the ponds or harvesting when filled.

You harvest when ponds are filled when doing partial harvest,when water is scarce or where draining by gravity isnt easy.

partial harvesting involves removal of part of the fish stocked from a fish pond and the rest allowed to continue growing.

Complete harvesting involves removal of all the fish stocked from the pond.

Equipment required in harvesting fish include, seine nets, scoop nets, clean plastic buckets and baskets, clean source of water and clean fish storage containers.

Once harvested, fish should be handled with care and transported to the market while still fresh.

Where the fish are not destined for immediate sale, simple processing at the farm level can greatly reduce post harvest losses.

Simple processing would include:

i). Gutting and scaling

ii). Sun drying

iii). Smoking

iv). Salting

v). Frying

vi). Deep freezing

Marketing

- Fish has ready market in the locality as its widely consumed in kenya.
- You can preserve and send to major towns where there are hotels.
- Most of the fish is sold at farm gates or at the fish ponds .

- The marketing channel for aquaculture products is very short : Producers to consumers or retailers.
- Quantities sold- generally small and supply is inconsistent.
- No group marketing. Buyers include institutions-(restaurants, schools), and private individuals form the local community
- Fish is sold fresh but some low cost preservation technologies (smoking, deep-frying) are used to add value to their products. Fish producers contact buyers about availability of fish and pricing using mobile telephone, person to person and public Barazas. Most marketing is done by women.

Low returns due to absence of: Established marketing mechanisms, Infrastructure (cold storage and refrigeration facilities, transport) Information on potential lucrative markets, Value addition on fish products and Certification.