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TILAPIA CAGE FARMING IN LAKES

ANTONIO M. BAUTISTA
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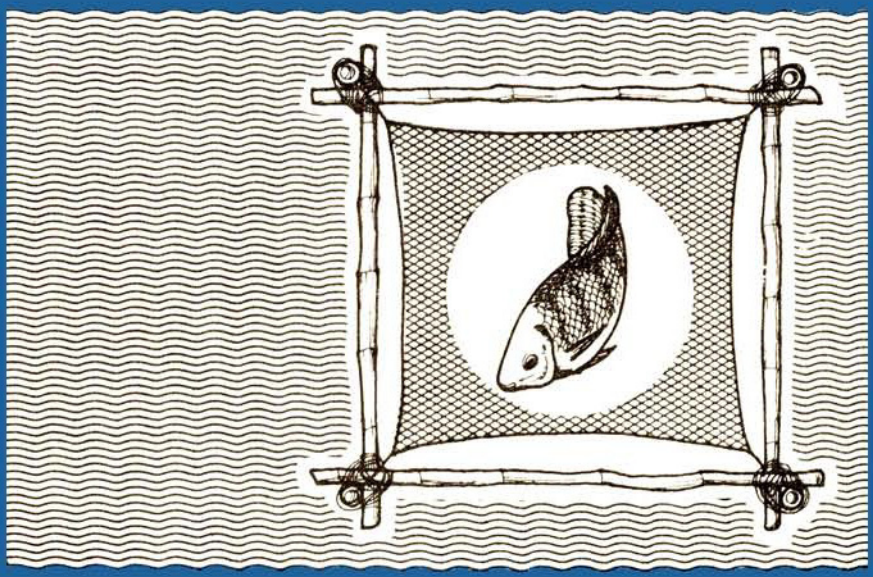

AQUACULTURE DEPARTMENT
Southeast Asian Fisheries
Development Center
Tigbauan, Iloilo, Philippines

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FOREWORD

The Aquaculture Department (AQD) of the Southeast Asian Fisheries Development Center (SEAFDEC) is mandated to contribute to food production efforts by evolving and disseminating appropriate technologies on fish culture.

The Department is now launching the maiden issue of its AQUACULTURE TECHNOLOGY Series under its Training and Extension Program to disseminate aquaculture technologies generated, refined, and verified by its researchers and extension specialists. The series consists of illustrated booklets, each dealing with a particular subject matter on aquaculture and is designed for self-study.

AQUACULTURE TECHNOLOGY Series 1, Tilapia Cage Farming in Lakes, *is a guiae for prospective fish farmers planning to raise tilapia in lakes and similar water impoundments. The basic techniques presented and described here are those practised in Laguna Lake. This technology has spread to major lakes in Bicol and Mindanao. Judging from the increasing popularity as foodfish and good business potential of growing Nile Tilapia, it is expected that cage farming will also be practised in other lakes, rivers, and reservoirs throughout the country with similar ecology as Laguna Lake.*

Dr. A.M. Bautista, the author, is the Tilapia Project Leader and one of the senior researchers of the Department's Binangonan Research Station.

ALFREDO C. SANTIAGO, JR.
Chief
SEAFDEC Aquaculture Department

28 December 1984

PUBLISHER'S NOTE

SEAFDEC Aquaculture Department is launching the AQUACULTURE TECHNOLOGY Series with this maiden issue, "Tilapia Cage Farming in Lakes", in response to incessant demand for packaged technology on tilapia culture. While this module is being made available, it is still being subject to critical review by authoritative persons other than those who have been involved in similar studies in the Department.

Suggestions and comments from the readers and other sectors are welcome. You may write directly to:

TRAINING & EXTENSION
SEAFDEC Aquaculture Department
P.O. Box 256, Iloilo City
Philippines

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INTRODUCTION

The farming of tilapia in fresh water lakes is a lucrative business in the Philippines. Some 20,000 hectares of pens and cages in Laguna de Bay are now being stocked, at one time or another during a year's operation, with the fast growing and attractive-looking Nile tilapia *(Oreochromis niloticus = Tilapia nilotica).*

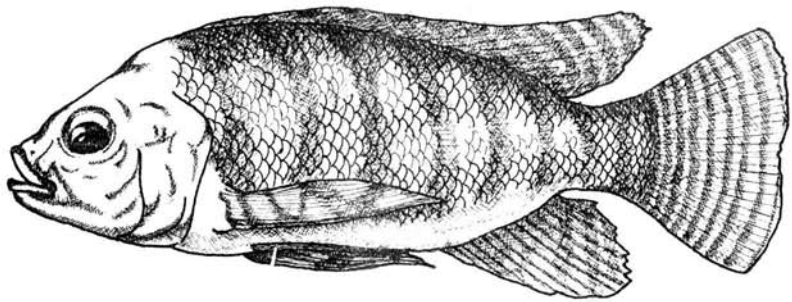


Fig. 1. Nile tilapia

Many pens and cages are stocked with tilapia only while some are stocked with milkfish in combination with tilapia. Called "pla-pla" by many, a large-size tilapia weighing one-half kilogram or more are now a common sight in the markets of Metro Manila where before only the small and dark Java tilapia *(Oreochromis mossambicus = Tilapia mossambica)* were available. Even in first class restaurants, the "pla-pla" has become a favorite fish in a number of native dishes.

Evidence of the popularity and success of tilapia farming can be seen in the countryside bordering Laguna Lake where a

