For more information please contact:

Bureau of Fisheries and Aquatic Resources
Regional Office No. 8
Tacloban City
Tel. # (053) 325-3174
Email Address : region8@bfar.da.gov.ph
Fax # : (052) 321-1732

Fisheries Extension Manual AQ _____

TECHNO GUIDE SERIES

Tilapia In Ponds

Department of Agriculture
BUREAU OF FISHERIES AND AQUATIC RESOURCES
Regional Office No. 8
Maharlika Highway, Brgy. Diit, Tacloban City
Telefax : (053)3211732/3253174/3213152
Email : bfar_region8@yahoo.com or region8@bfar.da.gov.ph
Website : http://region8.bfar.da.gov.ph

Introduction

Tilapia (Family Cichlidae) is widely grown in warm countries both in domestic and commercial scale.

It is a fast growing fish reaching an average weight of 200 to 350 grams in four months with at least 80% survival. Though essentially herbivorous, it eats diverse food and grows favorably even under a low protein diet. It feeds on detritus, crustaceans, benthos, and various forms of supplemental feeds present in the water. It tolerates crowding and resistance to pests and diseases.

Tilapia serves as natural biological control for most aquatic plant problems. Tilapia consumes floating aquatic plants, such as duckweed watermeal (Lemna sp.), most "undesirable" submerged plants and most forms of algae. They are becoming the plant control method of choice, reducing or eliminating the use of toxic chemicals and heavy metal-based algaecides. Furthermore, tilapia helps control mosquitoes which carry malaria parasites

.They consumes mosquito larvae, which reduces the number of adult females, the vector of diseases (Peter 2002).

Like, the marine fishes, tilapia is a very good source of protein, vitamins, and minerals needed by the body. It can be a good substitute for marine fishes whose prices are getting higher.

In the Philippines, tilapia is an important food fish and has gained acceptance in the local markets. It ranks with milkfish as the most extensively cultured finfish in the country's inland waters.

Species/Strain

The kind of species/strain to be cultured should be well defined according to the purpose it is intended for. For a semi-intensive production, the Tilapia nilotica, is recommended considering its advantages in terms of growth, survival, and adaptability to various environment.

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E. Income

GROSS SALES	=	1,000 kilos @ 85.00/kilo
	=	85,000,000 x 3 croppings (for 1 year)
	=	**P 255,000.00**
LESS		
Operating Cost	=	P135,405.27
Depreciation Expense	=	P 5,709.49
NET INCOME BEFORE TAX=		**P 113,885.24**

ROI

$$= \frac{113{,}885.24}{135{,}405.27 + 5{,}709.49} \times 100\%$$

$$= \frac{113{,}885.24}{141{,}114.76} \times 100\ \%$$

$$= 80.7\%$$

$$\text{Payback Period} = \frac{141{,}114.76}{113{,}885.24}$$

$$= 1.2 \text{ years}$$

Biology of Tilapia

Taxonomy

Tilapia is the generic name of a group of Cichlids. The group consists of three aquaculturally important genera Oreochromis, Sarotherodon and Tilapia. Several characteristics distinguish these three genera, but possibly the most critical relates to reproductive behavior. All tilapia species are nest builders; fertilized eggs are guarded in the nest by a brood parent. Species of both Sarotherodon and Oreocrhromis are mouth brooders; eggs are fertilized by the nest but parents immediately pick up the eggs in their mouth and hold them through incubation and for several days after hatching. In Oreochromis species only females practice mouth brooding, while in Sarotherodon species either the male or the female are mouth brooders.

Physical Characteristics

Tilapia are shaped much like sunfish or crappie but can easily identified by an interrupted lateral line characteristics of the Cichlid family of fishes. They are laterally compressed and deep-bodied with long dorsal fins. The forward portion of the dorsal fin is heavily spined. Spines are also found in the pelvis and anal fins. There are usually wide vertical bars down the sides of fry, fingerlings, and sometimes adults.

Banding Patterns and Coloration

The main cultured species of tilapia usually can be distinguished by different banding patterns on the caudal fin. Nile tilapia has strong vertical bands, blue tilapia has interrupted bands, and mossambique tilapia has weak or no bands on the caudal fin. Mature male Nile tilapia has gray or pink pigmentation in the throat region, while Mozambique tilapia has more yellow coloration. However, coloration is often unreliable method of distinguishing tilapia species because environment, state of sexual maturity, and food source greatly influence color intensity.

Reproduction

In all Oreochromis species the male excavates a nest in the pond bottom (generally in the water shallower than 3 feet) and mates with several females. After a short mating ritual the female spawns in the nest (about two to four eggs per gram of brood female), the male fertilizes the eggs, and she then holds and incubates the egg in her mouth (buccal cavity) until they hatch. Fry remain in the female mouth through yolk sac absorption and often seek refuge in her mouth for several days after they begin to feed.

Feeding Behavior and Nutrition Requirements

Tilapia ingest a wide variety of natural food organisms, including plankton, some aquatic macrophytes, planktonic and benthic aquatic invertebrates, larval fish, detritus and decomposing organic matter.

