TILAPIA FARMING

Better Management Practices Guide

ABSTRACT

This guide will help the fish farmers to have the better management of farms such as pond preparation, stocking density, data collection, feeding, etc resulting in more productivity and revenue.

Fisheries Development Board

Inland Farming

Acknowledgement

Fisheries Development Board used the recommendations, feedback and comments of several experts of Fisheries and aquaculture sector and progressive fish farmers, who are currently doing Tilapia farming in the country. We gratefully acknowledge that this 'Better Management Practices' guidelines are based on international best practices and local experience of Pakistani fish farmers during the years 2010, 2011 and 2012.

We acknowledge the contribution of following experts and farmers for their helpful contribution during the consultative process for preparation of this document.

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A. Introduction

Tilapia spp. originated from Africa is now a cosmopolitan species, and has emerged as one of the most productive and internationally traded food fish in the world. The farming of tilapias, especially of Nile tilapia (*Oreochromis niloticus*) is very popular in warm water areas. The uncontrolled breeding of tilapia in ponds, which led to excessive recruitment, stunting and a low percentage of marketable-sized fish, dampened the initial enthusiasm for tilapia as a food fish. However, the development of hormonal sex-reversal techniques, followed with research on nutrition and culture systems, along with market development and processing advances, led to rapid expansion of the industry since the mid-1980s. Though several species of tilapia are cultured commercially Nile tilapia is the predominant cultured species worldwide.

Aquaculture in Pakistan is predominantly based on Carp farming with extensive to semi intensive system and the average fish production is below one ton per acre per year. Various species of Tilapia was introduced in Pakistan in late 70s and 80s but there was no farming success mainly due to non-availability of fish feed in the market.

Fisheries Development Board is promoting Tilapia farming in Pakistan. Through field trials (during 2011-12) Fisheries Development Board is able to demonstrate production of Tilapia from 2-6 ton per acre, depending upon management practices and investment level of the farmers. Based on the results of these field trials, a best management practices guide is produced for Tilapia farming in Pakistan. The guide will help fish farmers to produce more fish per unit area and earn higher profit from the existing resources.

B. Pond preparation

The pond may be newly constructed and has not held fish yet. It may be a pond from which fish has just been harvested. For a new

pond, the dyke compaction and leveling of pond bottom need to be done before water filling and the bottom should be deeper slightly toward drainage pit. For existing ponds following points need to be kept in mind for pond preparation for the next growth cycle.

i. **Drainage and repairs:** The ponds should be drained completely, remove the tree roots emerges out of banks and bottom and repair the damages, if any in the banks and bottom.

ii. **Removal of mud**: Fish has been harvested and the pond has been drained. See the amount of mud accumulated. The mud may be allowed to dry until it cracks. This makes it lighter and easier to remove. The mud is removed from the pond bottom. The lighter surface mud, rich in manure, should be carried away and used to fertilize gardens for agricultural fields. The firm part of clay can be used to repair the broken banks and dykes.

iii. **Applying liming**: Lime is applied to a dry pond, the bottom should be covered with lime, and if it is used in standing water, it should be evenly distributed in the pond. Keep in following points in mind before liming of a pond:

DO LIMING	**DO NOT LIME**
Dry pond • If the pH of the pond bottom soil is less than 6.5 • If the pond bottom is very muddy • If to control the common pests • If the amount of organic matter is too high **Pond with water** • If total alkalinity of water is less than 25mg/l CaCo3. • If pH of the water is below 6.5	**Dry pond** • If the bottom pH is above 7.5 **Pond with water** • If the water pH at the end of the day is 7.5 or above • If water total alkalinity is above 50mg/l CaCo3.

iv. **Fixing pond structures and filling of water**: After liming the ponds, the structures are fixed, it can now be filled with water. Attention must be paid to repair pond structures, the inlet and outlet. The emphasis is to screen the mouths of the inlet pipe to prevent entry of unwanted fish and to screen the outlet pipe to prevent loss of fish. Water is filled into the pond from the supply channels until the correct level is achieved.

v. **Applying fertilizers**: Fertilization is required before stocking of Fry in the nursery pond and during nursery rearing of fry. As soon the fish attains a size of 2-5 grams, it needs to be shifted to grow out ponds. During intensive farming of Tilapia in grow out ponds fertilization is not required.

