AQUACULTURE EXTENSION MANUAL NO. 25 MARCH 1999

THE MODULAR METHOD

Milkfish pond culture

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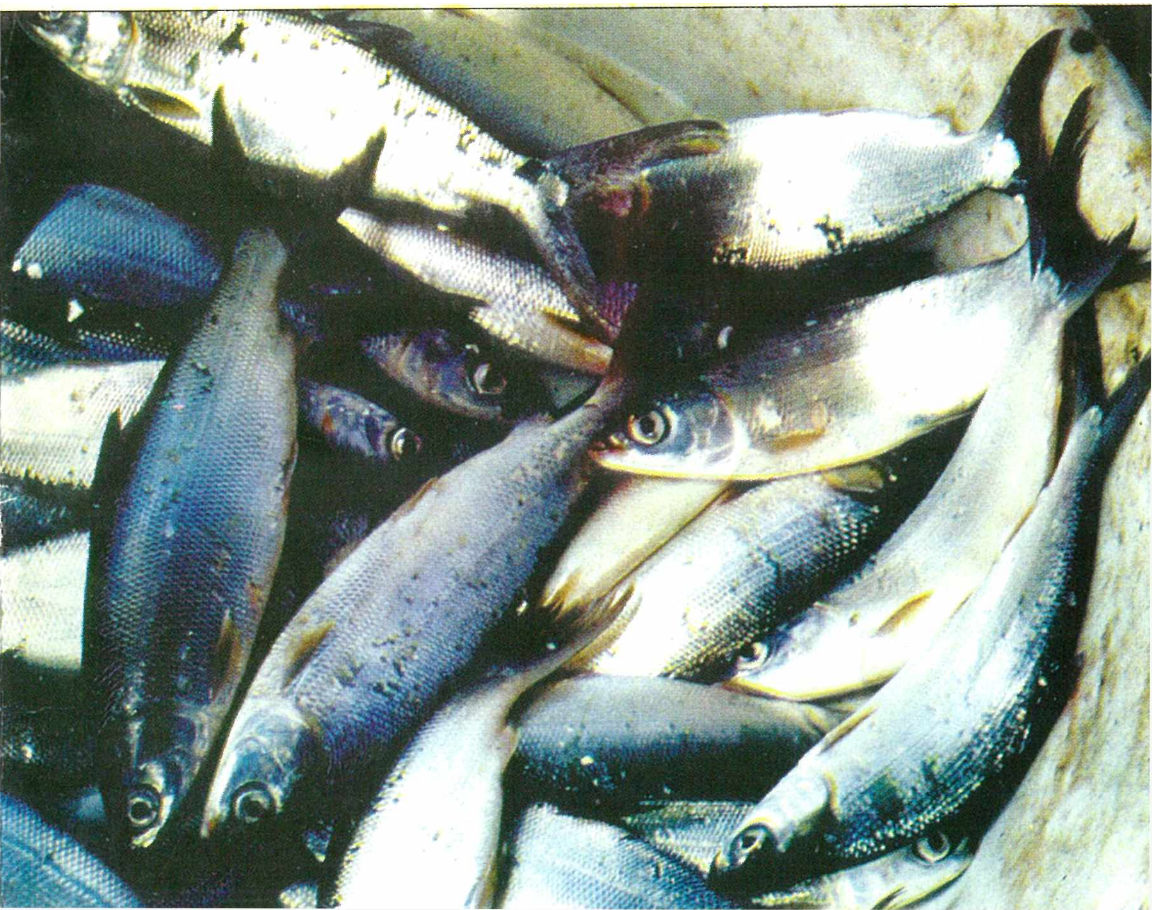

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FOREWORD

Milkfish has the oldest tradition of brackishwater aquaculture in the Philippines. Milkfish production has fluctuated between 150,000 - 250,000 tons over the last decade. On average, however, this production has largely stagnated.

This is beginning to change. Milkfish farmers are taking advantage of technological breakthroughs - development of artificial feeds, engineering of open sea cages, seed production in the hatchery - to move towards higher density systems and to utilize open marine waters. These advances are making milkfish one of the fastest growing sectors in the aquaculture industry.

