Draft Tanzania Standard

Code of practice for aquaculture production
Part I - Tilapia Farms

0 FOREWORD

The science of cultivating marine or freshwater food fish, such as salmon and trout, or shellfish, such as oysters and clams, under controlled conditions has been developed and fish production is growing. Farmers have experienced survival of up to 100% with increased growth rates. Therefore, this code of practice has been prepared to guide fish farmers especially tilapia farming in order to ensure safety and quality of fish produced under aquaculture.

1 SCOPE

This standard provides guidelines to Good Aquaculture Practices (GAP) for Tilapia in pond, tanks, cages and, raceways farming, harvesting and post - harvest handling in order to produce Tilapia of with required safety and quality for human consumption. This standard does not cover hatching and nursing.

2 NORMATIVE REFERENCES

The following referenced standards are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced standard (including any amendments) applies.

CAC/RCP 52-2003, *Code of practice for fish and fishery products*

3 TERMS AND DEFINITIONS

For the purpose of this standard the following terms and definitions shall apply:

3.1 aquaculture
the cultivation of aquatic animals and plants, especially fish, shellfish, and seaweed, in natural or controlled marine or freshwater environments.

3.2 biosecurity
measures designed to protect a population from transmissible infectious diseases.

3.3 chemicals
any substance either natural or synthetic which can affect the live fish, its pathogens, and the water, equipment used for production or the land within the aquaculture establishment.

3.4 cage
a container enclosed on all sides and bottom by mesh materials that permit free exchange with surrounding water used for holding fish.

3.5 diseased fish
fish on or in which pathological changes or other abnormalities that affect safety and quality are apparent.

3.6 fallowing
practice of leaving ponds empty of fish for a period of time.

3.7 feed additives.
means chemicals other than nutrients for fish which are approved for addition to their feed.

3.8 fish farm
is an aquaculture production unit (either land-or water based); usually consisting of holding facilities (tanks, ponds, raceways, cages), plant (buildings, storage, processing), service equipment and stock

3.10 tilapia
a common name for specie of cichlid from tilapiine cichlid tribe.

3.11 veterinary drug
any substance applied or administered to any food-producing animal, whether used for therapeutic, prophylactic, or diagnostic purposes or for modification of physiological functions or behaviour

3.12 stocking density
is the number or biomass of fish stocked per unit of area

3.13 withdrawal time
period of time necessary between the last administration of a veterinary drug to fish, or exposure of these animals to a veterinary drug, and harvesting of them to ensure that the concentration of the veterinary drug in their edible flesh intended for human consumption, complies with the maximum permitted residue limits

3.14 raceways
narrow, shallow and long canal often divided into compartment (culture-units) wherein aquatic organisms are raised under continuous flow system

4 PRE- REQUISITE FOR TILAPIA FARMS

4.1 Farm-site

4.1.1 Tilapia farms should be located in such a way that they are free from potential sources of contaminants (physical, biological or chemical) to reduce the risk of contamination.

4.1.2 The soils shall be impervious to water to avoid the ingress of possible pollutants and minimize underground seepage.

4.1.3 Before building a land-based aquaculture facility intensive and semi-intensive farmers are required to survey and carry out sample analysis of the soil to determine the concentration of micro-contaminants (heavy metals, pesticide residues and microorganisms) which are of importance for the safety of live fish and end products, .

4.1.4 For intensive aquaculture production purposes an Environmental and Social Impact Assessment (ESIA) study should be carried out in accordance with the conditions set by the relevant authority.

4.1.5 Document and date the condition of the farm site prior to establishment or at the time the producer begins to operate at a given site. Revise the list of documents and remove those which are not applicable.

a) Record the size of farm site and water surface area of production (hectares).
b) Identify key, central points of farm location.
c) Develop a schematic of farm to identify specific locations of all water inlets and outfalls or where aquaculture establishment are situated.
d) Changes to the size of the aquaculture operation should be kept up to date.

e) If available, satellite imagery should be available to confirm farm schematic.
f) Determine the receiving water body type – ocean, estuary, river, stream, lake, reservoir or no receiving water (when no discharge exists at farm site).
g) Contact local and national government offices to obtain, if available, an official national government certification that the tilapia species being cultured was established
h) Description of the major activities (beyond your operation) impinging on the receiving watershed.
i) Environmental Social and Impact Assessment(s) for initial farm siting and for expansion shall be housed on the farm site, if conducted.
j) Any other pertinent information regarding the receiving waters and any effect of farm activities shall be inventoried and housed at the farm site.
k) Farmers that conduct stewardship activities to protect the receiving watershed from pollution should articulate and document these activities and house descriptions of activities on farm.