Tilapia requires the ten essential amino acids. Protein requirements for maximum growth are a function of protein quality and fish size. Tilapia may have a dietary requirement for fatty acids of the linoleic (n-6) family. The feeding behavior of tilapia allows them to use a mash (unpelleted feeds) more efficiently than do catfish or trout, but most commercial tilapia feeds are pelletized to reduce nutrient loss.

Environmental Requirements

Salinity

Tilapia is tolerant to brackish water. The Nile tilapia is the least saline tolerant of the commercially important species, but grows well at salinities up to 15 ppt. The blue tilapia grows well in brackish water up to 20 ppt salinity, and the Mozambique tilapia grows well at salinities near or full strength seawater.

Water Temperature

The intolerance of tilapia to low temperatures is a serious a constraint for commercial culture in temperate regions. The lower lethal temperature for most species is 50 to 52 o F for a few days, but the Blue tilapia tolerates temperatures to about 48o F.

pH

In general, tilapia can survive in pH ranging from 5 to 10 but do best in pH range of 6 to 9.

C. OPERATING COST

QTY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL AMOUNT
3,600	pcs	Tilapia Fingerlings (1 grm)	.45	1,620.00
26	bags	Chicken Manure	78.00	2,028.00
2	bags	In-organic Fertilizer	1,470	2,940.00
3	bags	Fry Mash	410.00	1,230.00
7	bags	Starter Floater	770.00	5,390.00
26	bags	Grower Floater	785.00	20,410.00
7	bags	Finisher Floater	780.00	5,460.00
Sub-total				**39,078.00**
Add: Marketing Cost (5% of the Marketing Cost)				1,953.9
Sub-total				**41,031.9**
Add: Contingencies (10% of the Operating Cost)				4,103.9
TOTAL FOR 1 CROPPING				45,135.09
TOTAL FOR 3 CROPPING / for 1 year Operation				**135,405.27**

D. DEPRECIATION EXPENSE

ITEM DESCRIPTION	LIFE YEARS	TOTAL COST	DEPRECIATION COST
Pond & Dike Excavation & Construction	15	33,600.00	2,240.00
Inlet & Outlet Pipe	10	8,682.96	868.29
Catch Basin	10	1,012.00	101.20
Harvesting Bucket	5	7,500.00	1,500.00
Weighing Scale	5	5,000.00	1,000.00
TOTAL COST		**55,794.96**	
TOTAL DEPRECIATION COST			**5,709.49**

Bill of Materials for the inlet and outlet pipe

QTY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL AMOUNT
3	pcs	PVC pipe 4" dia.	1,000.00	3,000.00
2	pcs	PVC elbow pipe 4" dia.	676.00	1,352.00
2	quarts	PVC sealant	230.00	460.00
1	cu.m	Sand & gravel	800.00	800.00
2	bags	Cement (Portland)	230.00	460.00
		Sub-total		**6,072.00**
		Add: Labor Cost (30% of the mat. cost)		1,821.60
		Sub-total		**7,893.60**
		Add: Contingencies (10%)		789.36
		Total		**8,682.96**

Catch Basin (1.5 sq. meter)

QTY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL AMOUNT
20	pcs	Hollow blocks	12.00	240.00
1	bag	Cement (Portland)	230.00	230.00
1/4	cu.m	Sand & gravel	800.00	200.00
		Sub-total		**670.00**
		Add: Labor Cost (250.00/day @ 1 man a day)		250.00
		Sub-total		**920.00**
		Add: Contingencies (10%)		92.00
		Total		**1,012.00**

Ammonia

Massive mortality of tilapia occurs within a few days when fish are suddenly transferred to water with unionized ammonia concentrations greater than 2 mg/L. However when gradually acclimated to sub lethal levels, approximately half the fish will survive 3 to 4 days at unionized ammonia concentrations as high as 3mg/L.

Nitrate

For freshwater culture the nitrate concentration should be kept below 27 mg/L as nitrate.

Most Common Cultured Species:

Male (Top) and female Tilapia
Oreochromis niloticus

Male (Top) and female Tilapia
Oreochoromis aureus

Male (Top) and female Tilapia
Oreochromis niloticus

Male (Top) and female Tilapia
Oreochromis mossambicus

Classification of Tilapia

Substrate spawners Tilapia: T.Zillii, T. Rendalli, T. Sparmanii	Paterna/biparental mounth brooder Sarotherodon: S. Galilaeus, S. melanotheron	Maternal mouth brooder Oreochromis: O. Niloticus, O. Aureus, O. Hornorum, O. Mossambicus, O. macrochir
Broodfish morphology		
Little or no dimorphism between sexes, both sexes exhibit breeding color. Long period or pair-bonding; species monogamous at least for one brood.	Little dimorphism and color differences between sexes. Monogamy at least for one brood.	Dimorphism between sexes. Males generally larger, with conspicuous breeding colors, enlarge jaws, and modified papillae.
Spawning site		
Shallow water about 50 cm deep. Substrate variable; pebbles and sand preferred. Nests solitary.	Shallow water. Substrate variable, muddy sand and pebbles. Nest in common spawning grounds.	Shallow water, depth variable 0.15-8 m. substrate variable, mud, sand and pebbles. Nest in common spawning sites.
Territorial behavior and nest building		
Territory set up by both sexes and defended by both after pair bonding.	Territorial established by both sexes of courting pair.	Male solely sets up and defends territory, and is visited by ripe females.
Spawning		
Long courtship several days may precede spawning. Up to 7000-8000 yolk, olive green, 1-1.5 x 1-2 mm adhesive eggs laid on pre-cleaned substrate. Male passes over eggs to fertilize them.	Courtship lasting several hours to few days precedes spawning. Up 1500 greenish-brown 1.5-2.0 x 2.0-3.5 mm non-adhesive eggs shed in batches in a shallow nest. Eggs show vestigial adhesive layer. After all eggs are laid and fertilized, both parents and the males only pick up eggs for mouth brooding.	Courtship lasts several hours. Up to 2000 non-adhesive 1-2 mm x 1.5-3 mm eggs shed in batches in shallow nest. After fertilization, the female picks up each batch into the mouth. Females may also snap up semen directly from genital pipallae. This behavior prominent in species that have genital papillae modified into tassels to attracts females.