The modular method of milkfish culture described in this manual is an improvement over the traditional extensive method. It is environment-friendly and can improve yield per unit area. This manual results from AQD's Technology Verification and Extension (TVE) program. TVE facilitates (he change in our recent thrust in AQD which gives more focus on technology transfer and commercialization. TVE bridges the gap between AQD's research output of 25 years and the aquaculture industry's need for sustainable technologies.

We hope this manual will be of use to fishfarmers and aquaculturists, extensionists, and students of aquaculture not only in the Philippines but also in other milkfish-producing countries in Southeast Asia and the world.

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THE MODULAR METHOD: MILKFISH POND CULTURE
MARCH 1999

ISBN 971-8511-35-0

Published and printed by:
Aquaculture Department
Southeast Asian Fisheries
Development Center
Tigbauan, Iloilo, Philippines

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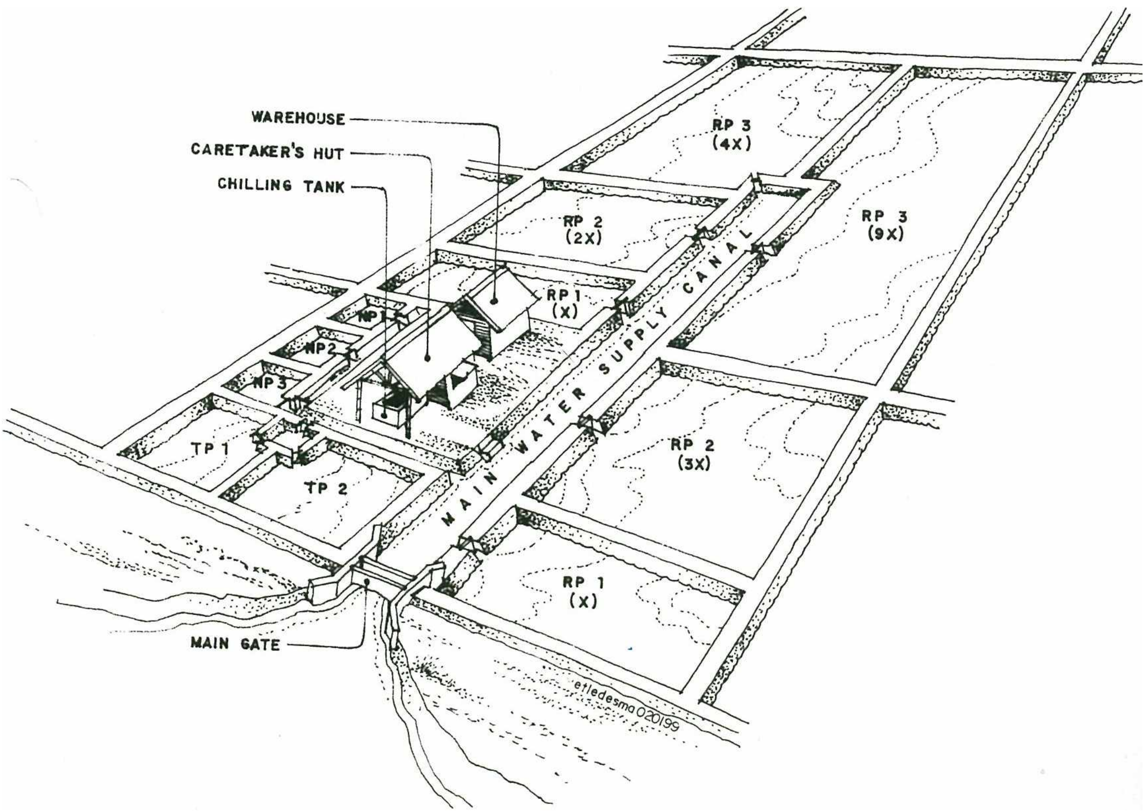
Contents