C. Grow out farm operation

1. Stocking protocol

a. Fish seed supply

Fisheries Development Board is promoting Tilapia farming in Pakistan and it is becoming popular by each passing year. As no Tilapia hatchery yet exists in Pakistan, therefore, tilapia nilotica seed is being imported from Thailand. Thailand is a good supplier of Tilapia seed in the region and has direct flight connections with Pakistan at three airports, viz. Islamabad, Lahore and Karachi. The imported seed is available in the form of Mono-sex Tilapia nilotica of one inch size and 0.2 gram weight. To ensure that the imported seed is healthy, provision of health certificate from government authorities of Thailand is demanded with each consignment.

b. Advanced nursing

Nile tilapia fry bought from hatcheries are normally less than 0.2 g and one inch in length. If such fry are stocked directly into ponds, survival is very poor. To increase the survival rate, fish seed need to be placed in nursery ponds to

nurse fry for a few weeks before releasing them to open pond water. The nursery ponds be fertilized two weeks before stocking of fry at the rate of 10 fish/m^2; in addition to fertilization the fry should be fed five times daily with commercial fish feed or a mixture of livestock concentrate of cow dung, duck or chicken, and rice bran at 2:1 ratio; or fishmeal and rice bran at 1:2 ratio at the feeding rate of 20% body weight per day to grow it to one gram weight and follow the feeding plan as discussed in the feeding section below. The nursing period is normally two to three weeks, when fish reach 2-5 g size and can be released to open pond water.

c. Stocking density and expected harvest per acre fish pond

Stocking density generally ranges from 0.5 to 3 fish/m2 (5,000 to 30,000 fish/ha) in semi-intensive to intensive culture ponds, depending on the availability of resources such as fertilizers, feeds and water aeration. Under similar pond conditions, fish size at harvest is usually bigger using lower stocking density. In nursing ponds where fry are reared to suitable size (about 50 g) for stocking in cages or grow-out ponds, the recommended stocking density is 10 fish/m2. Fisheries Development Board proposes the following four options (Table-1) for stocking of grow out ponds for Tilapia farming in Pakistan.

Table 1: Recommended options for stocking of grow-out ponds for Tilapia farming:

Options	**Recommended Stocking of 2-5 g seed**	**Expected out put**	**Management required**
Option one	4050	2500	Offer commercial feed and maintain at least 6 feet water depth
Option Two	4800	3500	Offer commercial feed and maintain at least 6 feet

			water depth. Emergency water aeration if DO falls below 2.
Option Three	5550	4500	Offer commercial feed and maintain at least 6 feet water depth. Emergency water aeration if DO falls below 3.
Option Four	7500	6000	Offer commercial feed and maintain at least 6 feet water depth. Mandatory water aeration to keep the DO above 4.

2. Feeding Protocol

i. **Complete feeds** are made from a mixture of carefully selected ingredients to provide all the nutrients necessary for the fish to grow. They are made in a form which the fish find easy to eat and digest. These feeds are difficult to make on the farm and are usually expensive to buy. Under intensive systems, feed provided to the fish must meet all their dietary requirements. The fish rely wholly on exogenous feeds. The feeds must be complete in terms of nutrients supply.

ii. **Feeding rate and frequency:** Research on Tilapia has shown that the following (Table 2) is a best suitable feeding program which suits at various age groups during Tilapia farming:

Table 2: Recommended feeding program for various size of Fish (*Tilapia nilotica*),