Cost and Return of Tilapia Cultured in Backyard Fish Pond

(Semi-Intensive)

Area	:	1,000 sq.m. (50mx20m)
Cultured Period	:	4 months
Stocking Ratio	:	
		1 meter depth – 3 pcs./sq.m
		1.5 meters depth – 5 pcs./sq.m
Initial Weight @ Stocking	:	1 gram
Stocking Density	:	3,600 pcs
ABW @ Harvest	:	4 pcs to a kilo
Harvest Volume/Cropping	:	1,000 kilos
FCR	:	1.1: 4
Price/kg.	:	P 85.00/kilo (FARM GATE PRICE)
No. of cropping per year	:	3 croppings

B. FIXED ASSET INVESTMENT

QTY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL AMOUNT
420	cu.m.	Dike and Pond Excavation and Construction	90.00	37,800.00
10,000	sq.m.	Pond Leveling	250.00	2,500.00
		Inlet & Outlet Pipe installation (include labor and materials)		8,682.96
		Catch basin construction (1.5 sq.m./include mat. & labor)		1,012.00
5	pcs.	Harvesting bucket	1,500.00	7,500.00
1	pc	Weighing Scale	1,000.00	1,000.00
		Total		**58,494.96**

D. DEPRECIATION EXPENSE

ITEM DESCRIPTION	LIFE YEARS	TOTAL COST	DEPRECIATION COST
Dike Construction	15	54,000.00	3,600.00
Pond Excavation	15	54,000.00	3,600.00
Sluice Gate Construction	15	33,902.55	2,260.17
Harvesting Bucket	5	7,500.00	1,500.00
Weighing Scale	5	5,000.00	1,000.00
Seine Net	5	4,766.40	953.28
Holding Hapa's	5	4,486.00	897.20
Caretaker's / Bodega House	5	10,000.00	2,000.00
TOTAL DEPRECIATION COST			**P 15,810.65**

E. Income

GROSS SALES = 7,500 KILOS @ 85.00/kilo
= 637,500 x 3 cropping (for 1 year)
= **P 1,912,500**

LESS
Operating Cost = P 1,133,132.96
Depreciation Expense = P 15,810.65
NET INCOME BEFORE TAX = **P 763,556.39**

ROI = $\frac{763,556.39}{1,133,132.96 + 15,810.65}$ x 100 %

= $\frac{763,556.39}{1,148,943.61}$ x 100%

= 66.46%

Payback Period = $\frac{1,148,943.61}{763,556.39}$

= **1.5 years**

Brood Care		
Both parents guard, protect, aerate the brood, and help remove clutch to different nest sites. Fry at first feeding are 4 – 6 mm and show feeble swimming ability. Fry survival relatively low.	Parents stay close to each other. Eggs and fry brooded in the mouth until ready for release. Brood may not be collected once released. Fry are 7-9 mm at first feeding, and have well-developed fins. Fry survival high.	Female solely involved in brood care. After spawning, female leaves nest to reach her clutch in safety. Extended period of care during which fry seek shelter in mother's mouth. Fry brooded until free-swimming. First feeders are already good swimmers. Fry survival is high.

Source: K Rana. 1988. Reproductive biology and hatchery rearing of tilapia eggs and fry, p397-406. In: JF Muir and RJ Roberts (eds). Recent Advances in Aquaculture, Vol. 3. Cited in Aqua Farm news, Vol. XI No. 3. May-June 1993

Cultured Method

The culture of tilapia in earthen ponds is the most common culture method ranging from small backyard ponds to large commercial pond systems.

Raising tilapia in earthen pond is the most economical and convenient method of production. They feed on natural food in the pond, which may be increased by adding inorganic or organic fertilizer.

Pond size may range from 0.02 hectare to more than 2.0 hectares. Generally, smaller ponds are easier to manage and involve lesser risk. However, large ponds cost less per surface hectare to construct and are more stable.

Choosing a Pond Site

Choosing the site appropriate for fishponds plays a vital role in fish farming.

Factors to be considered in building a fishpond:

a. Water

A year-round source of water must be available especially during dry season, to fill the pond when the level drops due to evaporation or seepage.