A milkfish farm using the modular system in west central Philippines



Perspective of a modular pond system for milkfish

THE MODULAR METHOD

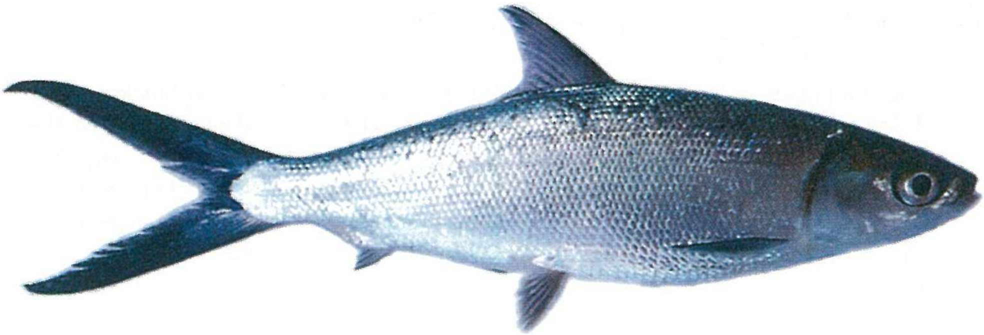
Milkfish pond culture

In the Philippines, culture of milkfish from fingerling to marketable size in brackishwater ponds generally requires the propagation and maintenance of abundant natural food, the *lab-lab*. Compared to *lumut* (filamentous grass green algae or plankton), *lab-lab* is better in supporting milkfish growth though it needs a relatively longer period of propagation, uses more material input and supervision, and is more susceptible to deterioration during prolonged adverse weather conditions. *Lab-lab* can be easily depleted by overgrazing of milkfish.

One attempt to solve the natural food problem is the use of the culture technique called progression or modular pond system. This system incorporates some semblance of stock manipulation. In demonstration experiments at the Leganes Research Station of SEAFDEC Aquaculture Department and in commercial trials in Negros Occidental, Carcar (Cebu), and MERALCO's farm in Buenavista (Guimaras), the modular pond system obtained an annual and consistent production of no less than 2 tons per hectare. This production is an improvement over that of existing industry practice (mono-size extensive / straight culture method) which only yields 700 to 800 kg annually. Though production in straight culture can be increased by using commercially-available feeds, the added cost oftentimes contributes to lower net production or income especially when milkfish market prices are depressed.

Interesting facts about milkfish

Milkfish (*Chanos chanos* Forsskal) or "bangus" as they are called locally comprise the bulk of aquaculture fish production in the Philippines. They are hardy and fast growing, and can be raised in fresh- and brackishwater ponds and pens. Being one of the cheapest sources of protein, milkfish are acceptable to all socioeconomic strata in the country. Over the years, production has improved from what is considered traditional into something more advanced. It is not unusual anymore to hear fishfarmers nowadays talking about pH, salinity, temperature, feed conversion rate, days of culture. Fishfarmers can easily relate these factors to fish production. Better still, fishfarmers have found it a must to learn the biological nature of the cultured commodity.



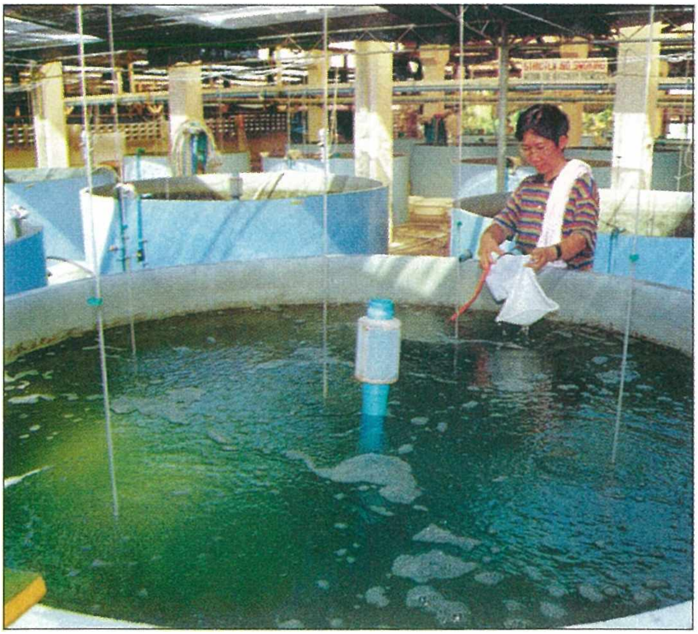
Milkfish are:

- **Filter feeders.** They have no teeth but have fine gill rakers that concentrate microplankton.
- **Benthic feeders.** They nibble or browse on adhering or even floating *lab-lab*, periphyton, or *lumut.*
- **Daytime feeders.** They feed less at night.
- **Euryhaline.** They can withstand extreme but gradual salinity fluctuation (from 0 to 100 ppt) but grow faster in natural waters of 0-40 ppt.
- **Phytophagous.** They eat plant materials, and can easily digest plants owing to their long intestines. But milkfish can also adjust to artificial feeds — rice bran, trash fish, fish pellets — and hence are also considered omnivorous.
- **Resistant to diseases and not cannibalistic.** They do not prey on each other and are not easily affected by infectious diseases, hence, they can be grown in relatively higher densities.
- **Exhibit compensatory growth.** Milkfish growth may be stunted under adverse conditions, but they can grow fast (exponentially) when conditions become favorable again.

ARTIFICIAL BREEDING OF MILKFISH

Reproduction of milkfish broodstock in concrete tanks and floating cages by SEAFDEC/AQD has already been undertaken and documented (see list of AQD publications on page 14). Milkfish broodstock mature from 5 to 10 years old in captivity and spawn spontaneously in concrete tanks and / or floating cages. Survival, growth, and fry quality of hatchery-reared fry is comparable with wild-caught fry.

SEAFDEC / AQD's milkfish hatchery in Tigbauan, Iloilo.

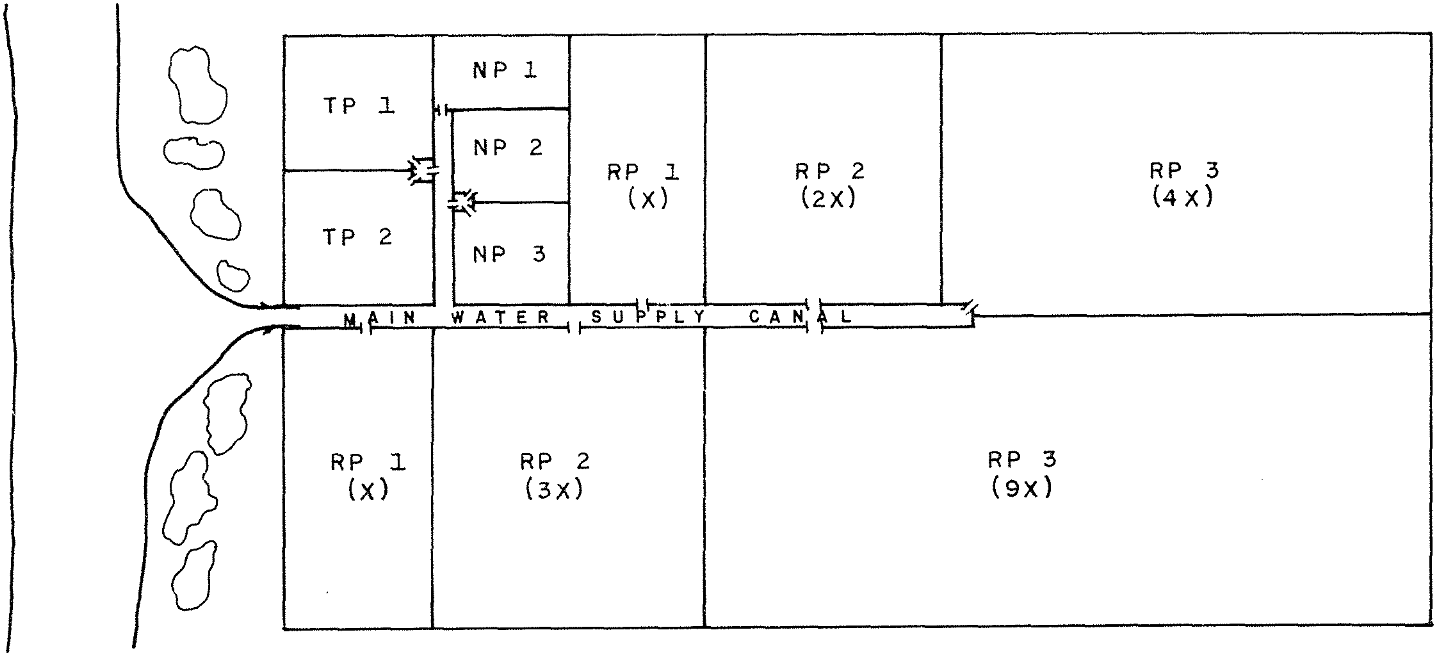


Design and operation of modular pond system

Culture of milkfish from fingerling to marketable size is carried out in three stages using ponds with progressively increasing area. The proportion of rearing ponds is 1:2:4.