4.2 Pond Culture

Pond culture should be practiced where it is convenient in receiving seeds; delivery of inputs and feeds; harvesting procedures and in managing and planning other operations for compliance.

4.2.1 In accordance with relevant regulations, a pond fish farm should be registered with relevant Authorities. Registration should be used as an official document to allow government authorities recognize the farm-site location, and to further facilitate the process for any assistance to be provided as appropriate. In the procedure of registration, farmers should have to identify the evidence on the rights to use land, possession, or legal land rental by law.

4.2.2 Should not block access to public areas, common land, fishing grounds or traditional natural resources used by local communities.

4.2.3 Farm-site shall be located in an area where the supply for the clean, suitable and sufficient volume of water with a pH 6.5 to 9.5 and dissolved oxygen of not less than 4 mg/l can be obtained.

4.2.4 In order to prevent contamination from polluted sources, farm-site shall be located away from industrial factories, waste from communities.

4.2 5 Farm site should have no record or infrequent incidence of flooding.

The farm-site should not be located in areas prone to flooding or tidal tides in order to avoid damage to and contaminants flowing to the farm. In the case that farm is located in a flooding area, protective measures need to be put in place in advance.

4.2.6 Water quality criteria for land-based farms

Pond water contains two major groups of substances:
a) Dissolved substances made of gases, minerals and organic compounds
b) Suspended particles made of non-living particles and very small plants (phytoplankton) and animals (Zooplankton)

The composition of pond water changes continuously, depending on climatic and seasonal changes, and how a pond is used.

Table 1??The following recommendations are made for the maintenance of good water quality:

No	Parameter	Standard unit	Remarks
	pH (standards units)	6.5-9.5	When pH of water is consistently low i.e. acidic conditions (water tests sour, prevents phytoplankton growth despite fertilization, etc.) the pond should be limed (using agricultural lime) to bring to the desirable pH level of 6.5 -9.5.

	Total suspended solids (mg/L)	100 or less	Maintain pond water at green colour (too deep green colour should be avoided). Prevent run-off water (which may contain silt, clay or sand which clog gills and cause anoxia, or pollution from entering the pond by construction of proper drainage channels across flow of water. Also install sand-gravel filters or siltation tanks along supply channel.
	Soluble phosphorus (mg/L)	0.5 or less	
	Total ammonia nitrogen (mg/L)	5 or less	Prevent toxic pollutants from entering your pond by proper site selection. Locate ponds away from industrial centres, oil fields and chemically treated agricultural fields.
	5-day biochemical oxygen demand (mg/L)	50 or less	Maintain water depth at 1 – 1.5 m.
	Dissolved oxygen (mg/L)	4 or more	Avoid or watch out for cause of low dissolved oxygen (excessive fertilization of ponds and heavy plankton blooms, excessive feeding/high feeding rates, overcrowding/very high stocking densities and extended periods of cloudy weather). Symptoms include when fish come up to the water surface to gulp for air, when the water has offensive colour, and presence of scum over surface water. If symptoms of low dissolved oxygen are detected, take immediate action (i.e. stop fertilization, decrease feeding rate, renew water completely or replace with fresh oxygenated water, etc.)
	Chloride discharge into freshwater (mg/L)	800	

4.2.7 The drain system for the pond shall be properly designed to prevent contamination among the ponds inside the farm. In addition, this facilitates better farm management as well as cost-effective for energy consumption and expenses for pumping water in or out of the farm.

4.2.8 Availability of basic utilities is an important factor for smooth operation and management. Farms should have access to basic utilities such as electricity supply for water pumping and aeration.

4.2.9 Requirements for construction of Commercial Grow-Out Ponds

The pond levees should be well compacted with a slope of at least 2:1

a) The greater the degree of compaction, the stronger the levees hence during construction, one should lay down about 15 cm of soil which, when compacted will become about 10 cm high.

b) There should be no stumps or debris left within the pond levees.

c) Soil should be compacted shortly after it is laid to prevent hardening (some soils become rock-like if they are allowed to harden).

d) The pond bottom should be firm, without pot-holes and gently sloped (1 to 2%) from the inlet to outlet.

e) Average water depth in a pond should be 1 meter (0.8m at the shallow end to 1.2m at the deep end) for ponds without aeration.

f) Inlet pipe at least 20 cm above the pond water level and screened with a properly fitted sock.

g) Outlet pipe fitted with anti-seep collar and screened correctly with cone mesh.

h) Freeboard of about 30 to 50 cm depending on the size of the pond and its levees planted with grass are recommended.

i) Having a harvest basin is highly recommended especially in breeding ponds.

j) The pond should be able to drain completely.

k) Preferably, the pond should be rectangular in shape.

l) It is also common among fish farmers to let the bottom of the pond dry out before the new fish arrives in order to kill off any fry and fingerlings that might otherwise interfere with the new production cycle.

m) Warming up the water during dry season should heat the water during the cold season to avoid production stop with recommended water temperature 25 - 30 ºC.

n) Death occurs at temperature drop below 10 ˚C depending on Tilapia spp. and temperature below 13 ºC are harmful to immune system of the fish.