Spring, streams, lake reservoir and ground water are good water sources for fishponds. The water source should be free from industrial, agricultural and domestic pollution.

b. Soil

Clay loam soil is best for pond for it holds water well. The following are practical ways to check the soil type good for a fishpond:

1. Dig at least 1 meter and take a sample from the bottom of the hole
2. Squeeze and handful of moist soil into a ball
3. Throw the ball into the air (about 50 cm) and catch it
4. If the ball falls apart in your hand it is not good for fish ponds
5. If the ball holds together, it may be good for a fish pond

c. Topography

Gently sloping land is ideal for fish farming. Pond can be built in flat or hilly areas but it is more difficult to construct and manage. Avoided building pond in steep areas, valleys, gullies and flat or swampy low areas for it is difficult to drain.

C. OPERATING COST

QTY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL AMOUNT
36,000	pcs	Tilapia fingerlings (1 grm)	.45/pc	16,200.00
260	bags	Chicken Manure	78.00	20,280.00
12	bags	16-20-0	1,470.00	17,640.00
25	bags	Fry mash	410.00	10,250.00
62	bags	Starter floater	770.00	47,740.00
215	bags	Grower floater	785.00	168,775.00
57	bags	Finisher floater	780.00	44,460.00
25	bags	Agricultural lime	210.00	5,250.00
Wages of caretaker @ 3,000/month x 4 months x 1 person				12,000.00
Sub – Total				**342,595.00**
Add : Marketing Cost (5% of the Gross Sales)				17,129.75
Sub – Total				**359,724.75**
Add : Contingencies (5% of the Operating Cost)				17,986.24
TOTAL FOR 1 CROPPING				**377,710.99**
TOTAL FOR 3 CROPPINGS / FOR 1 YEAR OPERATION				**1,133,132.96**

Bill of Materials and Labor Cost for Seine Fabrication

QTY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL AMOUNT
1	bundle	DD net	3,890.00	3,890.00
1	roll	Poly rope # 10	398.00	398.00
10	spools	Multi-netting twine, 210/12	40.00	400.00
		Sub – Total		**4,688.00**
		Labor (30%)		1,406.04
		Total		**P 6,094.04**

Bill of Materials and Labor Cost for holding hapa's fabrication & installation

QTY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL AMOUNT
1	bundle	B54	3,750.00	3,750.00
1	roll	Poly rope # 8	320.00	320.00
6	spools	Multi-netting twine, 210/9	55.00	330.00
		Sub – Total		**4,400.00**
		Labor (30%)		1,320.00
		Total		**P 5,720.00**

d. Location

The pond should be built near the house for easy feeding and checking from thieves and predators. Keep the area free from trees and shrubs. Tilapia thrives best in an open, sunny area where water is warm.

Pond Design and Construction

The size and shape of the pond is greatly dependent on the topography of the area. Pond size is determined based on the following factors : quantity of water and area available, technology to be followed, (e.g. extensive, semi-intensive or intensive farming), production and income required to make the enterprise economically viable, access to markets, manpower and equipment.

Consider the following steps in building better ponds

1. Site preparation

Remove the trees, brush and rocks and cut the grass in the are. Remove the topsoil containing roots, leaves, etc. measure and stake out the pond. In sloping areas, use a level or transit to find the best layout.

2. Lay-out Farm

Small ponds should be located with their long axis parallel to the prevailing winds, in order to provide maximum aeration. Large ponds may have the long axis at right angles to the prevailing winds, as the winds blowing over a long stretch of water may create higher waves and greater erosion of the dike.

The type of pond you build depends on your land:

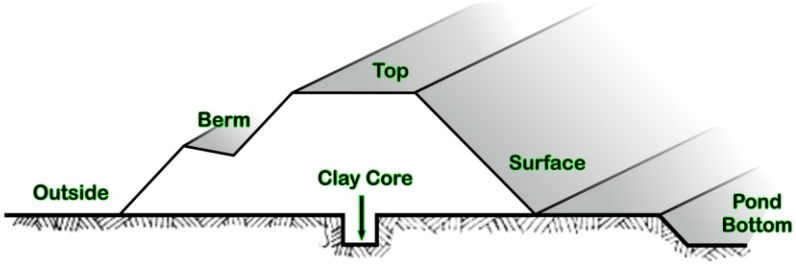
a) Dugout ponds are built in flat areas by digging out soil in all parts of the pond. The water level will be below the original ground level.

b) Contour ponds are built in sloping hills. The soil on the upper side of the pond is dug-out to build up a dike on the lower side. In these ponds, the dikes must be strong because the water level in the pond will be above the original ground level.

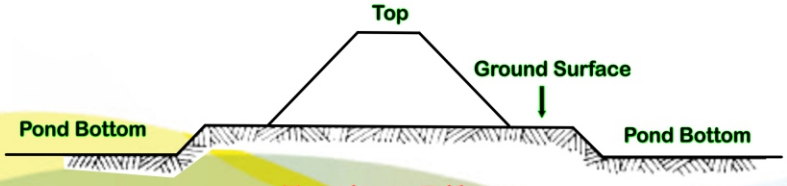
3. Dike Design and Construction

The most important construction in a pond farm are the dike system and the water control structures.

The design of the dike is dependent on the nature of soil, water depth wave action and possible erosion. The following figures illustrate the cross-sections of some typical dikes.



