WWF
SUSTAINABLE SEAFOOD
IDN
2011

SUSTAINABLE SEAFOOD
WWF-INDONESIA NATIONAL CAMPAIGN

Better Management Practices

Small Scale Fisheries Guidline Series

GUIDELINE FOR TILAPIA AQUACULRE

FLOATING CAGE SYSTEM

Version 1 | October 2011

Better Management Practices

Small Scale Fisheries Guideline Series

GUIDELINE for TILAPIA AQUACULTURE - FLOATING CAGE SYSTEM

Version 1 | October 2011

ISBN 978-979-1461-17-7

Editor	:	WWF-Indonesia Fisheries Team
Contributor	:	Sofi Hanif, Bambang Kuntoro Setyo, Budi Syahputra, Johnson Hutajulu
Publisher	:	WWF-Indonesia
Credit	:	WWF-Indonesia

Preface

Praise the Lord so the guideline of Tilapia Aquaculture BMP - using floating cage system can be finalized. This document was arranged through several stages, namely data collection, desk study, pilot project and assistance for tilapia aquaculture groups in Lake Toba, internal review of WWF-Indonesia fisheries team, and external expert review involving professionals and practitioners of tilapia aquaculture.

The purpose of this BMP is to comply with environmental and social standards of ISRTA (International Standard for Responsible Tilapia Aquaculture) which is part of the ASC (Aquaculture Stewardship Council) certification where the development includes a large number of international scientists and refers to FAO standards.

Additionally, the BMP is also arranged based on findings of WWF-Indonesia fisheries team during the pilot project of tilapia aquaculture carried out in Lake Toba. As a living document, this BMP will be further adjusted according to the situation, condition and inputs from stakeholders.

Special thanks to all people and institutions who have contributed so much in the development of this BMP, they are: Freshwater Fish Hatchery – Sukabumi and PT. Aquafarm Nusantara – North Sumatra. We are open and appreciate to any constructive suggestions for the improvement of this guideline.

October 2011

Editor

WWF-Indonesia

Table of Contents

© WWF-Indonesia / Candhika YUSUF

Glossary

- **Anatomy** : Internal organ of fish
- **Cool Box** : a cooler, portable ice chest used to keep fish and maintain the proper temperature to remain stable
- **GPS** : Global Positioning System; a device that provides coordinate points of certain locations
- **Grading** : the process of classifying fish according to their size
- **Pest** : an organism that is damaging to livestock
- **Hatchery** : a place where fish eggs are hatched and produce fingerlings
- **Insulated Box** : a Styrofoam cooler, shipping box to keep the fish cool
- **IUCN** : International Union for Conservation of Nature, an international non-government organization dedicated in nature conservation
- **Quarantine** : the isolation of fish to prevent the spread of disease
- **Morphology** : Physical appereance of fish
- **Galvanis Pipe** : a copper and low-carbon steel pipe containing 99.7% zinc (Zn) and most commonly used as drinking water pipe
- **Predator** : a carnivorous animal that hunts kills, and eats other animals in order to survive
- **Reservoir** : a large tank or natural or artificial lake used for collecting and storing water
- **Sampel** : a small amount or part of something/water or fingerling/fish, used as an example of the quality of the whole
- **Sampling** : the process of selecting a group of fingerling/fish or some water to be used as a representative or random sample
- **Secchi Disk** : a circular disk used to measure water turbidity
- **SR / Survival Rate** : value indicating the percentage of cultured fish which are alive for a given period of time (culture cycle)
- **Polyethylene Rope** :a rope made from plastic polymer of ethylene (plastic)
- **Transgenic** : fish that contain genes from a different species, transferred using the technique of genetic

© WWF-Indonesia / Muhammad YUSUF

I. INTRODUCTION

Tilapia (*Oreochromis niloticus*) is one of the fresh water fish mainly consumed by lots of people. This kind of fish is relatively easy to culture and many people do it in their own pools / cages by applying traditional method. However, on business scale, tilapia farming would need to be intensive method in order to manage the culture more efficiently such as controlling water quality and feed selection.

Tilapia culture techniques are expected to constantly develop. The stakeholders of tilapia aquaculture have developed a standard in order to manage the aquaculture more responsibly called BMP. This BMP is compiled from all tilapia aquaculture techniques applied in Indonesia, especially in Lake Toba. It can be used as guideline for tilapia aquaculture. Moreover, an international standard for responsible tilapia aquaculture known as ISRTA is also incorporated into the BMP.

The goal of ISTRA is to provide standards or measurable indicators that would minimize social and environmental impacts caused by tilapia aquaculture.

II. CLUSTER SYSTEM ON TILAPIA AQUACULTURE

To start a tilapia aquaculture enterprise would need a big investment. Therefore farmer groups should be developed in district level so the farmers, local governments, producers, and so forth can coordinate and cooperate effectively.