Size of fish	**% body weight per day**	**Feed frequency (per day)**
Upto 1 gm	30- 10 (20)	8
1-5 gm	10-6 (10)	6
5-20 gm	6	4
20-80	4	3-4
80-150	3	3
150-250	2	3
More than 250	1.25-1.4 (1.4)	2-3
The bracket figures are recommended in the given range		

3. Water quality management

Fish Farmer should maintain good water quality of fish pond for good growth, survival and health of the fish. The suitable ranges of water quality parameters for Tilapia farming is given in Table 3:

Table-3: Suitable water quality parameters for Tilapia farming

SNo	**Parameters**	**Suitable Ranges**	**Remarks**
1	Temperature	27-32 0C	Below 10C fish will die, below 20C no growth Growth slow after 32.
2	Oxygen	Above 4 ppm	Can survive upto 1ppm but slow growth below 3ppm.
3	pH	6.5-8.5	
4	Carbon dioxide	0 - 15 ppm	
5	Total CaCo3 alkalinity	60+ ppm	
6	Total CaCo3 Hardness	60+ ppm	
7	Nitrate	2-2.5 ppm	
8	Magnesium	Trace for buffer	
9	Iron Total	0-0.5 ppm	
10	Phosphorous	0.01-3.0 ppm	
11	High suspended solids (SS)	Below 50 ppm	

4. Monitoring, Record Keeping and Accounting

Record keeping of all farming activities is necessary for good farm management and analysis of profit of the enterprises. Proper management consists of monitoring your fish ponds regularly, keeping good records and planning ahead for the operation of your farm. On this basis, you can for example decide when to fertilize your ponds and how much to feed your fish. You can also judge how good your supplementary feeds and being utilized and how fast your fish are growing and you can plan the transfer and harvesting of your fish.

Farmer needs to monitor, pond structure, water quality, stocking, growth, biomass and fish stock, fertilization and feeding status, labour cost and related parameters in various registers, sample registers are given at Annexure-1 to Annexure-4.

5. Growth monitoring and data collection

Prior to sampling and harvesting all equipment and nets (seine and dip nets or scoop nets, buckets, scales and note pad for record keeping) are positioned beside the pond or tank. Everything is well-positioned and organized for an efficient sample or harvest. Sampling should not involve seining the entire pond or tank. Efforts should be made to avoid undue stressing of fish. Seining should be rather quickly done in only a corner or quarter of the pond or tank. A short general purpose seine can be used with only one person moving one end of the net into the pond and the other person holding his end of the net at the side of the pond. Fish may or may not be baited with feed prior to seining. But the actual time spent seining is minimized so as to reduce disturbing the fish to a minimum. Fish sampled are weighed and counted back into the pond. Fish are always to be kept in water. Buckets for weighing are tared on balance (zero weight) with water before seining. Fish are put into the bucket with water and reweighed, then the fish are counted back into the pond or tank. For such operations, plastic hampers with holes can be used to hold fish live in a large tub, then fish can be weighed dry in the hamper and moved to a transport box or tank for holding. One

person should be in charge of maintaining all records using forms elaborated beforehand.

6. Harvesting

After about 6 to 9 months, depending on the size of the fish and best market price, it is crucial to conduct a final harvest in which the water is drained from the pond, all the fish are harvested, and the pond is dried out for few weeks. Drying out the pond will kill the wild fish, its fry (small young fish) and eggs.

For improved results during a total harvest from a drained pond:

- Stop feeding your fish two to three days beforehand;
- manage your pond for efficient draining by good maintenance of its bottom slope and drainage channels;
- remove water slowly and regularly, enabling the fish to follow it towards the outlet where they should concentrate;
- at the end, collect fish from the water pools and muddy bottom, if necessary.
- farmed fish can be harvested in several ways, either from a pond filled with water, or drained, according to your needs and circumstances.