4.2.10 Requirements for preparing ponds for stocking

The steps below should be followed to prepare ponds for stocking:

1) Remove excess pond bottom mud and dry pond bottom in order to kill off any fry and fingerlings that might otherwise interfere with the new production cycle;
2) Ensure pond is not leaking and is deep enough;
3) Undertake the necessary repairs;
4) Screen the inlet and outlet to ensure that no live fish is left in the pond;
5) Treat the bottom of the pond with lime for pond that cannot drain completely for kill of parasites and ;cysts
6) Fill the pond with water and maintain water depth at 1-1.5 m;
7) Check pond water quality before stocking as indicated in Table 1; and
8) Maintain pond record sheets with the details of any management treatments.

4.3 Cage Culture

The on-growing and production of farmed aquatic organisms in caged enclosures has been a relatively recent aquaculture innovation. The perceived current issues and challenges to cage culture development, and in particular the need to minimize the potential environmental and ecosystem impacts are pivotal.

The fundamental issues of cage culture are; discharge of untreated wastes, mass escapes, diseases and parasites (which can spread to wild populations), the use of toxic chemicals and fish feed, care of other water users such as water abstraction points, navigation channels, fishing grounds.

4.3.1 Requirements for cage culture

The following requirements are key to establishment of cages carried out in public rivers/ open water bodies.

4.3.2 Cage farm should be registered with relevant competent authority.

4.3.4 Farmer should observe the legal rights of possessing land and water areas.

4.3.5 Cage-site shall be located in the area where the supply of clean, suitable and sufficient volume of water with a pH 6.5 to 9.5 and dissolved oxygen of not less than 4 mg/l can be obtained.

4.3.6 Cage-site shall be located away from pollution source. In case that the cage site is subjected to tidal current or located in upstream/downstream area, the farmer shall ensure that the cage-site will not be affected by pollution sources. Prerequisite information such as possibility and levels of pesticide contamination in the water, outflow from the other agricultural activities located at upstream Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) analysis is required.

4.3.7 Cage-site shall be located in the area of good accessibilities (i.e. road, river, canal, etc.) This will be convenient for receiving seeds, feeds, and other inputs. This is essential for management and marketing throughout the farm's production processes.

4.3.8 Availability of basic utilities is an important factor for smooth operation and management. It includes power supply for water pumping and aeration and clean water for farm's employee consumption.

4.3.9 The placement of the cage in a water system shall be such that it does not obstruct the flow of water or the navigation of water vessels such as boats. It shall also be in a place that facilitates adequate aeration for best growth of the fish with minimal disturbances from aquatic plants.

4.3.10 Cage culture development should be prohibited in the following areas:

a) Areas of military or security interest or activities;
b) Published anchorages (where ships and boats anchor) and their defined berths;
c) Established navigation channels for ships or ferries or any other form of water transport;
d) Established harbours (where ships and boats seek shelter from stormy weather, or are stored for future use) and harbour approaches;
e) Marinas or mooring areas with structures to which vessels may be secured such as piers;
f) Fish sanctuaries and Marine Protected Areas (MPA);
g) Cables, pipelines and drilling platforms;
h) Parks, conservation and heritage or tourist sites;
i) Gazetted fish breeding sites, fish spawning and nursery grounds;
j) Existing domestic and industrial water intake and extraction points;
k) Fish migration routes;
l) Existing hydropower plants;
m) Core Zones of Ramseur sites;
n) Areas gazetted under the Lacustrine Statutory Instrument;
o) Areas where water depth and quality fluctuation is high such as seasonal rivers;
p) Effluent discharging gates of industrial and urban effluents;
q) River and stream mouths and sources; and
r) Conflicting fishing areas with capture fishers.
s) prominent areas for wild life including birds nesting
t) socially and culturally important areas

Table 2: No go areas within proximity of some establishments around candidate sites