Each group comprised of 5-10 farmers which assistance should be given to every group by a local Fisheries Agency Field Officer.

The group meeting should be held on a regular basis, for instance every two weeks, convened in certain place and time to discuss technical issues related to the culture activities. The meeting can also be held incidentally when an urgent matter occurs and needs to be solved immediately.

Through the establishment of farmer groups, the risks of harvest failure are hoped to be reduced. In addition, farmers can sale their productions to the buyers/retailers with good price, so their revenues would increase.

III. TILAPIA AQUACULTURE ACTIVITY PLANNING

- Period of culture has to be adjusted with the environmental condition, so the unexpected results caused by natural impacts such as bad weather or currents can be prevented;
- The floating cages should be sited on proper locations, allowed by local government to be used as aquaculture areas;
- The plan will decide the amount of profit that can be gained from the business. Harvesting in line with the period when the market demand is high could boost the price of the products;
- Using recommended fingerlings taken from authorised hatchery so the use of fingerlings vulnerable to certain diseases can be avoided;
- Considering recommendations disseminated by relevant agencies regarding period (month) of culture to prevent failure on aquaculture;
- Setting up plan (period of culture), so fish can be harvested monthly. Operational costs can be minimised and revenues can be gained every month;
- Identifying strain/colour of fish preferable in the market.

IV. PRELIMINARY STANDARDS TO START TILAPIA AQUACULTURE

- The most suitable locations have to be first selected. They can be reservoirs, rivers, streams, ponds, etc;

- The farmers must comprehend the BMP on tilapia farming complied with national and international standards, specifically ISTRA;

- The farmers must present legal documents/licenses related to the use of land/public reservoir, rivers, and streams issued by relevant agency or at least local government;

- Having some investment suitable for business scale. For instance when the fish are nearly harvested or reach economic size (500 grams/fish), the quantity of feed needed would increase (70%). The farmers must have enough budgets to buy the feed. It could be simply stated no feed will mean no growth. Without growth there will be no profit.

V. TILAPIA AQUACULTURE ARRANGEMENTS

a. Site Selection

- Water levels around fish cages are not severely fluctuated;
- Reach-able;
- Near to feed sources;
- There should be no runoff from row crops, households or industries;
- To avoid the strong flow of water, fish cage should be sited in a point where the distance between the cage end and the pond/lake bottom should be at least 10 meters;
- There should be enough current so the amount of oxygen dissolved in the water would be sufficient;
- Infrastructure near farms/cages are well developed;
- There should be no chronic problems nearby the location caused by the development of the tourist attractions, public transportation lanes or other human activities that could disturb the aquaculture practices;
- Fish cage placement should take into account eutrophication and carrying capacity of the site

b. Facilities and infrastructures

Floating cages are a series of floating structures used to keep the fish cultured.

Facilities:

1) Cage structure: bamboo, wood, galvanic pipe, floats (plastic/steel barrels) and nets;

2)Housing facility and storage, shelter for the farm workers and facility to store feed and some equipments;

3) Some tools such as scissors, brushes, baskets, plastic containers for grading, scales, cool boxes where the feeds are stored, and boats.

Infrastructures:

1) Access to transportations
2) Access to communications
3) Electricity
4) Fresh water source

The design of floating cages

The components of floating cage construction are floating rafts, nets, floats and anchors.

Each component of the floating cages is set up as follows:

1) Floating Raft

Setting up the raft can be done on land with size 8 x 8 m, or it depends on the net size. The other measurements commonly used are 6 x 6 m or 12 x 6 m. The frame of floating cage would be more durable if it was built from steel pipes.

The raft/frame will be then attached to the net (rectangular shape); the raft can be made from bamboos or stainless galvanic pipes.

On top of the rafts, 2 or 4 cages can be built. However it would be more economical if there are 4 cages.

Four anchors will be attached in each corner of the raft bottom so the cages will be steady