Secondary Dike



Tertiary Dike

Bill of Materials for Sluice Concrete Gate

QTY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL AMOUNT
4	pcs	Marine plywood, 1/4 x 4' x 8'	368.00	1,472.00
40	bags	Cement (Portland)	225.00	9,000.00
40	pcs	Corrugated steel bars 10mm	135.00	5,400.00
4	kls	Tie wire # 16	55.00	220.00
12	cu.m	Coarse Sand	1,200.00	14,400.00
15	bdft	Coco lumber, 2" x 2" x 12'	18.00	1,080.00
20	bdft	Coco lumber, 1 x 2" x 12'	18.00	720.00
3	kls	Nails, 4"	55.00	165.00
2	kls	Nails, 2"	55.00	110.00
8	bdft	Hardwood slab, 1.5 x 12" x 12'	65.00	9,360.00
Sub – Total				**41,927.00**
Add: Labor Cost (35%)				14,674.45
Sub – Total				**56,601.45**
Add: Contingencies (10%)				5,660.145
TOTAL				**62,261.595**

Cost and Return Analysis of Tilapia Cultured in One Hectare Fish Ponds

(Semi-Intensive)

A. ASSUMPTIONS :

Area	:	1 hectare (100m x 100m)
Cultured Period	:	4 months
Stocking Ratio	:	
		1 meter depth – 3 pcs./sq.m
		1.8 meters depth – 5 pcs./sq.m
Initial Weight @ Stocking	:	1 gram
Stocking Density	:	36,000 pcs
ABW @ Harvest	:	250 pcs
Harvest Volume/Cropping	:	7,500 kilos
FCR	:	1.1: 1
Price/kg.	:	P 85.00/kilo (FARM GATE PRICE)
No. of cropping per year	:	3 croppings

B. FIXED ASSET INVESTMENT

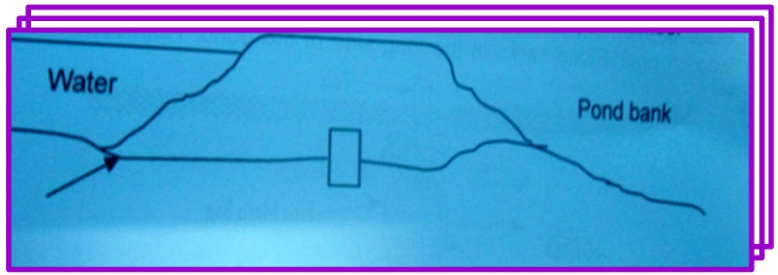
QTY	UNIT	ITEM DESCRIPTION	UNIT PRICE	TOTAL AMOUNT
1,200	cu.m	Dike Construction	45.00 / cu.m	54,000.00
1,800	cu.m	Pond Excavation	45.00 / cu.m	81,000.00
10,000	sq.m	Pond Leveling	2.5 / sq.m	53,344.50
2	units	Sluice gate construction (include materials & labor)+15%		41,927.00
1,200	cu.m	Harvesting bucket	287.50	1,437.50
	cu.m	Weighing scale	1,000.00	1,000.00
	sq.m	Seine Net (include mat. & labor)		4,755.40
		Holding Hapa's (include mat. & labor)		4,485.00
		Caretaker's / bodega house (include materials & labor)		10,000.00

It is necessary to determine the steepest slope inclination of the dikes that will ensure stability of the structure on a long-term basis.

a. Build a clay core (contour ponds only)

A clay core is the foundation for the pond bank which makes it strong and prevent leaks. This is needed in contour ponds and is built under those parts of the dike where the water will be above the original ground level. It should be placed along the lower side of the pond.

To build the clay core, remove the topsoil and dig a "core trench" for about 50 cm wide and 30 to 60 cm deep or until the strong clay subsoil is hit. Fill the trench with good clay soil and compact this each time you add several inches of new clay to provide strong foundation for pond dikes.



b. Pond dike construction

Remove top soil containing roots and leaves. Put it well outside the pond area. Save this topsoil because you will use it later when you plant grass on the pond dikes.

As you dig out the pond, use clay to begin building up the dikes on top of the core trench. If you hit sandy soil, throw this outside of the pond area. DO NOT USE sandy or rock soil, grass, stocks, roots and leaves in the dike. These will decay later and leave a week spot where the water will leak out.

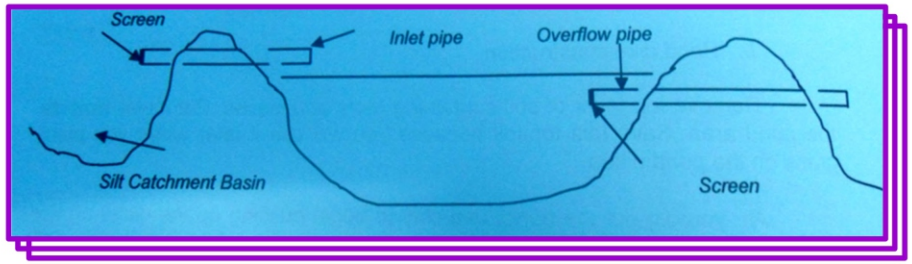
Compact the soil often as you build the dike. After adding each 30 cm. of loose soil, trample on it and pound it with a hoe.