Tilapia are difficult to harvest from large earthen ponds without draining the pond. Seine nets are commonly used to partial harvest tilapia from full ponds, but they are adept at escaping by jumping and by burrowing under the seine, especially when the pond bottom is soft mud. To effectively harvest tilapia in ponds, many people are needed to hold the lead or mud line firmly on the bottom and the float line above the water surface. Even with many people, harvest of more than half of the tilapia in a pond is difficult with one or two seine haul. All fish should

be harvested to remove the few mature females that may be present. Ponds, therefore, are usually drained to complete harvest.

7. Marketing

There is a great demand of high quality fish products in Pakistan. The import statistics data of Pakistan showed that during 2011-12, about 12000 ton of Pangasius fillets were imported and sold at hyper star, Metro, Makro and other big store chains and the demand is increasing. The demand of Pangasius fillets at these stores has opened a new market for high quality seafood products and Tilapia can fill this gap if planned to market it properly. Therefore, the sale of Tilapia in local market is not a big issue for Tilapia farmers for many years to come.

Farm raised Tilapia is a new product in the Pakistani fish market. With the efforts of Fisheries Development Board, about 3 ton Tilapia was produced during 2011 and about 15 ton during 2012. Keeping in view the development efforts of Fisheries Development Board and acceptance of Tilapia as farm fish by the Fish farmer community of Punjab, Sindh and KPK, it is expected that more than 100 ton Tilapia will be produced during 2013, which is far below the standing market demand of 12000 tons.

The sale results of Tilapia during 2012-13 showed that the local markets have following preferences:

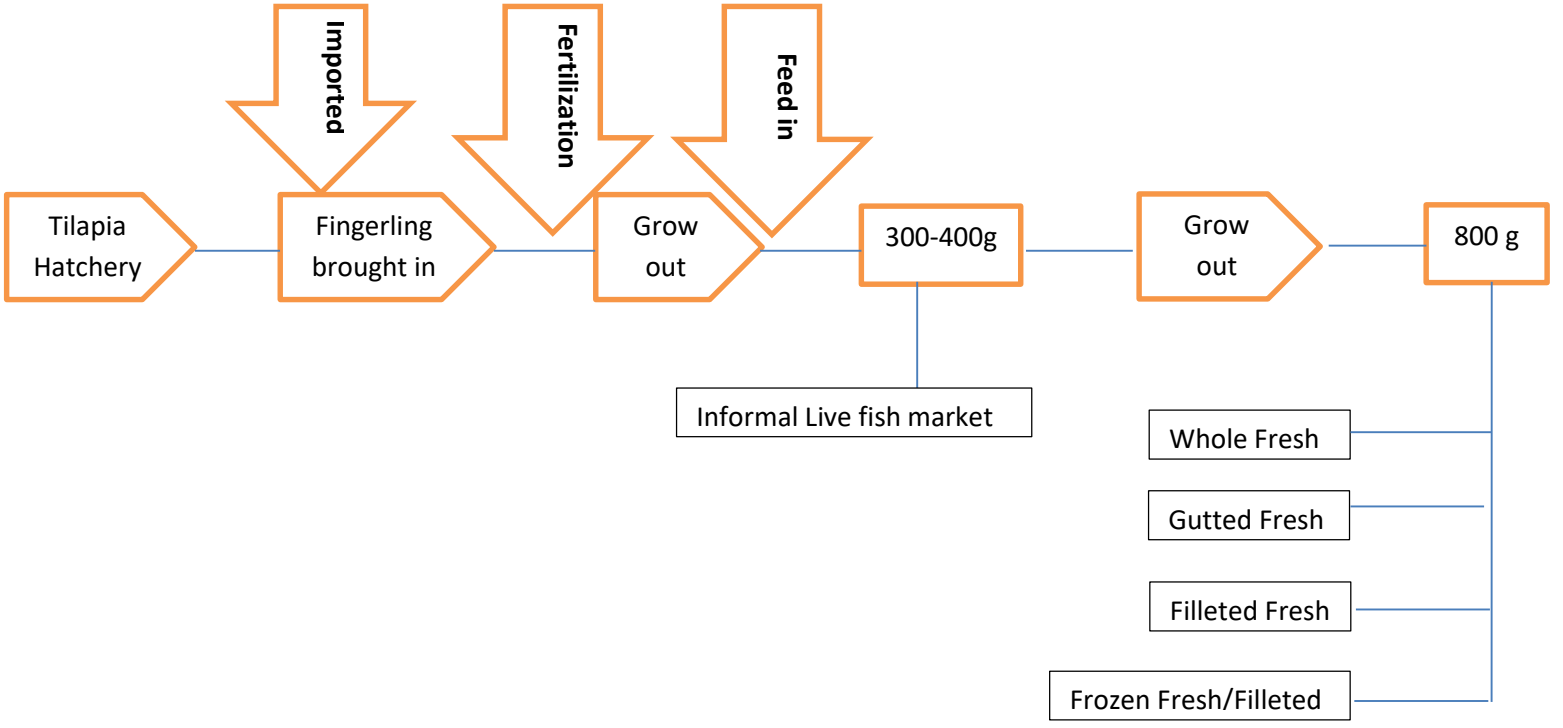
1. **Size**
   Large size Tilapia (more than 600 g) was much preferred than the small size fish and fetched higher prices.
2. **Market Location**
   Punjab markets offered higher prices than Sindh Markets, and within Punjab, Gujranwala market and Rawalpindi markets offered higher prices than Lahore and Faisalabad markets.