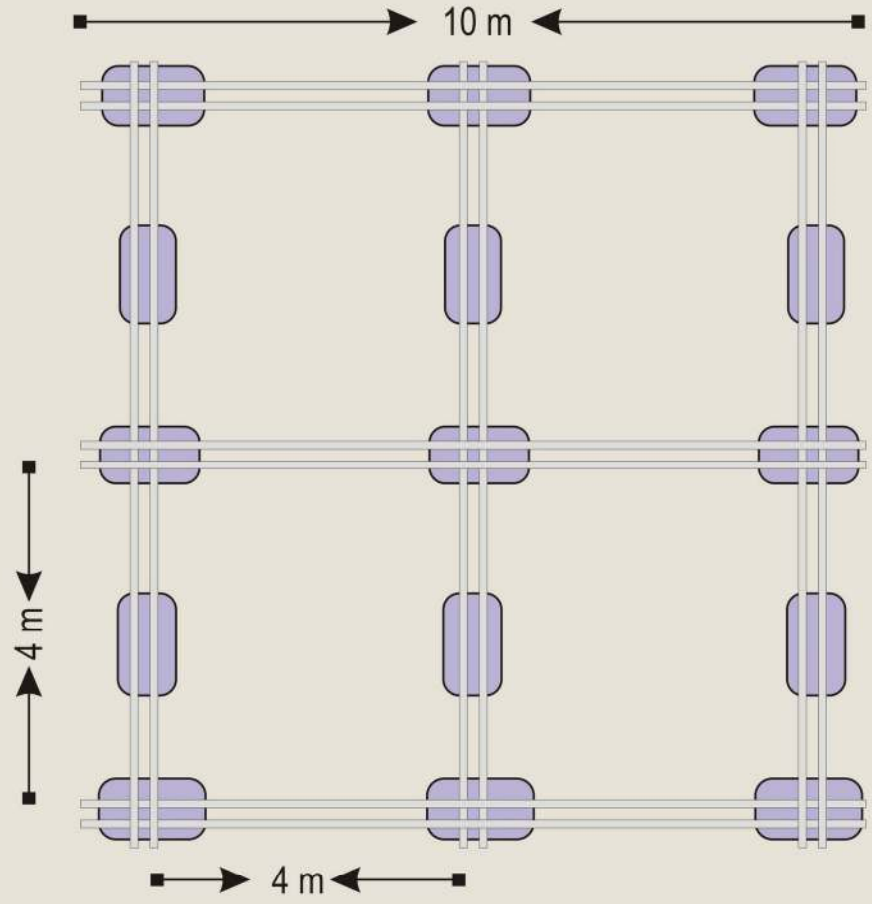


Figure 1.
Raft frame structure

2) Floats

Floats are used not only to keep the cages on surface of the water but also the housing facility. Farmers commonly utilize plastic barrels (200 lt.) as the floats. To float a raft with 4 cages sized 6 x 6 x 4 m, it would need 24 to 30 barrels depending on the weight of the raft and the cages. The floats will be tied by using polyethylene (PE) ropes (0.8 – 1.0 cm in diameter). The nets drowned in the water should be minimum 3 meter deep.

3) Nets

The nets are used as the body of the cages where the fish are kept and cultured. They are made from polyethylene (PE) D.18 and the mesh sizes are ranging from 0.75 to 1 cm. The net size is selected by considering the minimum possibility for fish to escape.

The shape of the cages depend on the raft size, the measurements are mostly 6 x 6 x 4 m. Then the cages are attached to the rafts by tying up each corner of the rafts. Setting up the nets and attaching the cages can be seen at Figure 2 and 3. To keep the cages in rectangular shape, weight has to be placed in each corner of the cage bottom.