The pond wall should be about 30 cm. above the pond water level. The pond walls should be slant (1m. in height for every 2m in length) to make it strong and prevent from undercutting and collapsing in the pond. It is easiest to slope the walls after digging out the main part of the pond.

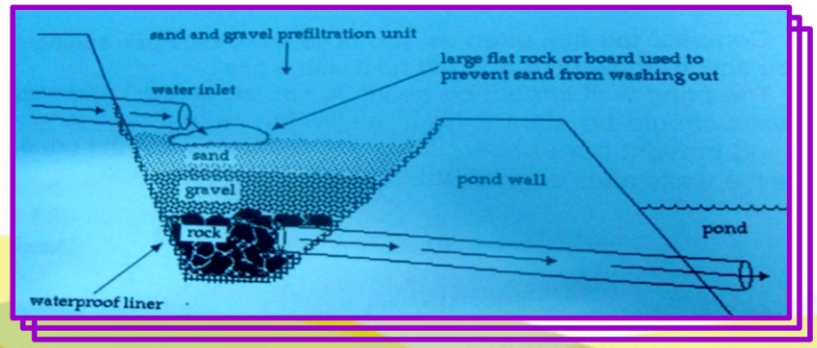
Pond bottom should be slope where water depth is 30 cm. from the inlet and 1m at the outlet. Smooth out the pond bottom after reaching the proper pond depth.

4. Build the Water Control Structures

The simplest type of water inlet system consist of a canal to bring in the water, s silt catchment basin and a pipe to carry water in the pond.



The silt catchment basin or pre filtration until will stop the soil from entering the pond. Widen and deepen the inlet canal right outside of the pond bank.



DISEASE	PARASITE	INFECTED FISH	TREATMENT
	Gyrodacttylus	Found on the skin. Infected fish is pale in color, fins droop and fold and gradually become torn. Skin shows small blood spots.	
Hermorrhagic	Bacteria Aeromonas Pseudomonas	Large bloody eroded areas on the side and base of fins are common signs.	

Source : Pillay, T.V.R. 1993. Aquaculture Principles and Practices. Fishing News Books.Osney Mead Oxford, England.

Harvesting

Tilapia can be harvested after 4 months. Stop feeding fish 48 hours prior to harvest. Harvest during the coolest part of the day. When doing a complete harvest, water should be lowered the night before the harvest. Fish should then be harvested in the early morning before temperatures rise above 28o C. Use seine net to harvest the fish and drain the pond. Collect the remaining fish. Wash the fish immediately and dip in ice water. Sort the fish according to sizes. Count and weight harvested fish immediately after sorting.

Packing and Marketing

Pack the harvested fish with crushed ice at 1: 1 ratio and place in styrofoam boxes.

Tilapia can be sold in the local market at P 90.00-120.00 per kilo depending on size.

Common parasites of tilapia and their control treatment

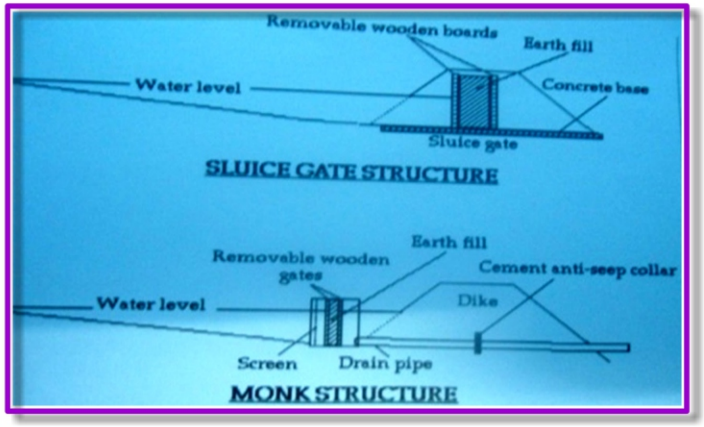
DISEASE	PARASITE	INFECTED FISH	TREATMENT
Trichodinasis	Trichodina	Fish appears to have a bluish white coating on the skin and localize discolored area or lesions. Parasites adheres to the gills, skin, and fins of fish.	Therapeutic batch in 0.1 mg KMNO 4 per 50 liters of water 30 seconds or in 1 g salt per 50 liters water for 10-15 minutes.
"Ich" or white spot	Itcthyopthirius	Fish develops a thickened epithelium and produce excessive mucus. Parasites appear as small white modules over the body surface. Parasites infect the gills, skin, and fins of fish.	Therapeutic batch in 0.7% salt solution from 3 to 20 days
Rea sore disease	Epistylis	Scales and spines may be eroded away. A cottony growth which is actually colonies of Epistylis, may be associated with sores. The sores could be the entry of bacteria and fungus.	(Treatment for bacteria and fungal infection)
Anchor worm disease	Lemea	The external parasites can be seen attached to or projecting from the skin often surrounded by a patch of fungus. The parasite resembles a shaft of a small barb inserted into the flesh of the fish.	Therapeutic batch 0.1% $KMNO_{4\ solution}$
Skin flukes	Dactylogyrus	Found on the gills. Infected fish gape for breath, gills are expanded and very pale.	Therapeutic batch in 2.5% salt solution for 10-15 minutes (early stage of infection). Or bath in 15 ppm formalin solution.