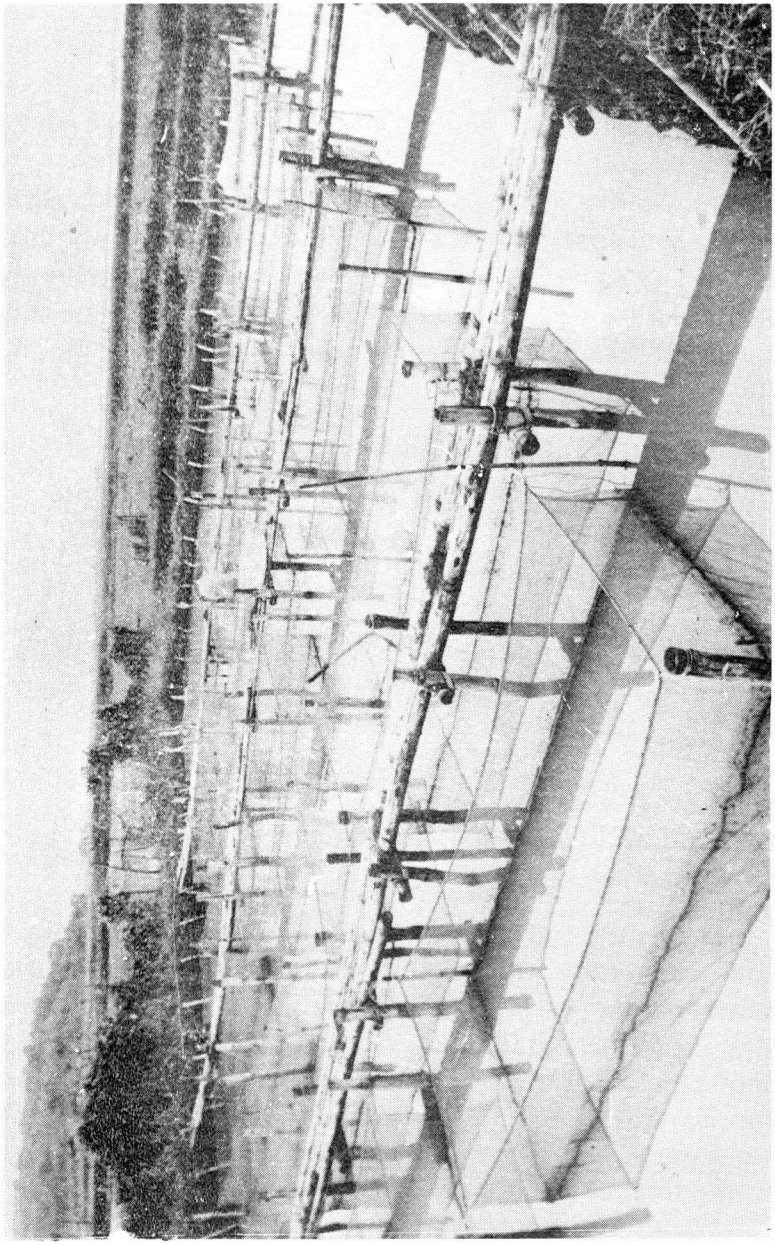


Fig. 2. Hatcheries in paddy ponds

large number of tilapia hatcheries have been established. Paddy ponds (Fig. 2) and even concrete tanks are used as hatcheries as well as grow-out for fry and fingerlings to supply the growing demand for seed stock.

Rationale

The potentials of the tilapia industry in other lakes, rivers, and reservoirs throughout the country have not been fully tapped. There are 70 other freshwater lakes with an aggregate area of around 200,000 hectares where the cage farming practices applied in Laguna Lake can be adopted.

More fishfarmers are shifting to cage culture because the technology is simple and does not require much space and capital. The further growth of the industry, however, must be favorable and beneficial to both businessmen and small-scale fishermen.

Learning Objectives

After going through this AQUACULTURE TECHNOLOGY module, you should be able to apply the guidelines in tilapia cage farming. Specifically, you should be able to:

1. select a good site for your cage farm;
2. design and layout a cage farm; and
3. operate and manage a cage farm using practical techniques in acquiring seedlings, stocking, care of stocks and cages, and harvesting.

SITE SELECTION

It is extremely important to investigate the suitability of a site for tilapia cage farming. In choosing the site, consider the following:

1. *Availability of natural fooa*

   The presence of abundant natural food in the water partly ensures a good growth of the fish even without supplemental feeding. During their fry to fingerling stage, Nile tilapia feed on plankton – tiny free-floating plants (phytoplankton) and animals (zoo-plankton) some of which are visible only under a micro-scope as shown in Fig. 3. Water rich in plankton is brownish, bluish-green or grass-green in color. Grayish or murky water indicates a low natural food productivity.

2. *Natural hazards/calamities*

   The ideal site is sheltered from strong winds and high waves. Coves and inlets where the terrain of the surrounding shore areas deflects or weakens the prevailing winds are good sites for cage farming. Places where water hyacinth often concentrate should be avoided. Large masses of these plants can press against the cages and destroy them.

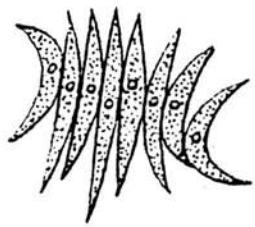
3. *Bottom soil*

   A site with a sandy to clay loam bottom is preferred. It will allow easy and firm penetration by bamboo poles used to support and anchor the cages. Areas with deep and loose soil are also good sites for cages.

4. *Availability of fingerlings*

   There should be a reliable supply of good quality fingerlings near the site. Buying fingerlings from a far

Chlorella



Scenedesmus

Ankistrodesmus

Fig. 3 Three types of plankton that serve as natural food to tilapia from fry to fingerling stage

place will mean additional overhead expense for transport and, possibly, higher mortality rate.

5. *Proximity of Market*

There must be an assurance that the produce can be disposed at any nearest major market that will allow a fair margin of profit. Alternative market outlets should also be studied.

CAGE DESIGN AND LAYOUT

The cage is made up of netting materials which are sewn together to form an "oversized mosquito net". It is installed in the water in an inverted position (open side up), and held in place by various types of anchors (Fig. 4) and floats (Fig. 5).