SN	Establishment	Distance with not go within
1	Shore line	200m
2	Areas of military or security interest or activities;	2km
3	Published anchorages (where ships and boats anchor) and their defined berths (sufficient space for a vessel to manoeuvre);	500m
4	Marked navigation channels for ships or ferries or any other form of water transport;	100 m
5	Established harbours (where ships and boats seek shelter from stormy weather, or are stored for future use) and harbor approaches;	5 km
6	Marinas or mooring areas with structures to which vessels may be secured such as piers;	500m
7	Fish sanctuaries and Marine Protected Areas (MPA);	2km
8	Cables, pipelines and drilling platforms;	100m
9	Parks, conservation and heritage or tourist sites;	100 m
10	Gazetted fish breeding sites, fish spawning and nursery grounds;	200-300 m
11	Existing domestic and industrial water intake and extraction points;	100 m
12	Fish migration routes;	
14	Existing hydropower plants;	1km
15	Core Zones of Ramseur sites	2km
16	Areas gazetted under the Lacustrine Statutory Instrument	1km
17	Areas where water depth and quality fluctuation is high such as seasonal rivers;	500m
18	Known common and important fishing grounds;	1km
19	Effluent discharging gates of industrial urban effluents and other waste disposal points	500m
20	River and stream mouths and sources	1.5 or 3km
21	Landing sites	200 m
22	Weed hotspots (e.g. water hyacinth)	100 m
23	Recreational facilities	500m
24	Conflicting fishing areas with capture fishers	
25	Prominent areas for wild life including birds nesting	
26	social and culturally important areas	
27	public use (drinking water, cleaning, navigation	

4.4 Stocking Density in cages and ponds

4.4.1 Proper stocking densities should be adopted at any given time so as to prevent pollution, diseases and parasites outbreak and maximize profits.

4.4.2 Fingerlings should only be stocked in nursery cages after attaining the initial recommended minimum size of at least 5 g that is efficiently retained by a 5 mm mesh net nursery cage.

4.4.3 For cages a maximum stocking density is 120 kg m^{-3} and the pond is 4 fish per $m^2$and this may be exceeded with special permission issued by the competent authority.

4.4.4 Sites with good water exchange can have high stocking densities, while those with poor water exchange should use lower stocking densities.

4.4.5 Fingerlings for stocking should be graded before stocking and these should continuously be graded throughout the production cycles to ensure uniformity in size at stocking and harvest.

5. INPUTS

There are varieties of inputs used for tilapia culture including seeds, feeds, supplements, vitamins,

probiotics, veterinary drugs, liming, salt and chemicals. The selection of such inputs depends upon the age/size of the tilapia, stocking density and tilapia targeted size.

5.1 Seed

Quality of Tilapia seed is an important variable for the success of the farm.

5.1.1 Selection of good quality seed

a) Quality of the seed includes good external appearing characteristics such as free of deformities, no injuries at all fins, good shape, bright-eyes and scales; actively swimming.

   Seed should be obtained from reputable farm and registered suppliers.

b) The supplying farm should provide appropriate documentation of the seeds, and be able to inform on the quality of seeds being produced and husbandry practices.

5.1.2 Conditioning of fish before transportation

Conditioning of fish should be done in accordance with the EAC code for conditioning and transportation.

5.1.3 General requirements

The live fish seeds shall be stored where they shall not be subjected to desiccation, extreme high and low temperatures and any other type of stress.

Only healthy, disease free and conditioned live fish seeds with minimum of 24 h shall be selected and released for packing and transportation.

Source of live fish seeds shall be controlled to ensure healthy stock in accordance with CAC/RCP 52.

As far as practicable, live fish seeds of the same species and size shall be packed for transport. However, fish seeds of certain compatible species, of uniform size which are non-predaceous in habits can be packed in the same container.

Fish seeds shall be transported by the fastest means possible.

A minimum of 50 % of the space in each polyethylene bag used as a container for holding live fish seeds shall be filled with oxygen, so as to provide a pressure of 1.0 kg /m^2.

The mouth of the polyethylene bag shall be tied tightly to prevent escape of oxygen during transportation

During transport, jerks, jolts and shocks shall be avoided as far as possible.

5.1.4 Specific requirements

Fry and fingerlings for long transportation have to be prepared or conditioned. The most common method of conditioning is to store fry in a cloth ‘hapa’ in ponds or in a still part of a river or canal. The depth of water where a conditioning enclosure is to be installed should be 30 to 35 cm.

The period of conditioning depends on the size and health of the spawn (hatchling), fry and fingerlings, the prevailing temperature and the duration of transport involved i.e.,

a) The fry needs to be conditioned for a minimum of 3 hours;
b) early fingerlings (35-50 mm) for 6 hours;
c) advanced fingerlings (80-100 mm) for 9 hours; and
d) Juveniles (150 mm) for 12 hours.

The bigger the seed, the more time it takes to condition it.