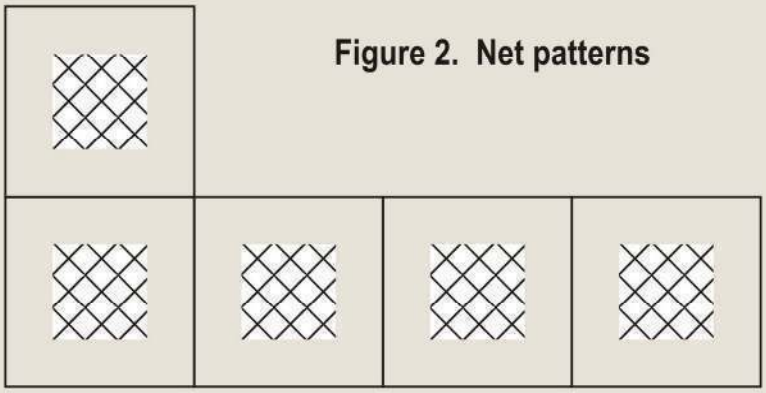


Figure 2. Net patterns

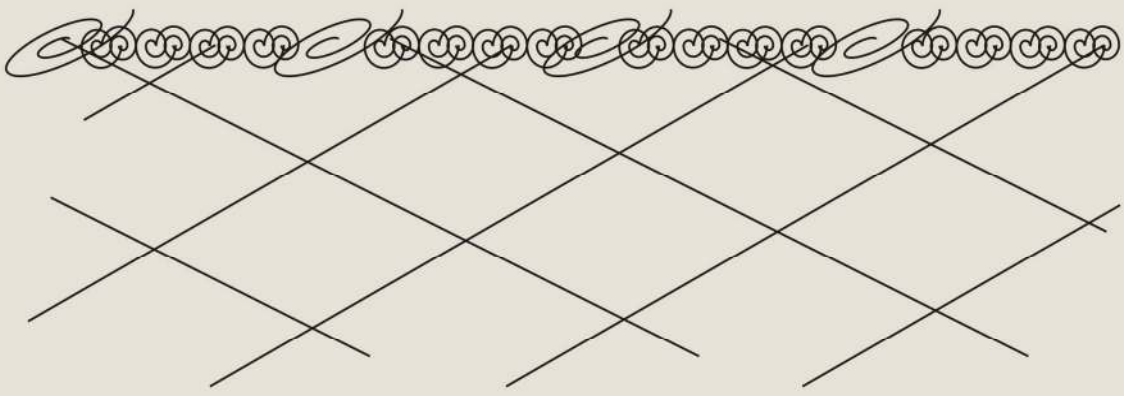


Figure 3. Binding the nets

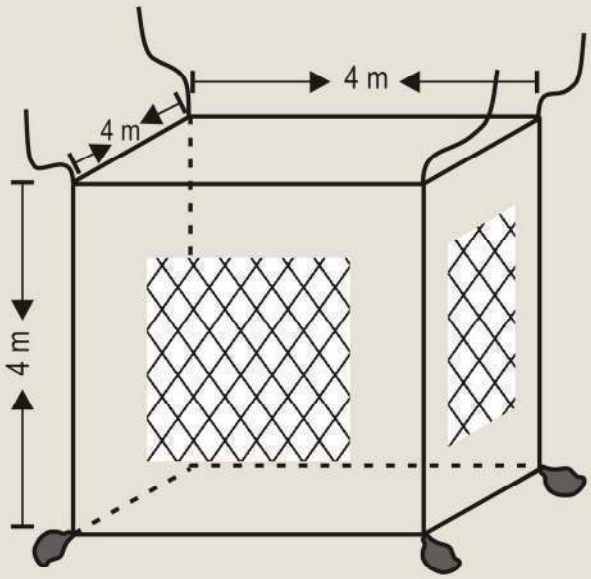


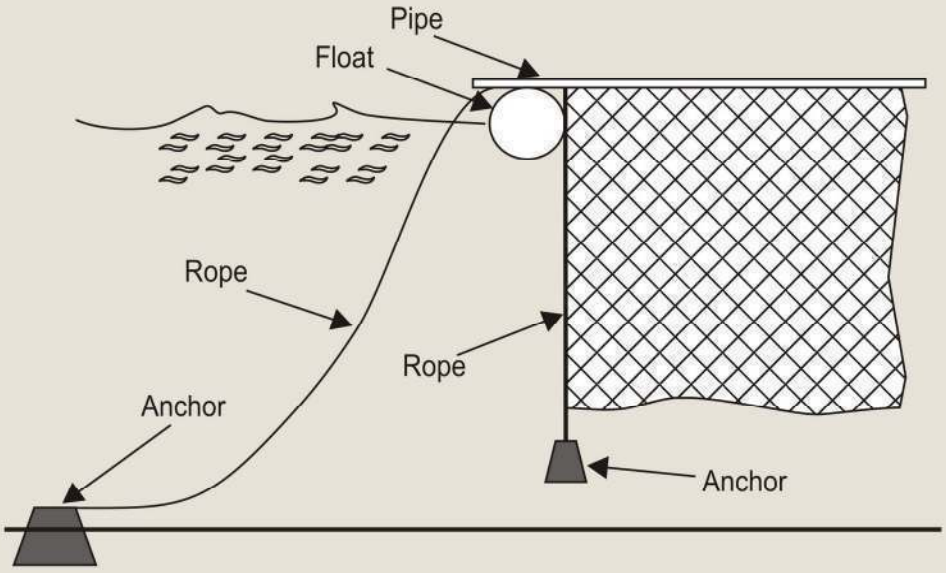
Figure 4
Nets attached to the raft structure

4) Anchor

Anchors will hold the cages to keep steady, not dragged away by currents, winds or waves. Every floating cage has to be equipped by four anchors (50 kg in weight) made from cement.

The length of the anchor rope is usually 1.5 times of the water depth and its diameter range is from 12-20 mm; rope is used to prevent the anchors from drowning during high tides or when the water surface in reservoir/rivers/streams rises.

Cage is also equipped with traps attached between cages or discharge channels so when the fish escape, they will be caught in the traps.



Fisgure 5. Placement of anchors on floating cage structure

VI. Fingerlings

a. Fingerlings selection

•Fingerlings have to be taken from a well managed hatchery, so it can be assured that they are treated well, and the data of adult tilapia / broodstock, feeds, supplements etc would be available. Fingerlings have to be high quality ones that are free from diseases. When a fish is infected by a certain organism, it could infect other fish in the cage or could lead to the disease outbreaks. The visual characteristics of healthy fingerlings generally are as follows:

© WWF-Indonesia / Wahju SUBACHRI

- The body shape is normal
- Actively moving
- Having good response to the feed deployed
- Having similar size
- Free from disease and the absence of scars/wounds
- Having bright colour

- **Do not use genetic modified fingerlings**
- **95 % male fingerling is preferable.**

b. Transporting Fingerlings

The shipment of the fingerlings can implemented in two ways, open or closed transporting system.