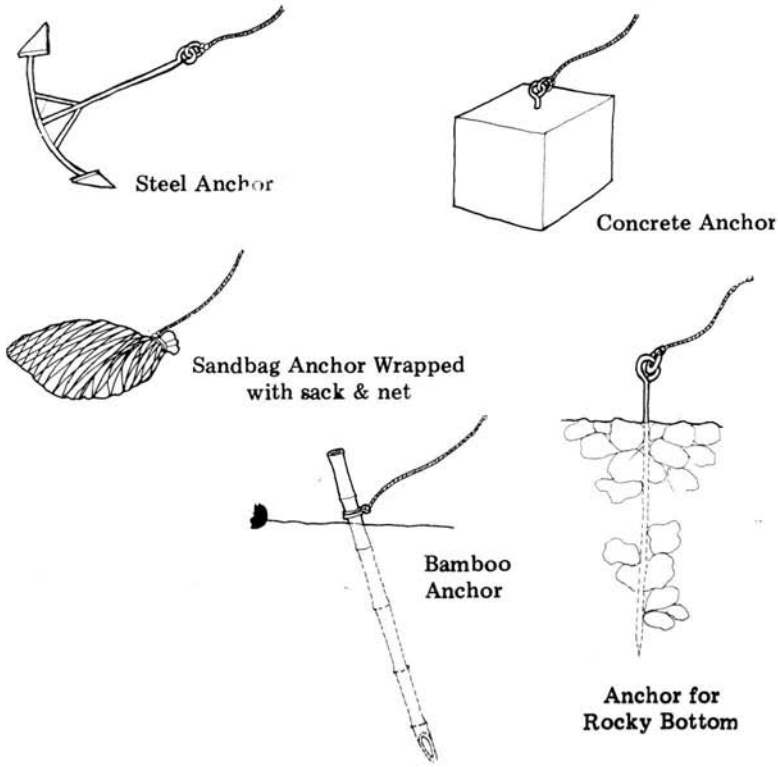
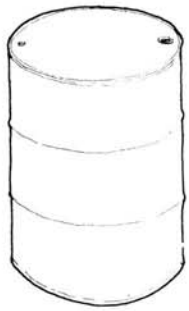
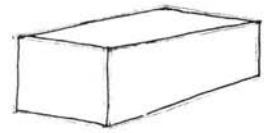


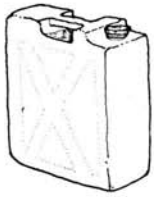
Fig. 4. Types of anchors



200 liters capacity
steel drum

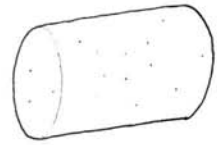


Marine Plywood

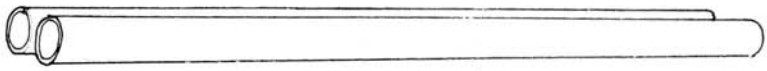


Carbouy
20 ltrs. cap.

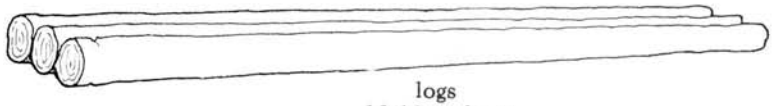
Used tire
interior



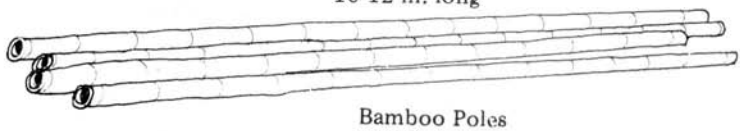
Styrofoam
(circular)



PVC pipes Sch. 40
3.00 m. long



logs
10-12 m. long



Bamboo Poles
10-12 m. long

Fig. 5. Types of floats

The cage may be stationary or floating. The cage design described in this booklet makes use of stationary bamboo modules to hold the net cages in place as in Fig. 6.

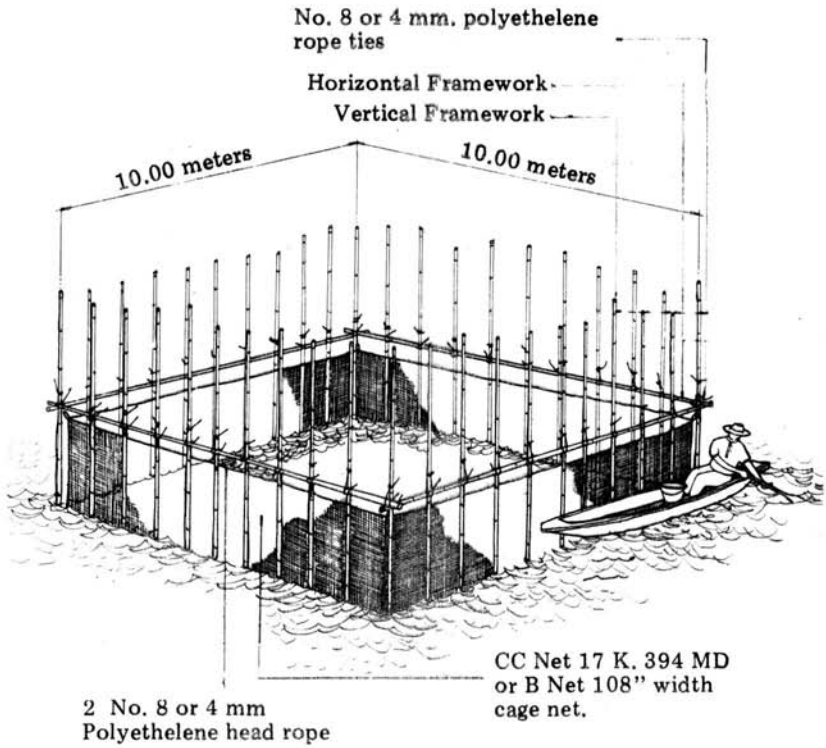


Fig. 6. Stationary cage using bamboo modules

Size of Cage

The size of a grow-out cage may vary according to one's choice, needs or capability. For instance, a farmer who has a small capital may start with cages measuring

6 x 6 x 3 meters or 12 x 12 x 3 meters as shown in Figs. 7 and 8. For large-scale production, the ideal size per cage is 150 to 200 sq. m.