3. **Timing**
   The sale of Tilapia got more prices in late December, and early January than the prices offered in November or early December.

4. **Product**
   On average sale of whole Tilapia get more money than the Tilapia sold after making fillets.

5. **Product Quality**
   Tilapia sold by maintaining cool chain in ice boxes got more prices than Tilapia sold in ordinary manner in open vans/sacks.

8. Tilapia production and supply Chain in Pakistan



At the moment Tilapia hatcheries do not exist in Pakistan and the fingerlings are being imported from Thailand, while the facility to develop frozen fish products is not available in Punjab which is main tilapia production area

9. Economic Analysis of Tilapia Farming

The purpose of a business is to make money, or to generate profits. This would seem to be a simple and straightforward concept. The following are the economic analysis based on four options given above in table-1.

Table-4: Economic analysis for one acre Tilapia farming as per option-1

item		description	unit	Quantity	Price/unit	Total
Gross Receipts						
Tilapia		Fresh whole	kg	2,500.0	200.0	500,000.0
Total Gross Receipt						500,000.0
Variable Costs						
Fingerlings		Imported	Individual	5,400.0	8.5	45,900.0
Commercial Feed		28% crude protein	Kg	3,750.0	55.0	206,250.0
Agricultural lime/Manure			Kg			1,000.0
water Cost			Rs.	Lump sump		20,000.0
Labour operation			Rs.	Lump sump		8,000.0
Security personal			Rs.	Lump		

		sump		5,000.0
land lease	Rs	Lump sump		30,000.0
Total Variable Cost (TVC)	**Rs.**			316,150.0
Net return above (TVC)	**Rs.**			**183,850.0**
Net returns / acre				183,850.0
Breakeven price per kg sold				126.5
Breakeven yield at kg/acre				1,580.8
FCR				1.5

Table-5: Economic analysis for one acre Tilapia farming as per option-2

item		description	unit	Quantity	Price/unit	Total
Gross Receipts						
	Tilapia	Fresh whole	kg	3,500.0	200.0	700,000.0
Total Gross Receipt						

						700,000.0
-			**Variable Costs**			
	Fingerlings	Imported	Individual	6,400.0	8.5	54,400.0
	Commercial Feed	28% crude protein	Kg	5,250.0	55.0	288,750.0
Agricultural lime /Manure			Kg			1,000.0
Cost of aeration			Liters			20,000.0
water Cost			Rs.	Lump sump		20,000.0
Labour operation			Rs.	Lump sump		8,000.0
Security personal			Rs.	Lump sump		5,000.0
land lease			Rs	Lump sump		30,000.0
Total Variable Cost (TVC)			**Rs.**			427,150.0
Net return above (TVC)			**Rs.**			**272,850.0**
Net returns / acre						272,850.0
Breakeven price per kg sold						122.0