Open system

Open transporting system is usually for short distance shipment. Containers used are buckets or other waterproof containers (not leaked). The containers will be filled with water and covered. It would prevent the fingerlings from getting stressed out and the unintentional release of fingerling from fish transport containers can be avoided. There should be enough oxygen inside the containers so the fish will survive during the transporting. Open transporting system can also be implemented for long distance shipment by reducing stocking density of fingerlings.

Closed system

Closed transporting system is performed for long distance shipment. Fingerlings should be shipped in 0.06-0.10 mm Polyethylene (PE) plastic bags (50 cm in width and 85 cm in height). The bags have to be filled with 10 liter of water and fill it with oxygen. Bags should be kept at 20 – 23 Celcius degree temperature. The volume of the oxygen is three times of the water volume.

Transporting should be conducted early in the morning (before 9 am) or in the afternoon when the sun doesn't shine very brightly.

Tabel 1. Amount of fish in plastic bag versus transport duration

Fish Size and Weight		Transport Duration (Hours) (Kg of fish / bag)			
Lenght (Cm)	Weight (Gr)	1 hour	2 hours	24 hours	48 hours
1,0 – 1,5	0,5 – 1,0	0,8 – 3,0	0,75 – 2,5	O,5 – 2,0	0,3 – 1,0
2.5 – 3,0	2,0 – 3,0	1,0 – 3,5	0,9 – 3	0,6 – 2,5	0,3 – 1,25
5,0 – 6,0	6,0 – 8,0	1,0 – 4,0	0,9 – 3,5	0,75 – 3,0	0,3 – 1,5
7,0 – 8,0	12,0 – 15,0	1,0 – 4,0	0,9 – 3,5	0,75 – 3,0	0,3 – 1,5

Source: Drupee & Unner, 1991 in S. Rachmatun Suyanto, Nila, 1993

c. Fingerlings Stocking

- Put the bags onto the waters and let them float for about 20 – 30 minutes. Water temperature in the bags will gradually change and adjust to the temperature of the surrounding waters;
- Untie top of the bags one by one. Fill up the bags with water taken from the surroundings to adjust the substances contained in the water, especially pH. It might take 15 – 30 minutes;
- Release the fish by tilting the bags. The fish that can adapt quickly with the new environment will swim fast out of the bags. Wait until the all fish come out of the plastic bags;
- The proper stocking density is ranging from 60-65 fish/meter square when the size of fingerlings is usually 20 gram. The density should be remain the same (no adding) until the peak season;
- The density depends on the aquaculture scale and harvest quantity expected. Stocking densities for tilapia fingerlings in Lake Toba range from 5,000 – 10,000 fish per cage, with the fingerling size from 3 -4 inches (20 grams).

When open system of transportation is applied, use fishnet with small mesh size and smooth thread. It would prevent damages on fingerling scales and fish stocked will not easily get infected by diseases.

VII. DURING THE CULTURE PERIOD

a. Feed

1) Floating feed is preferable. This kind of feed can always be seen; on the other hand the feed that drowns would easily contaminate the water if the fish didn't eat it.

© WWF-Indonesia / Muhammad YUSUF

However floating feed would be easily taken away by the currents. Therefore boxes have to be put on the cages. The width of the boxes is about 25% of the whole cage surface. Placement of the boxes is 40 cm in the water and 20 cm upper the water surface. The boxes will keep the feed in the cages.

Feed is given 4 – 5 times a day and it should be finished within 5 minutes. The amount of feed per day is 3 – 4 % of the fish weight. It can be given per hour from 9 am to 6 pm. Sampling should be done per 10 days to know the fish weight and the amount of feed that should be given. Records shall be available in every cage since fish weight and survival rate in every cage might vary.


© WWF-Indonesia / Muhammad YUSUF

2) Feed for tilapia mainly contains 25 – 28 % protein, 8 – 13 % fat and 45 – 55 % carbohydrate completed with some minerals and vitamins. The purchase of feed should be perfomed every 7 days or at least every 10 days, especially when the store room is not very large. Moreover feed kept for long period of time might deteriorate and on top of that the concentration of protein in fish food is fairly high, bacteria or fungi could easily grow and those can cause diseases to the fish.

© WWF-Indonesia / Candhika YUSUF

The efficient use of feed is based on FCR (Feed Consumption Ratio) 1 : 1.5 – 1.8. For 1 kg fish it would need 1.5 – 1.8 feed. To determine Feed Fish Equivalence Ratio/FFER, see appendix.