The water inlet should be screen (made of wire mesh or polyethylene net) to keep out wild fish, twigs, leaves and other trash. The inlet pipe should be about 15 cm above the water level. This will help mix air into the water.

The outlet is issued in draining the pond. It should be screened to keep the fish from getting away.

The inlet and outlet pipes can be made of metal, plastic, bamboo, wood or other material. These are installed through the pond bank near the water surface.

Other types of water control systems are the wooden and concrete sluice gates and the monk structure.



5. Protect the pond dikes

After diking cover the pond banks with topsoil for the grass to grow and protect the walls from erosion. Divert the runoff water around the sides of the pond to prevent from flood and protect pond walls.

6. Leaching

Let in water to a depth of 0.3 m and let stand for 3 to 5 days to leach out soil acidity. Flush out water and check soil pH. If soil is very acidic, continue leaching.

Pond Preparation

1. Pond Draining and Drying

Drain ponds to eliminate predators and unwanted species. Plow the pond and dry for at least 3 days.

1.1 Pest Eradication

Apply organic pesticides which can either be teaseed cake powder, derris root, or tobacco waste.

a) Teaseed cake (ground) at 1.5 to 2.0 kg per 10 cu.m of water. The required amount of cake is first crushed into small pieces and soaked in a tub or vat of water for about 24 hours. This mixture is then broadcast evenly over the pond surface. In large ponds, the poison mat be soaked overnight in the bottom of a boat and broadcast over the pond the next morning.

b) Derris root-rate of application: 0.25 kg of dried derris root per 100 sq.m. of pond surface area covered with 5 to 10 cm of water. This equals 2.5 g of dried root per sq.m. The roots are first dried; then soaked in water overnight, then pounded flat. The flattened fibers are dipped and squeezed into a pail of water until the water becomes milky. The milky liquid is broadcast over the pond surface.

c) Tobacco waste : 5.5 to 2.0 kg of water per 10 cu.m of water. Tobacco waster is best applied when water is 5 to 10 cm deep. Soak the waste overnight in water and broadcast the waste over the pond bottom as evenly as possible.

Apply during sunny day or late in the morning or early afternoon when pond water temperature has risen, for it to be more effective. Scoop out floating dead fish (pests/predators).

Control of Parasites and Diseases

Parasite infection had not been observed in tilapia but a number of parasites have been isolated from fish.

Fouling of water, crowding and fish stress can render fish vulnerable to parasites and fungal infection. Parasites may inhibit the external (skin, fins, gills) and internal (body cavity, eyes, organs, and flesh) parts of the fish.

Their presence are characterized by lesions, cottony growth or discolored spots at various parts of the fish. Infected fish suffer from body distortions, slow growth and sometimes, death.

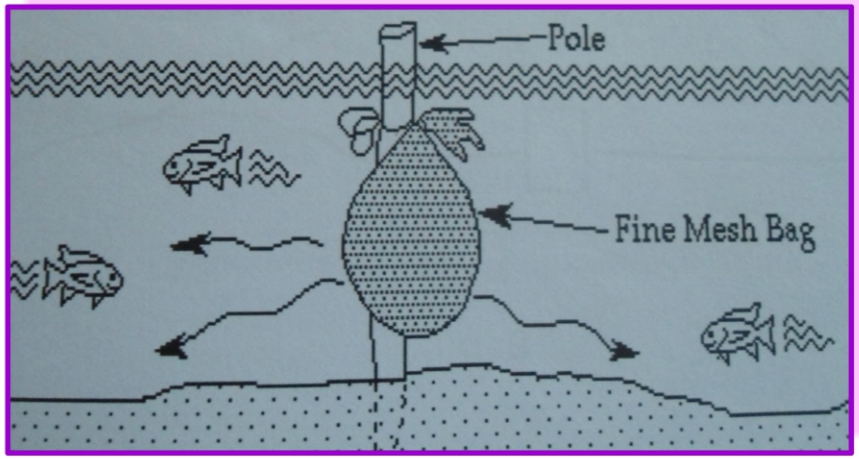
Fishpond Management

1. Fertilization / Dressing (once every week) Broadcast or Stake method

Side Dressing Fertilization (Broadcast Method)

Dried Chicken Manure (DCM) – 2,000 kilograms per hectare per month or 500 kilograms per hectare per week.

Amophos (16-20-0-125) – 100 kilograms per hectare per month or 25 kilograms per hectare per week.



2. Pond Maintenance

Check the water control system. Remove weeds from ponds and cut grasses in pond banks. Repair leaks and cracks in dikes. Check for signs of theft and predators. grasses in pond banks.