Breakeven yield at kg/acre				2,135.8
FCR				1.5

Table-6: Economic analysis for one acre Tilapia farming as per option-3

item	description	unit	Quantity	Price/unit	Total
Gross Receipts					
Tilapia	Fresh whole	kg	4,500.0	200.0	900,000.0
Total Gross Receipt					900,000.0
Variable Costs					
Fingerlings	Imported	Individual	7,400.0	8.5	62,900.0
Commercial Feed	28% crude protein	Kg	6,750.0	55.0	371,250.0
Agricultural lime /Manure		Kg			1,000.0
Cost of aeration		Liters			30,000.0
water Cost		Rs.	Lump sump		20,000.0
Labour operation		Rs.	Lump sump		8,000.0
Security personal		Rs.	Lump sump		5,000.0
land lease		Rs	Lump sump		30,000.0

Total Variable Cost (TVC)	**Rs.**			528,150.0
Net return above (TVC)	**Rs.**			**371,850.0**
Net returns / acre				371,850.0
Breakeven price per kg sold				117.4
Breakeven yield at kg/acre				2,640.8
FCR				1.5

Table-7: Economic analysis for one acre Tilapia farming as per option-4

item	description	unit	Quantity	Price/unit	Total
Gross Receipts					
Tilapia	Fresh whole	kg	6,000.0	200.0	1,200,000.0
Total Gross Receipt					**1,200,000.0**
Variable Costs					
Fingerlings	Imported	Individual	11,500.0	8.5	97,750.0
Commercial Feed	28% crude protein	Kg	9,000.0	55.0	495,000.0
Agricultural lime/Manure		Kg			1,000.0
Cost of aeration		Liters			50,000.0
water Cost		Rs.	Lump sump		20,000.0
Labour operation		Rs.	Lump sump		8,000.0
Security personal		Rs.	Lump sump		5,000.0
land lease		Rs	Lump sump		30,000.0
Total Variable Cost (TVC)		**Rs.**			

				706,750.0
Net return above (TVC)	**Rs.**			**493,250.0**
Net returns / acre				493,250.0
Breakeven price per kg sold				117.8
Breakeven yield at kg/acre				3,533.8
FCR				1.5

Annexure-1

Pond Management Record Forms
Pond Stocking Records
Fish Pond Management Sheet

Farm: _____ Period of Management:_____ Manager: _____

Pond No.	Date Stocked	Species	Number stocked	Average weight (g)	Total weight in (kg)	Source of fish	Cost per piece	Comment

Annexure-2

Fish Sampling Records
Ponds should be sampled bi weekly

Farm: _____ Period of Management:_____ Manager: _____

Pond No.	Date of Sample	Days of Production	No. Fish Sampled	Total Weight (kg)	Average Weight (g)	Estimated Total Biomas (kg)	Estimated Weight Gain (kg)	Comment

Annexure-3

Fish Feeding Records

With High Quality Feeds, Fish Should be Fed at 6% body weight in first 6 weeks; 5% for next month; 4% for next month; then 3-4% till harvest; Feed should not be dumped into ponds, but fed according to feeding response.

Farm: _____ Period of Management:_____ Manager: _____

Pond No.	Estimated Total Biomass (kg)	Feeding Rate (%)	Weight of total Daily feed ration	Type of feed	Comment

Annexure-4

Daily Fish Feeding Records

Farm: _____Month:_____ Manager: _____

Ponds No: _____

Date	Pond Number				Comments/Observations
1	1	2	3	4	
2					
3					
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Sr. No.	Note	Reference


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