3) Ask feed manufacturer to provide the list of ingredients contained in the feed. Make sure that the fish meal and oil are not taken from the species categorized as red list by IUCN (endangered and threatened species). The brands have been authorised by Ministry of Marine Affairs and Fisheries (MMAF) and their ingredients have been verified.

b. Cage Maintenance

1) Nets and other tools shall be cleaned on a regular basis. The nets should be cleaned every week or anytime when needed;
2) Fish health should be monitored; the number of dead fish has to be recorded daily.
3) The dead fish are collected and buried every day;
4) The reared fish should be protected from predators and pests;
5) The predators prevention should not lethal. Please be noticed on the conservation of threatened and endangered species listed on the IUCN's Red List;
6) Observing leaking on nets, loose stitches, removing water hyacinth from inside and outside the cage.

© WWF-Indonesia / Candhika YUSUF

c. Fish Health

© WWF-Indonesia / Wahju SUBACHRI

1) To keep the reared fish healthy, the water quality has to be controlled all the time. Infected fish should be isolated/quarantined;

2) The cage facility should be clean. When some fish are infected, feeding frequency should be reduced (feed on 3 pm is not given). If mass mortality occurs, the survived fish should be fasted at least in three days;

3) Quarantine is done by separating the infected fish into containers away from the cages;

4) The infected fish that cannot be cured should be directly removed from the cages and banished;

5) Use only antibiotics or medicine allowed by local government (local Fisheries and Marine Affairs Agencies) to treat the infected fish. The fish that have been totally recovered can be put back into the cages with other fish. Records on fish treatment should be available;

6) The infected fish might show following characteristics: the movement is irregular, there are wounds on the surface of the body or white spots all over the body, the eyes are swollen and the body color seems to fade, loose appetite to feed.

VIII. HARVESTING

© WWF-Indonesia / Arifsyah NASUTION

- The fish are harvested when they reach economic size. The economic size is ranging from 300 to 1,000 grams/fish. The fish are marketed in two ways; they can be sold as fresh or live. The fresh fish will be kept in the containers and iced;
- At least one day before the fish are being shipped, they should be moved to another containers (in order to cleanse them from dirt and other substances);
- Handling live fish is similar to harvesting or transporting fingerlings in plastic bags. The bag size is 100 cm x 50 cm and water volume inside the bag is 8 litres. The weight of each bag would range between 2 – 4 kg. The ideal water temperature in the bag is about 22- 23 C , the fish will be calmer on those temperatures.
- For fresh fish, the ratio between fish and ice cube is 1:1. The ice is predicted to be melting down after 15 hours. The fish are kept in insulated boxes with the ice where the temperature will be maintained.

© WWF-Indonesia / Candhika YUSUF

IX. ENVIRONMENTAL MANAGEMENT AND WATER QUALITY CONTROL

Environment around the cages has to be well conserved. Bad environment will give direct negative impacts to the aquaculture such as water pollution.

© WWF-Indonesia / Wahju SUBACHRI

Components that should be intensively monitored are as follows:

1. Water quality (pH, oxygen concentration/DO, temperature and so forth).
2. Supporting the conservation of endangered and threatened species protected by national as well as international lows. The use of lethal tools in handling those species shall be avoided.
3. The use of carbon-based energy shall be monitored on a continual basis. Monitoring can be done by measuring total energy consumption on aquaculture facilities in kilo joule/one ton of fish/year.

Healthy environment will result high quality production

- Secchi disk visibility observation is done monthly in the same time and location (marked by GPS);
- When the visibility is less than 5 meters, water sample has to be taken to the lab. The concentrations of chlorophyll a and total phosphorus in the water will be tested;
- The concentration of dissolved oxygen (DO) is measured in three locations before sunset or sunrise;
- Monitoring shall be done monthly in the same time and location, GPS can be use to mark the location.
- Date, hour and minute when the monitoring is taking place should be documented.

Water quality control shall be done in three points: RWFA, RWFO, RWFP

RWFA: Receiving Water Farm Afar is the point where aquaculture water meets receiving water afar from mixed zone, 1 -2 meters outside the cages and in 1 meter depth.

RWFO: Receiving Water Farm outfall is the point where aquaculture water meets receiving water; the measurement is done in the cage.

RWRP: Receiving Water Reference Point is the reference or the point least affected by aquaculture activities. A point in maximum distance away from aquaculture activities will be identified.

Water Quality Monitoring Sheet

Water Quality	RWRP	RWFO	RWFA
Receiving Water System (Estuary, lake, etc.)			
Monthly Sampling Date/Time			
DO (mg/L)			
Discharge water volume			
Turbidity			
Specific conductance (us/cm) for salt water aquaculture			
Chlorofil a (ug/L)			
Phospat-posporus (ug/L)			
Ammoniac-nitrogen (ug/L)			

X. DOCUMENTATION

All aquaculture activities should be documented so they can be easily monitored and analyzed and effective correction plan can be developed and implemented in the next cycle. Record from every cycle should be kept for at least 3 year period, components included in the record are but not limited to as follows:

a. Fingerling: source of fingerlings, varieties, number and size;
b. Treatment: daily mortality per cage, the use of antibiotics, weekly growth, number of fish when they are 3 month-old (when their weight is below 100 grams), the number of fish when their weight reaches 100 grams;
c. Feed: the amount of whole feed purchased, the amount of feed per cage until harvest, feed quality, ingredients of feed used by manufacturers;
d. Number of fish harvested: number of aquacultural production per cage, harvesting and marketing processes (buyers should be identified);
e. Parameter of water quality: water quality in cages, the quality of water that goes into the cages (can be seen from the current), the quality of water that goes out the cages (can be seen from the current);
f. Business management and maintenance: cage and raft maintenance, recruitment mechanism of employees (contract, health, etc.).