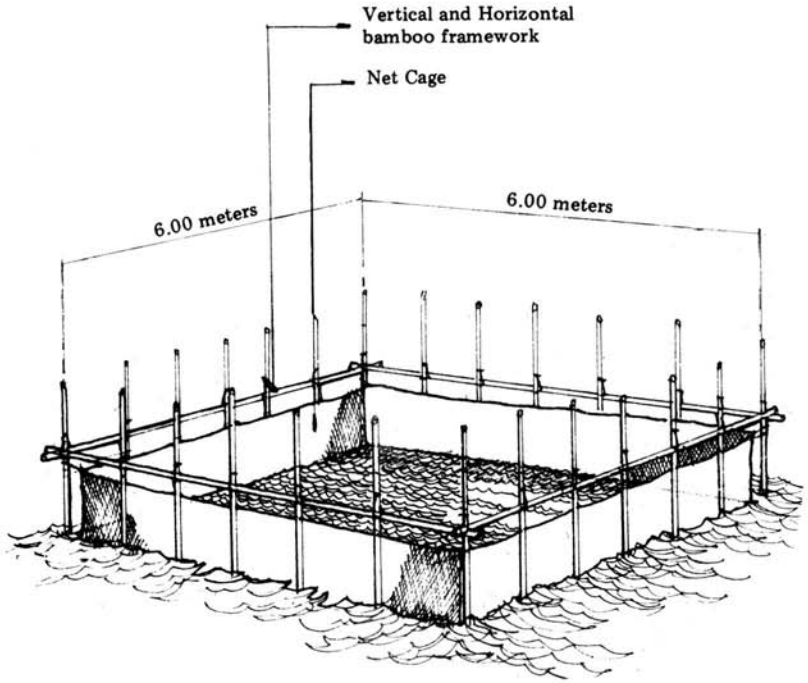


Fig. 7. A 6 x 6 x 3 meter cage

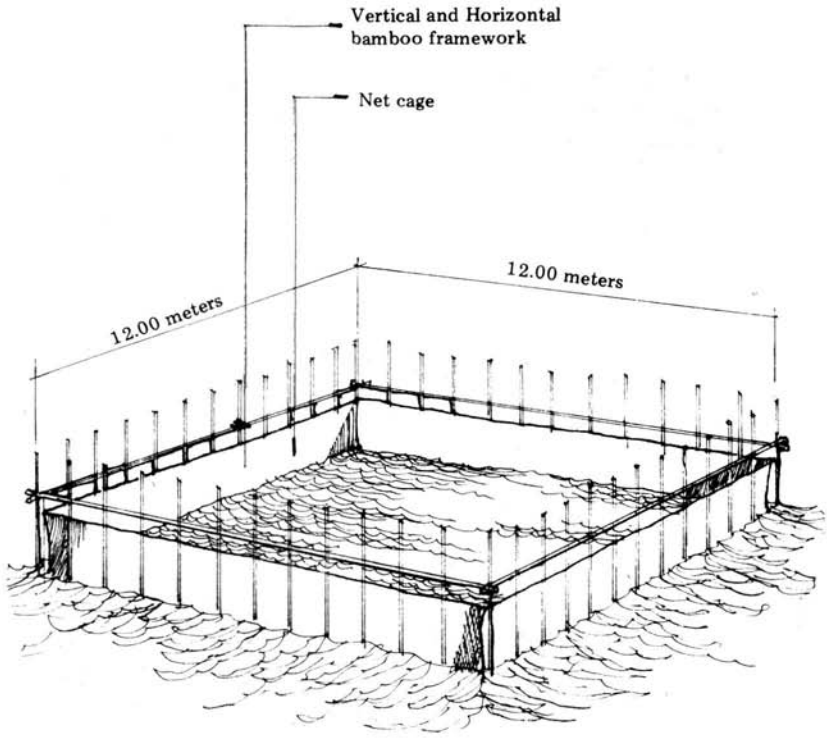


Fig. 8. A 12 x 12 x 3 meter cage

Large and small cages have their advantages and disadvantages:

a. Small cages use more netting materials per unit area enclosed, and are more expensive than large cages.

b. A small cage is more susceptible to poaching because it can be easily dismantled and carted away by one or two persons.

c. On the other hand, when nets are destroyed by strong winds and waves, or when slashed by poachers, only a small portion of the total farm

stock is lost if only one or two small cages are affected.

d. Large cages are more difficult to harvest and need more people to haul. With a small cage, harvesting is easier and fish are generally better in quality.

Netting Materials

There are many kinds of nets that can be used to construct grow-out cages. The most common are B-net (one-fourth inch or 0.63 centimeter mesh), DD-net (three-eighth inch or 0.9 centimeter mesh) and CC-net (one-half inch or 1.3 centimeter mesh).

Of the three, the B-net (Fig. 9) is more widely used because of the following advantages:

a. Small-size fingerlings can be stocked directly into the grow-out cages, otherwise, a separate nursery cage becomes necessary.

b. B-nets are cheaper per unit area compared to other sizes.

c. B-nets are wider (108" or 2.74 meters) compared to others, hence labor cost for fabrication is lower.

d. A tear in one or two meshes does not readily provide an escape route for bigger fingerlings.

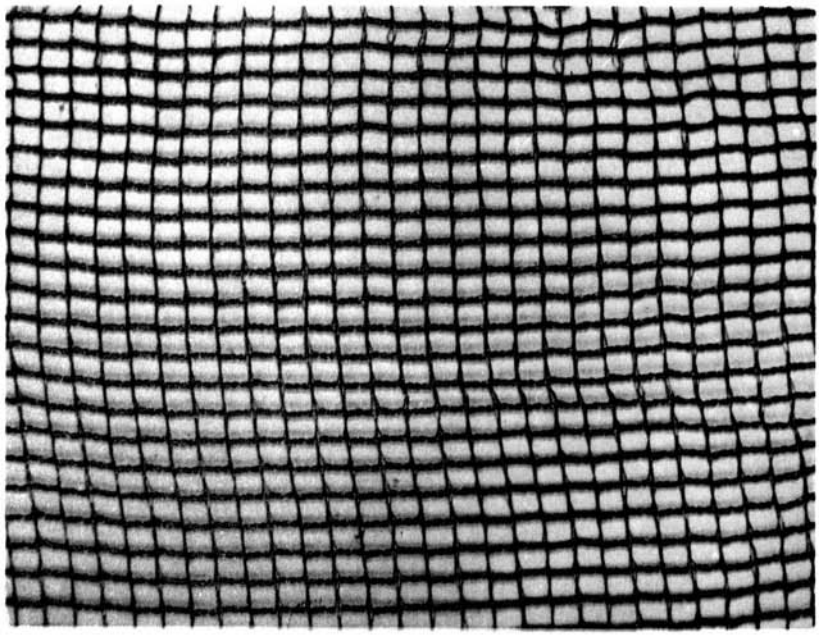


Fig. 9. B-net is more widely used in constructing grow-out cages

Cage Arrangements

The farm may consist of a single cage if the operation is small. If there are several units as in a large-scale production, the cages should be arranged in such a way as to minimize overcrowding among cages, but at the same time make the farm compact for convenience in harvesting, inspecting and repairing and maintaining.