5.1.5 Methods of Packing and Transport

Transport carriers are of two types: (a) open system comprising open carriers, with or without artificial aeration/oxygenation/water circulation and (b) closed system having sealed air tight carriers with oxygen. The choice of transport system depends on the facilities available to the purchaser, the distance, number and size of the fish species.

Place the sealed bags into wooden boxes for protection during transportation. Wet clothes placed over the bags will keep them cool. Ice may be placed on top of the bags in hot weather. Some form of shade can be provided using banana or coconut leaves.

Number of fry or fingerling

Type	Size (mm)	Numbers packed (range)
Spawn	10	35,000 – 50,000
Fry	20 - 25	1,000 – 1,500
Fingerlings	35	500 - 800
Fingerlings	45	300 - 500
Fingerlings	55	200 - 250
Fingerlings	65	100 - 125
Fingerlings	75	75 - 100
Fingerlings	85	40 - 50

5.2 FEEDS

Fish feed are a major source of nutrients discharge into the water body in form of uneaten food and excreta. The type of fish feed used will greatly influence the amount of pollutants discharged in the water body.

5.2.1 The quantity of fish feeds should not exceed 15% body weight of total fish in fry and should be reduced as recommended by the competent authority as the fish grows.

5.2.2 In case of using feed supplement and other feedstuff from factories/distributors, the feed shall be attached with label containing information on nutrition, type of production, and expiry date.

5.2.3 In case of farm-made feed, raw materials such as fishmeal, soybean-meal, bran, and milled rice shall be free of veterinary drugs and prohibited substances in order to prevent the veterinary drug and chemical residue in the tissue of the tilapia.

5.2.4 In addition, farm-made feed shall be produced and stored in clean and hygienic containers.

5.2.5 Farm-made feed shall be nutritionally complete to meet the requirement of the tilapia in culture.

5.2.6 In case of using other non-food stuff, supplement, bio-microbe, and others relevant foodstuff; the feed shall be free from contamination of veterinary drugs and prohibited chemicals.

5.2.7 Veterinary therapeutic products and medicinal premixes for inclusion in fish feeds to be applied to fish should be done with approved for use by competent authority.

5.2.8 Farmers are advised to use feeds certified by relevant competent authorities for safety and quality and feeds used should:

a) Be water stable and easily acceptable by the fish;
b) Be dry extruded and pelleted; and
c) Proper feeding technology should be applied with regards to quantity and feeding method

5.3 Fish Feeding

Feeding fish on manufactured feed is a method of provision of an alternative diet for fish raised in captivity to replace the natural food available in natural water bodies. Fish farming requires enclosure with properties thatpermit water exchange and waste removal into the surrounding water while fish growth in weight, water quality maintenance and resistance to disease and its prevention are the main goals.

5.3.1 Proper feeding and feed guidelines:

a) Feed your fish to shorten the production period and maximize your profit.
b) Use locally feed stuffs to reduce the cost of making your feed.
c) Prepare feeds in small quantities to avoid prolonged storage with possible physical losses.
d) Package and store your feeds in sealed containers like jute bags with polythene lining.
e) Observe simple feeding techniques, procedures and rules below:
    i. Always maintain the pond water at green colour; and
    ii. Feed fish regularly twice a day at specific times at specific feeding spots and by gradual broadcast till fish cease to come up to feed.

5.3.2 Feed storage

a) Keep feed protected from contamination.
b) Store under cool and dry conditions.
c) Feed stores must be free of vermin.
d) Flour racks are mandatory.
e) Stacking must be observed (avoid internal warming).
f) Use dry & clean equipment

6 FISH HEALTH MANAGEMENT

In order to prevent the introduction, emergence and spread of diseases, and invasive species, within a tilapia farming facility, and to its surrounding environment, biosecurity policies and procedures are required to decrease the likelihood of health-related problems occurring.

6.1 Prevention through Good Health Management

The following should be done to prevent diseases in fish farms:

6.1.1 Ensure good water quality

Sufficient supply, with adequate dissolved oxygen concentration and free of pollution.

6.1.2 Keep the pond environment healthy

Control silt, control plants, keep a healthy balance of phytoplankton and zooplankton, and exchange water if needed. If necessary, use mechanical aeration Disinfect the pond regularly.

6.1.3 Keep the fish in good condition:

Control stocking density. Keep different sizes or sexes separate if necessary to control fighting. Ensure good food supply Handle the fish properly, especially during harvesting and sorting/grading. Care for your fish during storage and transport.