© WWF-Indonesia / Wahju SUBACHRI

XI. SOCIAL MANAGEMENT

a) Children labours/young workers (under 17 years old) shall never be exposed to work in whatever reasons (ex: debt bondage);
b) Unequal treatment of employees, based on certain characteristics (such as sex or race), is a violation of a workers' human rights;
c) Farms are not inhibiting or restricting local community access to public land, freshwater resources or public fishing grounds;
d) Workers shall receive training on health and safety practices/ procedures/ policies;
e) When an accident, injury or violation occurs, the company must record it and take corrective action to identify the root causes of the incident, remediate, and take steps to prevent future occurrences of similar incident;
f) Workers shall be paid fair and equitable wages that, at a minimum, meet the legal and industry standard minimum basic needs of workers as well as provide some discretionary income;
g) Workers have freedom to associate and bargain collectively;
h) Abusive disciplinary actions that can violate workers' human rights shall not be done;
i) A corrective action plan (updated annually) that addresses unintended problems associated with labour and local people relations and emergency action plan shall be developed and implemented;
j) Farms shall provide clean, sanitary and safe living quarters with access to clean water and nutritious meals;

Appendix 1. Daily Record

DAFTAR CATATAN HARIAN BUDIDAYA IKAN NILA

Bulan: TAHUN:

Asal Bibit :
Jumlah tebar :
Nomor Karamba:

Nama Penanggung jawab :
Alamat :

Tgl	Umur (Hari)	Kualitas air					Cuaca	Kesehatan ikan		Jumlah ikan			Perlakuan				Keterangan
		DO (mg/l)	pH	Suhu (°C)	Amonia (mg/l)	Posfat (mg/l)	Cerah (C) / Berawan (B) / Hujan (H)	Normal (N)	Tidak Normal (TN)	Awal	Kematian harian	Akhir	Pem-berian vitamin	Pemberian Obat-obatan	Jumlah pakan perhari	Pembersihan karamba	
Total																	

Appendix 2. FCR Measurement

$$eFCR = \frac{\text{Feed, kg / ton}}{\text{Total weight of fish, kg / ton (gross)}}$$

$$FFERm = \frac{(\%\ \text{fish meal}) \times (eFCR)}{22.2}$$

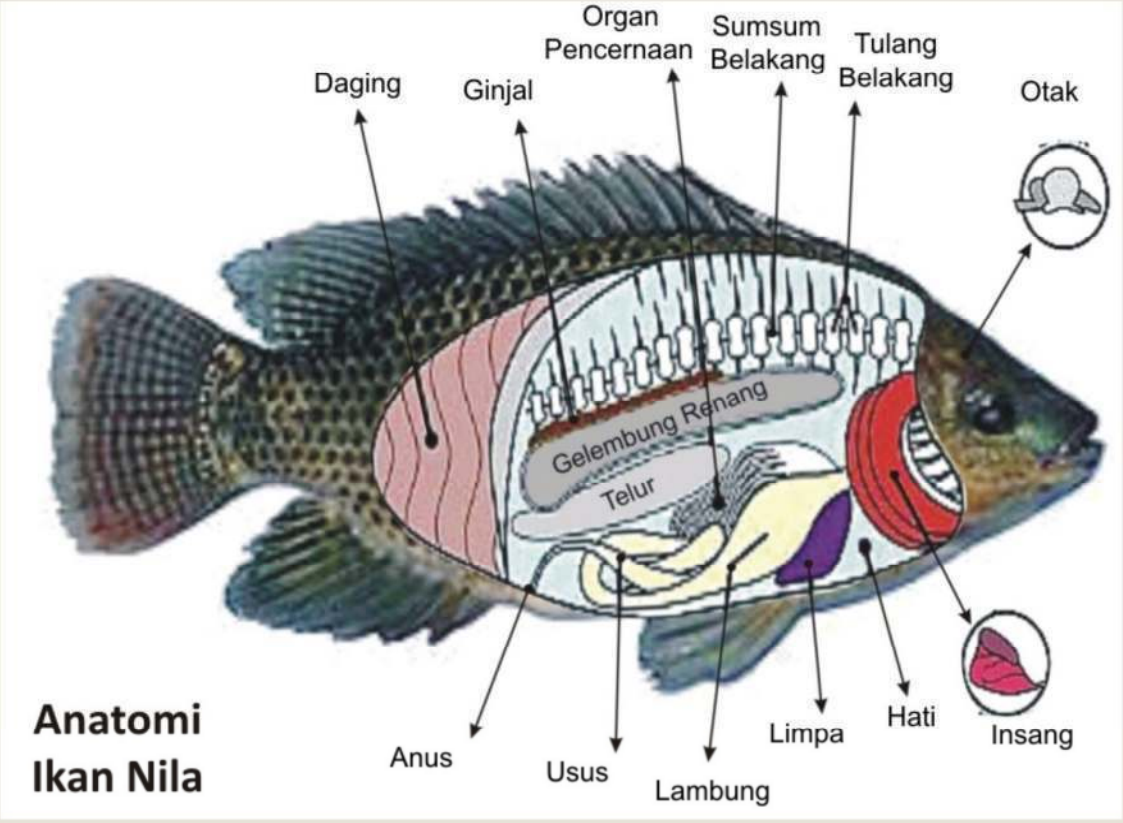
$$FFERo = \frac{(\%\ \text{fish oil}) \times (eFCR)}{5}$$