1.2 Liming

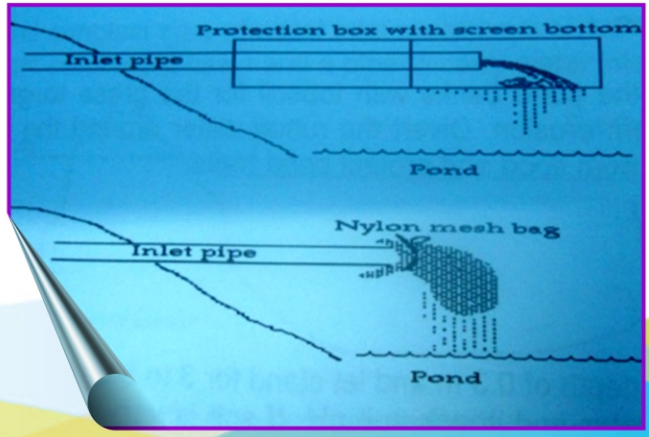
Check soil pH. If soil is acidic apply agricultural lime at 2,000 kgs./ha. Liming can be done simultaneously with pesticide application.

2. Pond Leveling

Level pond bottom sloping down to 30 cm deeper near the gate. Removes excess mud and dirt.

3. Gate/Pipe Screening

Check water inlet and outlet gates/pipes and replace screens.



4. FERTILIZATION

BASAL FERTILIZATION (BROADCAST METHOD)

Dried Chicken Manure = 3 to 4 tons per hectare per cropping for old ponds.

= 4 to 5 tons per hectare per cropping for new ponds.

Amophos (16-20-0-125) = 200 kg. / cropping

During basal fertilization the water depth is 5 cm – 10 cm depth. See to it that organic fertilizer application must be done in pond with the presence of water all over the pond.

Feeding Scheme

Supplemental Feeding is done to make sure that the marketable size will be meet after 4 months culture period. Fish sampling is performed every after a week for about fifty (50) pieces for every one thousand (1,000) stocks to determine the average body weight and feeding rate as shown on the table below:

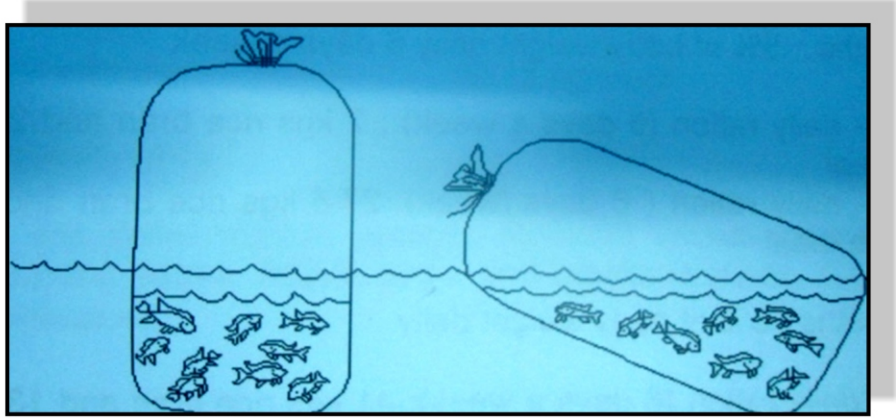
Months	ABW (g)	Feeding Rate (%)	Feeding Frequency	Type of Feeds
1	1 – 22	10%	6 times a day	Fry mash
2	36 – 99	5%	4 times a day	Starter floater
3	127 – 221.5	3%	3 times a day	Grower floater
4	256.5 – 361.5	2%	2 times a day	Finisher floater

The following formula is used in determining the feed requirements of the fish for one month.

$$= \frac{\textbf{ABW x Feeding Rate x No. of Stocks x No. of days (for 1 month)}}{\textbf{1000}}$$

Fish Stocking

Prior to stocking, acclimatize fingerlings by letting plastic bags float for 15 to 30 minutes in pond water until temperature in the bag reaches the same temperature as the pond water. Slowly add small amounts of pond water into the bag before releasing the fingerlings.



Fish are then allowed to swim out of the bags into the pond. DO NOT pout fish from any height into the new environment. They will be weak after transport and can easily be injured by rough handling at this stage

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Water Management

Gradually fill the pond with water to 5 cm water depth 3 days after liming and basal fertilization. Thereafter, increase water to at least 1 meter depth after 7 days.

Do not overfill the pond. Use the outlet when there is too much rain and runoff. Constant flow of water into the pond slows down fish growth. Add fresh water only when the pond level has dropped 15 cm or more from evaporation or seepage.

Observe fish for signs of oxygen depletion such as behavior (fish grasping or air at the water surface), water color (brownish to grayish), and pungent odor of water. Increase water level to 1 meter or change water if any of signs mentioned are observed.

Fingerlings Requirement

The number of fish to stock depends on the size or surface area of the pond. The stocking density determines the culture system to be used. These culture systems are classified into the following:

a. Extensive culture

Stocking density is 10,000 to 20,000 fingerlings per hectare. Fish depends on the natural food produced in the pond by Fertilization.

b. Semi-Intensive culture

The fish depends on natural productivity of the pond through fertilization and supplemental feed. Stocking rate is about 30,000 to 50,000 fingerlings per hectare.

c. Intensive culture

Intensive feeding and aeration is required. Stocking density is 50,000 to 100,000 fingerlings per hectare.

Fingerlings Transport

Transport fingerlings in plastic bags with oxygenated water. Leave about 15 cm space at the top of each bag for air. Put plastic bags inside the buri bags prior to transport.

It is advisable to transport fingerlings in the early morning or late afternoon to avoid drastic change in temperature during noontime. Place ice at the sides of the bag to maintain the water temperature.