6.1.4 Prevent the entry of disease organisms from outside your farm as follows

a) control wild fish by using filters and screens and regularly eradicate them from canals and ponds;
b) disinfect all fish stocks imported from outside as eggs, juveniles or adults;
c) be careful when using trash fish or processing wastes as supplementary feed; if possible boil the raw material for at least 30 minutes or use it for compost or silage feeds; if natural food supplies are limited, add vitamin* supplements to the cooked food to ensure its quality;
d) increase vigilance: if you have to use water downstream from a neighbouring fish farm, use screens to control escaped fish;

e) for a hatchery it is safest to use spring or well water, free of disease organisms; it is also useful for rearing small fry; alternatively, consider a sand filter to help remove smaller disease organisms; and
f) enclose hatchery and nursery areas with a fence to control access; use footbaths and protective clothing if necessary to limit contamination.

6.1.5 Prevent the spread of disease organisms within your farm as follows:

a) control fish-eating predators, particularly birds and mammals;
b) disinfect ponds regularly to kill both the disease organisms and their intermediate hosts;
c) keep different age groups of fish separate; disinfect breeding ponds well and, if possible, remove brood stock from them as soon as spawning has taken place;
d) use diversion ponds with parallel flow if possible; if your ponds are arranged in series, it is best to have the water flow from the ponds with the less infected and more sensitive, youngest fish into the ponds with the oldest fish (more infected and less sensitive);
e) disinfect juveniles before stocking them in clean fattening ponds; treat brood stock before using them for propagation in breeding ponds;
f) in a hatchery have separate equipment for handling small and large fish, if possible keeping one set of hand nets, buckets, etc. for each tank or pond; and
g) use disinfectant bins for routine disinfection of equipment, and clearly mark the equipment accordingly.
h) if a disease breaks out on your farm, remove dead or dying fish from the ponds as quickly as possible, at least daily, and do not disturb and stress remaining fish excessively;
i) bury diseased fish with quicklime away from the ponds; carefully treat infected ponds and disinfect all equipment that has come in contact with them;

6.2 Biosecurity measures

6.2.1 Disease prevention measures shall be put on the farm to prevent outbreaks of fish diseases and those related to public health. Regular checks on tools are strongly recommended to prevent fish injuries and subsequent disease challenges.

6.2.2. Farmers should regularly monitor fish behaviour and to check water quality to quickly identify fish health and diseases.

6.2.3 Any symptoms should be reported to the competent authority.

6.2.4 Treatment and administration of drugs and chemicals should be used under guidance by veterinarian or fisheries officer. Prohibited or expired veterinary drugs or chemicals shall not be used. Records of the use of drugs shall be kept for at least two (2) years for reference.

6.2.5 Farmers are advised to check for any updated information on prohibited drugs and use of drugs.

6.2.6 Examination for the cause of dead fish and its diagnosis shall be conducted immediately.

6.2.7 Any suspicious sign of sickness and death Disease outbreak shall be reported to the responsible authority immediately. The farmer shall have appropriate methods for animal carcass disposal (e.g. burying, bury together with anti-infection or liming, etc.). The outflow of water from the disease infected pond shall be correctly treated before draining.

6.2.8 As a control measure related to concerns relating to fish health and movement of live fish relate to the possibility of transferring or importing an “exotic” disease or disease causing agent, a fish transportation health permit shall always be required before transporting live fish across country boundaries.

6.2.9 Once a cage has been affected with disease, the net shall be disinfected using chlorine or potassium permanganate before any reuse.

6.2.10 It is advisable to continuously check the health of the fish and their feeding response so as to prevent disease outbreak.

6.2.11 Good fish condition is better maintained by proper management of the environment in which

the fish thrives. It is also important to keep record of the activities such as feeding, temperature and dissolved oxygen as well as sampling for growth so that changes can be better explained.

6.2.12 use only recommended chemicals for fish treatment and drugs and chemicals shall be used under guidance by veterinarian or fish pathologist.

7 FARM SANITATION

Sanitation is critical for both pond and cage culture. The farm shall keep high sanitary standards to keep the disease risks low. It is recommended to implement the suggested measures of farm management as follows:

a) Drain from household and farm system shall be separated in order to avoid water pollution. For example, household outflow shall not be drained to the same channel with the inflow of farm water system or reservoir;

b) Toilets shall be completely separated from the farm area, and waste control/management system. Sanitary and hygiene practices shall be maintained to ensure there is no leaking of waste water into the farm system. The presence of coliforms is indicative of faecal contamination of the water. The probable number of coliform bacteria shall not exceed 5,000 MPN/100ml. High numbers of enteral bacteria indicate contamination with waste water from toilets, household, or pets;

c) Proper treatment and disposal of aquaculture waste is required: i.e. dead fish shall be disposed by appropriate methods e.g. burning or burying. Expired veterinary drugs shall be disposed of according to relevant regulations. It is recommended to recycle the chemical containers;