eFCR (Economic Feed Conversion Ratio) : a measure of a fish's efficiency/economic ratio in converting feed mass into increased body mass/fish produced.

FFER (Feed Fish Equivalency Ratio): estimating the amount of wild forage fish used to produce a unit of farmed fish.

© WWF-Indonesia / Candhika YUSUF

Appendix 3. Morphology and Anatomy of Tilapia



Appendix 4. Business Case of Tilapia

No	Activity	Harga	Total	Keterangan
A	Modal Tetap			
1.	Karamba 1 unit 4 petak	20.000.000	20.000.000	Asumsi umur 4 tahun
2.	Peralatan pendukung Usaha (serok, *cool box*, gayung, senar, dll)	5.000.000	5.000.000	Asumsi umur 4 tahun
	Jumlah		25.000.000	Panen 7 bulan (6,8 siklus/4 tahun)\
B	Modal Tidak Tetap			
1.	Bibit ikan ukuran 3-4" Jumlah 8000/kotak @ 32.000	850	27.200.000	Menggunakan bibit PT. AFN dan diterima di tempat
2.	Pakan dengan FCR 1,4 @ 25.200	7.500	189.000.000	
3.	Pekerja 2 orang selama 7 bulan @ 1.400.000	1.400.000	19.600.000	
4	Pengeluaran tak terduga	5.000.000	5.000.000	
	Jumlah		240.800.000	
C	Pendapatan			
1.	Panen ikan berat rata-rata 700 gram dengan SR 75% @ 16.800	17.000	285.600.000	
	Jumlah		285.600.000	
D	Total pengeluaran siklus ini		244.476.471	
E	Total Pendapatan		41.123.529	
F	R/C ratio		1,168	Bunga bank kredit 1 %
G	Biaya produksi per kg ikan		14.552,17	
H	BEP		15.821	Modal kembali dengan penjualan minimal Seharga tersebut.

© WWF-Indonesia / Wahju SUBACHRI

REFERENCE

- Anonymus, 2010, *Tilapia cages farming in Brazil.*
- Badan Standarisasi Nasional; *Pengemasan Benih Angkutan Darat* SNI 7583: 2010
- CBIB, *Pelatihan Cara Budidaya Ikan yang Baik*
- Rahmatun Suyanto, S, 1993, *Budidaya Ikan Nila*, Penebar Swadaya, Jakarta
- Tilapia Aquaculture Dialog, 2009, *International Standart for Responsible Tilapia Aquaculture*
- http://www.fishbase.org/Summary/SpeciesSummary.cfm?genusname=Oreochromis&speciesname=niloticus+niloticu

---

BMP of Tilapia Aquaculture - Floating Cage System is part of small scale fisheries BMP published by WWF-Indonesia. The other series of BMP :

1. Tuna Fisheries, Guideline for Capture and Handling
2. Grouper and Snapper Fisheries, Guideline for Capture and Handling
3. Tiger Shrimp Aquaculture, with Feed and without Aeration
4. Tiger Shrimp Aquaculture, without Feed and Aeration
5. Grouper Aquaculture, Fix and Floating Cage Systems
6. Prevent and Overcome Disease on Tiger Shrimp in Traditional and Semi - Intensive Aquaculture System
7. Sustainable Tuna Long Line, To Reduce Bycatch
8. Sea Turtle Handling, as Bycatch on Longline and Trawl Fisheries

WWF-Indonesia

Gedung Graha Simatupang Tower 2 Unit C, Lantai 7
Jalan Letjen TB Simatupang Kav. 38,
Jakarta Selatan 12540
Phone +62 21 7829461

WWF Mission
To stop the degradation of the planet's natural environment
and to build the future in which human lives in harmony with nature

www.wwf.or.id