A group of cages or "cells" arranged to form a block is considered a module. At the start, a farmer may decide to arrange the modules in a row, either diagonally or parallel to each other as shown in Figs. 10 and 11.

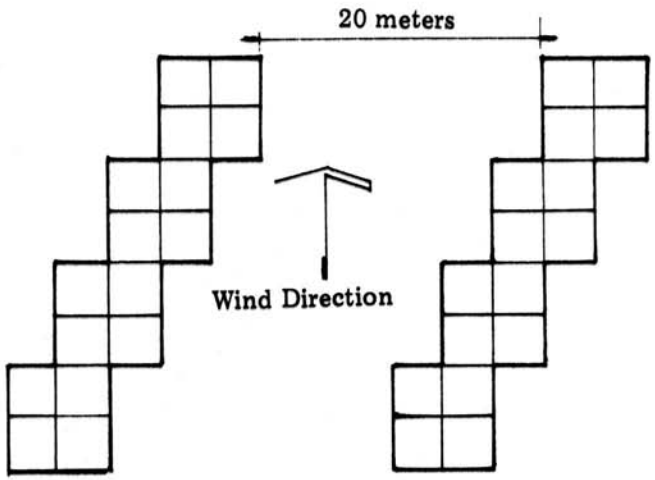


Fig. 10. Diagonal arrangement of cage modules

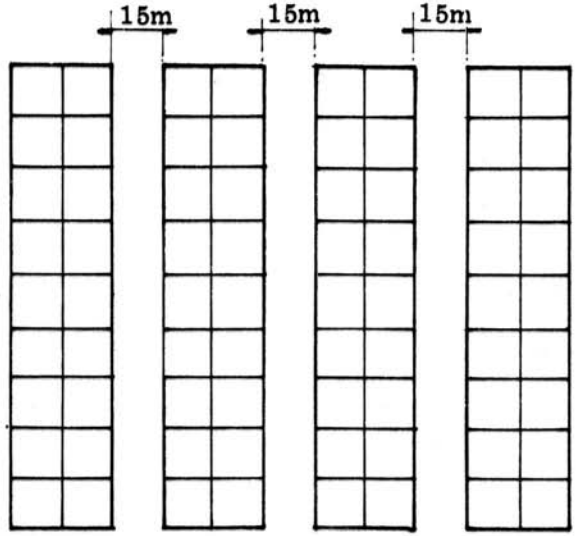


Fig. 11. Parallel arrangement of cage modules.

Distance between rows is from 15 to 20 meters to allow free circulation of water high in dissolved oxygen and rich in natural food for each cage. Cages should be constructed according to the prevailing wind direction to effect water change.

Large farms may be arranged as shown in Fig. 12 such that the modules are positioned along the periphery. The unoccupied middle section becomes a poor rearing area but it can be used to accommodate other utility cages.

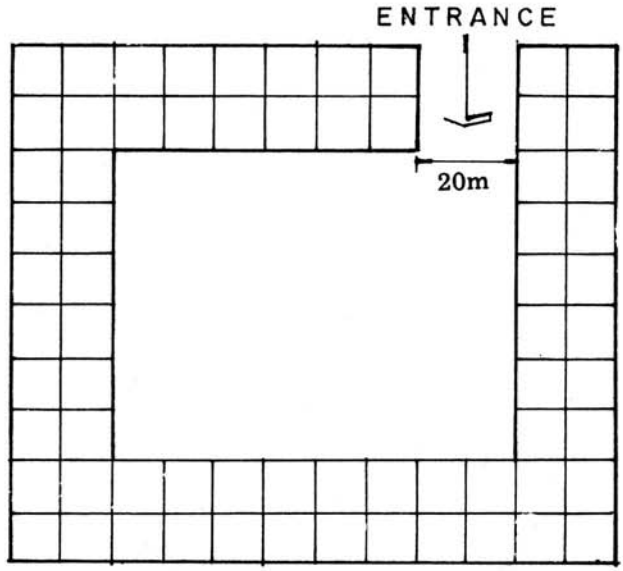


Fig. 12. Peripheral arrangement of cage modules.

The cages may or may not be provided with a cover. The cover is sewn along the sides of the net cage with a small opening. If the cover piece is of B-net material, position the upper edge of the cage at water line level. If it were No. 22 or No. 17 net, the cage can be raised 6 to 12 inches (or 15 to 30 cm) above the water. The bottom of the cage is tied security to the bamboo poles. It may or may not touch the lake bed.

TIPS ON OPERATION AND MANAGEMENT

Buying Seedlings

The success of the tilapia cage farming operation depends, to a large extent, on the quality of fingerlings. This refers not only to the physical condition of the fish during purchase (strong or weak, full bodied or thin, etc.) but, more importantly, to the genetic make up of fingerlings. High quality strains are fast-growing.

It is not possible to determine accurately the genetic quality of seeds by any simple and practical method. To be safe, one should deal with reputable and reliable fingerling dealers who operate their own hatcheries. It is not advisable to deal with fingerling agents. For a large farm, the surest way is for the farm to operate its own hatchery with facilities for broodstock development.

Stocking

Observe utmost care during stocking to minimize mortality. Stock newly arrived fingerlings (usually contained in oxygenated plastic bags) immediately provided the temperature of the lake water is approximately the same as the water in the plastic bags (Fig. 13).