d) Tools on the farm shall be stored in good order under hygienic condition and shall be well maintained. Workers' housing, offices, feed store, warehouse, feed preparation area, and buildings shall always be kept clean and well maintained;

e) Good management system for garbage including its routine collection and disposal is required. Trash bin shall be covered at all times in order to prevent flies, rodents, cockroaches, and pets. It is advisable to develop on site the waste disposal site which is isolated from the farm;

f) Do not allow other animals (e.g. duck, chicken, dog, etc.) into the pond area. In cases where dogs are used for security, they shall always be under leash and not free roaming;

g) Toilets shall be completely separated from the cage area. Waste management shall consider good sanitary practices to ensure that the waste will not leak/contaminate to/with cultural system. In case that toilet is located on land, it shall not drain or leak into the cages;

h) Tools in the farm shall be stored in good order and under hygienic conditions. Workers' housing, offices, feed store, warehouses, feed preparation area, and buildings shall always be kept clean and well maintained; and

i) Trash collection area shall be properly regulated and well managed. Trash bin shall be covered at all time in order to prevent flies, rodents, cockroaches, and pets. Garbage shall be properly disposed.

8 HARVEST AND POST-HARVEST PRACTICES

Appropriate harvesting technology shall be used to maintain good quality product. The farmer shall strive to avoid post-harvest losses due to spoilage and damages. The fish shall be sold in good condition for human consumption. The farmer shall therefore follow the following recommendations:

8.1 Farmer shall have a good harvest plan and rapid distribution means to deliver a fresh and health fish product that is of premium quality.

8.2 As confidence building measures the farmer shall be able to demonstrate the source of fish to relevant stakeholders whenever requested by presenting the fish movement documents issued by competent authority.

8.3 During the process of tilapia grow-out period in the pond or cage, tissue sample of the fish product shall be randomly sampled and sent for analysis of residual veterinary drugs or pesticides at least once a year. Further tests shall include microbiological analysis of public health concern. The prohibited veterinary drugs and chemicals shall not be found. The allowed veterinary drugs and chemicals shall not exceed the maximum limits specified by the standard.

8.4 For safe and quality fish products, guidelines for management and maintenance during harvest and post-harvest process shall be as follows:

8.4.1 In case Tilapia have problem with muddy taste due to the accumulated consumption of blue-green algae in the pond, recommendations for solving the problem are as follows:

a) In order to reduce the blue-green algae in the water, compost fertilizer shall not be used at least 2 months prior to the harvest; additional feed or supplementary feed shall be provided, together with water exchange. However, care shall be taken as accumulation of unused feed might lead to blooming of blue-green algae.

b) Muddy taste in the meat shall be determined by tasting the steamed fish sample without seasoning. If the meat does not contain muddy taste, the product can be sold. In case of muddy taste in the meat is found, water exchange is needed and microorganism treatment or liming shall be used for reducing the blue-green algae.

8.4.2 Fish shall be staffed one day before harvesting to allow the fish defecate the feed in the stomach. This way, quality and freshness of the fish product can be kept.

8.4.3 The personnel handling fish at the farm shall be screened of infectious or communicable diseases.

8.4.4 Tools, equipment, and harvesting method shall not pose negative effect to the quality of fish and post-harvest storage as well as cause contamination affecting food safety. Harvested products shall not be directly in contact with the bare ground.

8.4.5 Equipment used for fish handling e.g. media immersing and transferring, etc. shall be clean and made of strong materials withstanding corrosion and be in good condition and ready for use. After work, all equipment shall be immediately cleaned and stored so as not to harbour the microbes.

8.4.6 Clean and chemicals-free ices shall be used. Reuse of ices is not recommended.

8.4.7 Vehicles used for transporting the fish shall be designed in order to prevent heat during transportation. Areas for transferring the fish product shall be made of materials easy to be cleaned and shall prevent the entry of dust and shall protect the fish from direct sunlight and heat.

8.4.7.1 In the case of transporting dead tilapia, they shall be chilled immediately after harvest to maintain freshness as much as possible. The use of ground or flake ices is recommended because smaller size of ice has larger contact surface with the product, thus can chill the product faster. Water used for cleaning fish shall comply with the standard for drinking water and shall not be reused. For best quality, pack the product in appropriate-size container after putting the ice at the bottom. Then the product shall be packed in alternate layers with ice to preserve the quality and freshness of the fish.

8.4.7.2 In case of transporting live fish, container used during transport shall be insulated against external heat. Aeration shall be used during the transportation. Surfaces that will come in contact with fish shall be made of materials easy to be cleaned and preventing dust particles. During transportation, the use of ice is recommended in order to numb the fish and reduce the damages that may occur. However, the temperature shall not be too low that can cause injury to the fish. Injured, infected or dead fish shall not be included in the transportation container.