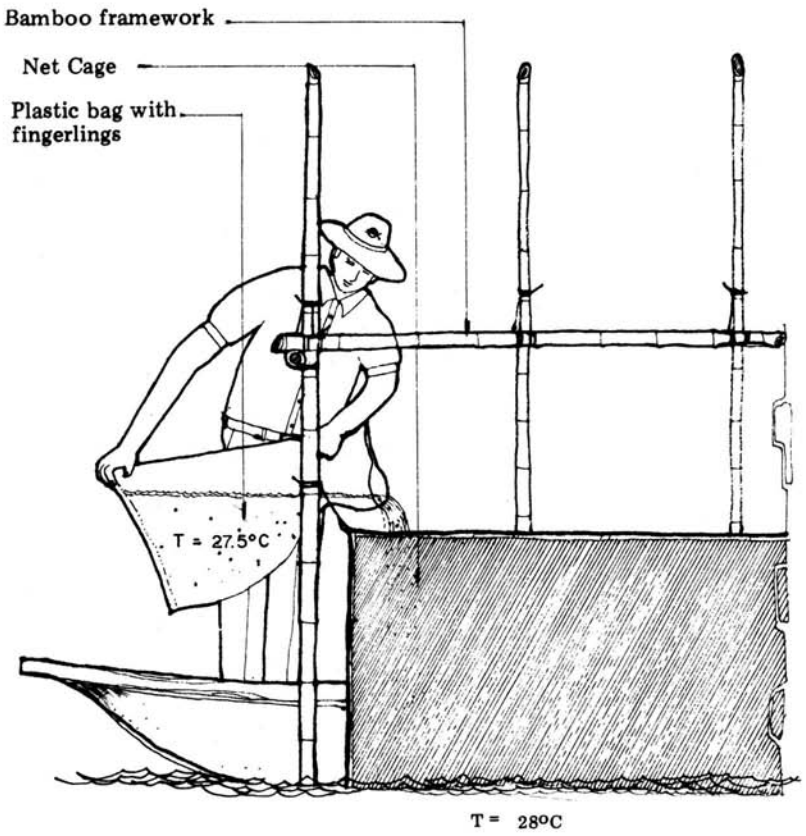


Fig. 13. Fingerlings in oxygenated plastic bags are stocked immediately in cages

If not, the water in the plastic bag must be gradually diluted with water from the lake until the same temperature as that of the lake is attained (Fig. 14). The best time for stocking is early in the morning or late in the afternoon.

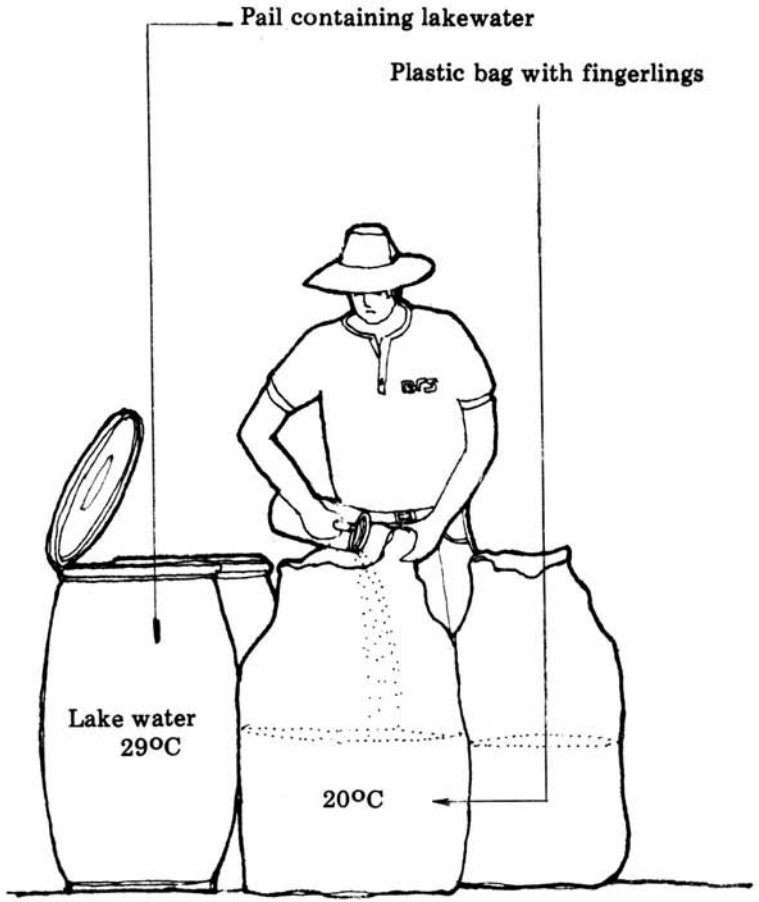


Fig. 14. Water in the plastic bag must be gradually diluted with water from the lake

Stocking rates vary (10-20 per m^2) depending primarily on the availability of natural food. In Laguna Lake, 5 cm (2 in) fingerlings are stocked at 20 pc/m^2 during the months of April to July. At this time, natural food is abundant and the fish normally attain 150 to 180 grams in 75 to 120 days without supplemental feeding. Stocking rate of 10 pc/m^2 recommended during the period from September to February. During these months, however, growth rate is slower because there is not much natural food in the lake and the water temperature is lower. The growing period may take from 4 to 5 months. Higher stocking rates require supplemental feeding to augment whatever natural food is available.

Care of stocks and cages

Once stocked, the fish need very little attention. At appropriate stocking densities the natural food in the lake can support good growth of the fish. The stock should be ready for marketing in 2-½ to 4 months' time depending on the size of fingerlings stocked.

The following table gives some estimates of fish sizes at harvest under varying stocking rates and duration of culture. Adjustments may be made to suit local conditions.

Months	Stocking Rate (fingerlings/m^2)	Growing Period (days)	Expected Average Weight (gm)
April to July	20	75-120	80-100
September to March	10	120-150	150-180

The cages, on the other hand, need constant attention and maintenance. Torn and worn-out sections should be immediately repaired to prevent escape of the stock as shown in Fig. 15.

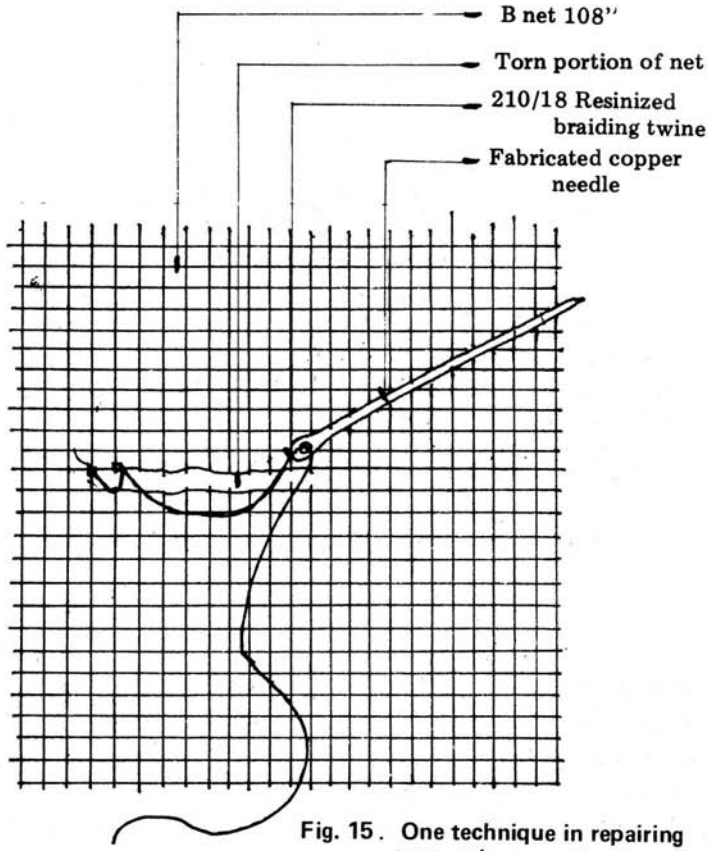


Fig. 15. One technique in repairing torn and worn-out net section

The nets have to be periodically cleaned of entangled debris as these prevent efficient water exchange or destroy the netting itself. In areas where water hyacinths pose a hazard, protective barriers of bamboo trunks or discarded nets should be erected. During inclement weather, cages that are provided with cover may be lowered at least one foot (30 cm) beneath the waves and passing debris and water hyacinths (Fig. 16).

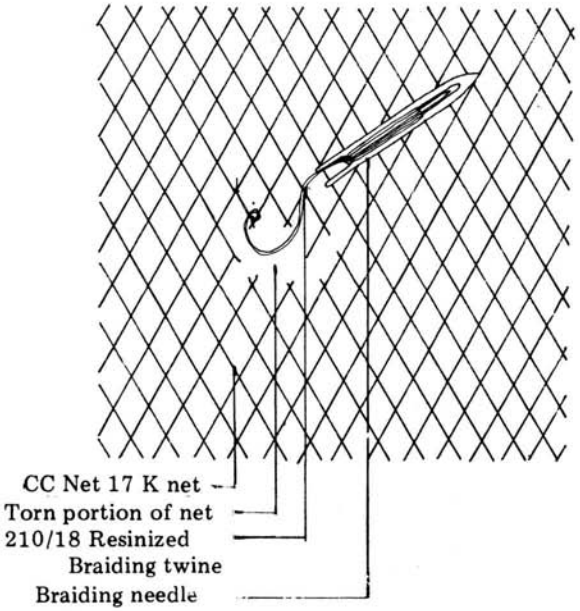


Fig. 16. Another technique in repairing net

The cage farm should have adequate security measures against poaching. A guardhouse as shown in Fig. 17 should be located strategically to allow for immediate detection of intruders. Meticulous inspection of the cages – both exposed and submerged sections – should be a daily activity. Nets could be slashed, and, if undetected, will result in the loss of the stocks.

Cage culture may also be systematized by periodic harvesting. The stocking density may be increased to as high as 40 or more pieces/m^2 but as soon as the fish reach 50 grams or more, they are sorted according to appropriate sizes. Those that weigh 50 grams or more are transferred to bigger nets with bigger mesh size. With this scheme, regular harvesting is done every 45 to 60 days.

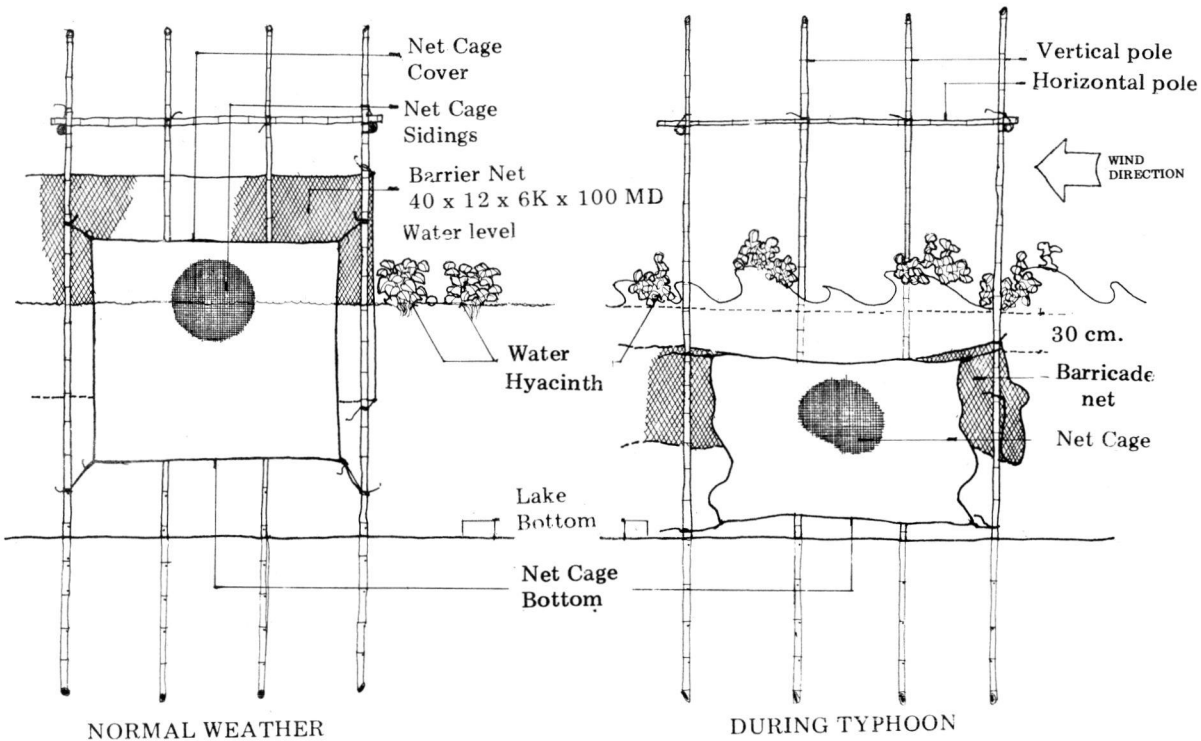


Fig. 16. Cage with cover lowered beneath the waves, passing debris and water hyacinths.