They shall be separated from the healthy fish and other species during transportation to reduce the possibility of contamination and infection.

8.5 Harvesting guidelines

There are some general guidelines for selecting a harvest seine.

a) Seine length should be about 1-1/2 times greater than pond width.
b) Similarly, net depth should be 1-1/2 to 2 times greater than pond depth - 3 to 4 feet of seine depth for every 2 feet of pond depth.
c) Seines should be made of nylon or polyethylene twine (number 42 twine is commonly recommended).
d) Mesh size (bar or square measure) should be no smaller than that needed to catch the minimum fish size desired - smaller mesh sizes create greater water resistance (drag) and make nets harder to pull.
e) A "live-car" or "harvest sock" with the appropriate mesh size can be attached to the seine net for size selective harvest and may also help reduce the number of fish that escape.
f) A weighted "mud line" (bottom rope) is preferred over a "lead line" in ponds with soft, muddy bottoms. A lead line digs into the mud while a mud line skims over the top of it. Sufficient weight (56.7 gm weights on 18-inch centres) should be attached to the lead or mud line to keep it on the bottom while pulling the net. The top rope of a seine has foam or plastic floats attached (on 18-inch centres) and is called the "float line".

8.6 Harvesting and marketing

Cropping or harvesting of a fish pond is undertaken when the fish stock or part of it has attained market size. The market size of fish is determined by customer acceptability and preference. Most fish species with proper feeding and management reach market size within 6-9 months of stocking (or maximum of 12 months) and should be cropped within this period. Moreover if partial cropping or the removal of bigger fish to allow smaller ones to grow more is repeatedly done at reasonable time intervals (2 or 3 times) before total cropping (or the removal of all pond fish at the same time), the cumulative yield due to multiple harvest will be greater than the yield from a single harvest.

8.7 Recommendations

a) Advertise at least days ahead of harvest in previously identified markets.

b) For convenience and cost reduction make sales on farm, or make adequate arrangement to move cropped fish to previously identified markets.

c) Stop feeding fish 1-3 days before harvesting, and crop when weather is cool especially in the early morning.

d) For economic reasons and optimum profit, crop within 6-9 month of stocking (maximum of 12 months), preferable during festival periods and by partial cropping 2-3 times.

e) Sort fish into species and size grades for marketing and consider total cost of inputs (and prevailing local price rates) before fixing prices.

f) Keep accurate record of yield and sales figures.

g) For maximum returns market fish live or smoked (for this, prepare holding tanks, cages, etc. for live fish storage of surplus/unsold fish. Furthermore to reduce work load and avoid losses, the fish could be contracted out to fish processors for smoking at a fee before marketing)

9 ESCAPES FROM AQUACULTURE FACILITIES

Tilapia escaping from aquaculture facilities may function as vectors of disease in the receiving water environment, or may out-compete native fish species or native tilapia strains. Escapes of stocked

tilapia should be done through monitoring and presence of escape barriers.

10 COMMON CHEMICALS AND THEIR USE ON THE FISH FARM

Most chemicals used for controlling disease organisms are toxic and/or irritant for the skin and respiratory tract. Many chemicals can cause serious health problems if swallowed or absorbed through the skin. You should therefore handle chemicals with care, mark them clearly and store them safely, away from children in particular.

When handling chemicals take at least the following precautions:

a) protect your hands by wearing rubber gloves and wear overalls and boots for general protection;
b) work in a well-ventilated area;
c) handle chemicals carefully, avoiding splashing or spillage and, if accidentally splashed, wash off immediately;
d) avoid inhaling dangerous vapours;
e) clearly mark all containers, equipment and protective clothing used for storing and handling chemicals; unless they can be thoroughly and safely washed out, do not use them for other purposes; store them safely when not in use; and
f) thoroughly take shower after use, and particularly before touching any food.

11 SOCIAL RESPONSIBILITY

Farmers should only employ workers that are of the legal minimum age allowed in the country.

12 RECORD KEEPING

To ensure that the tilapia culture management system can be efficiently implemented and improved from time to time, any person or establishment engaged in commercial tilapia production should keep records relating to measures in place to control hazards and health related problems including records on species quantities and their sources, analysis result of residues from laboratory, Fry Movement Document (FMD) and/or Movement Document (MD), nature and origin of feeds, feeding methods and quantities, fertilizers, veterinary drugs, treatment regimens and occurrence of diseases analytical results for water, soil, fish and feeds and veterinary drugs. These records shall be kept on the farm for at least a period of two years.