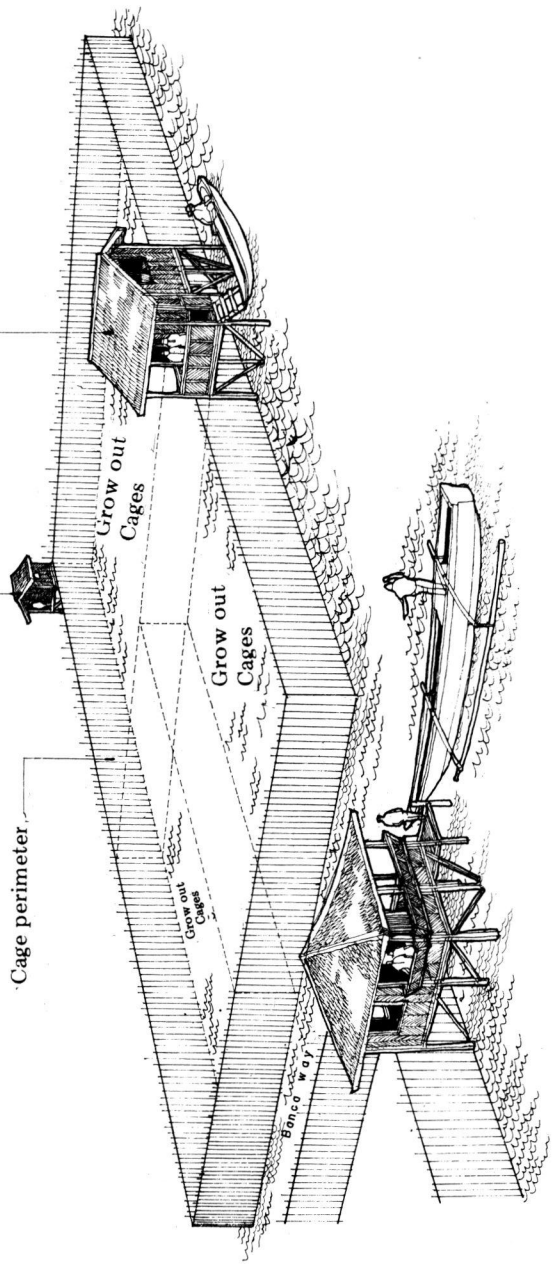


Fig. 17. Strategic location of guardhouses

Harvesting

Partial harvests may be made before the scheduled harvest if the market price allows a good profit even if the fish have not reached the projected or expected size. Sometimes, the fish population is deliberately reduced by partial harvesting to induce better growth of the remaining fish.

The stock is harvested totally when the fish have attained the desired size or when there is need to change the stock completely, as when the fish have stopped growing. The net is untied and lifted to catch all the fish. General cleaning and repair follow.

After harvesting, untie from the cages the bamboo poles and let them settle at the bottom of the lake to allow the decomposition of freshwater sponge and algae attached to the nets for at least two weeks. Repair the nets before re-stocking them for the next culture season.

Removing Off-Flavor of Tilapia

There are times when the fish flesh has a strong off-flavor – a taste (and smell) of algae or mud. This occurs in the lake when there is a bloom of "liya" or *Microsystis aeruginosa*, a phytoplankton. What exactly triggers this bloom is not yet known. To get rid of the off-flavor undertake the following: (Fig. 16).

1. Confine harvested fish in a temporary holding cage for at least 6 hours to induce fish to empty their stomach.

2. Transfer fish to a tank filled with a clean tap or well water at a density of about 200 fish per cubic meter. Provide aeration. (see Fig. 16).

3. After 3 days, check the gills of a few fish if the off-flavor smell still persists. You may cook a few fish to sample the taste. Change water completely if off-flavor persists.

4. Repeat step 3 until trace of off-flavor is completely removed. This process could take from seven to 14 days.

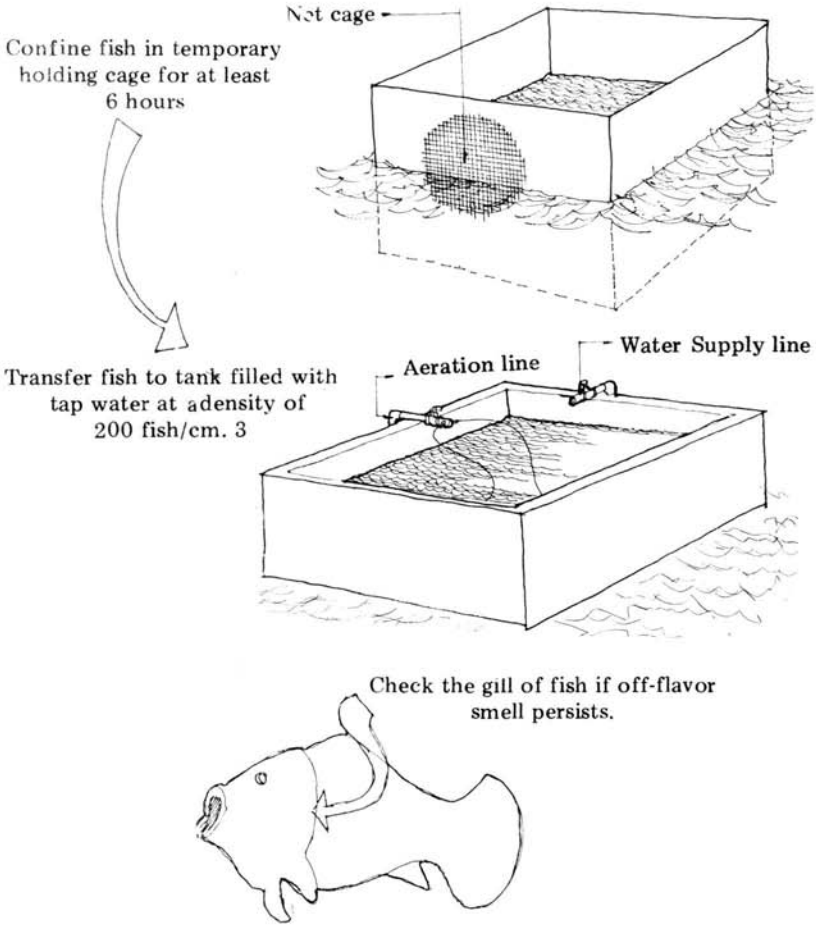


Fig. 19. How to get rid of the off-flavor of tilapia

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