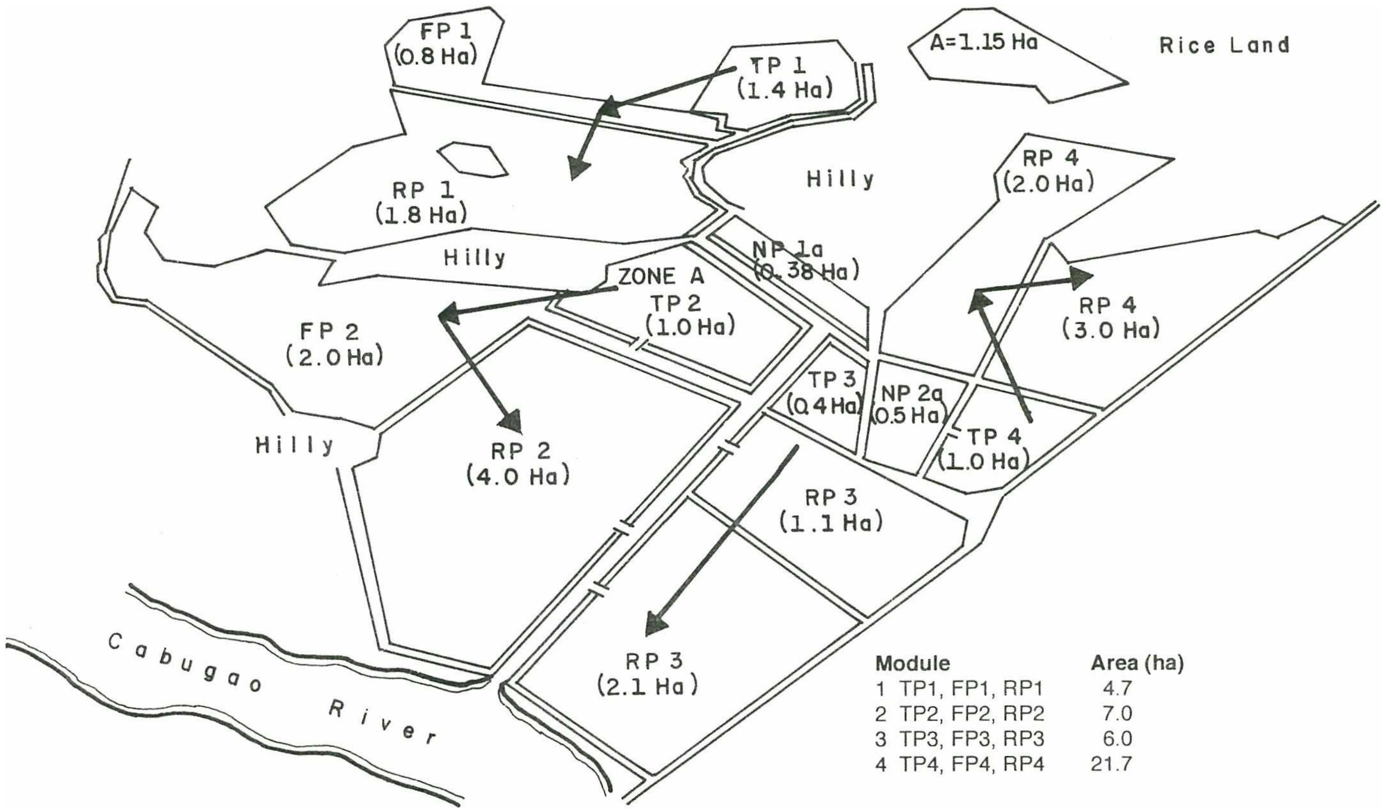
To design the modular pond system, the topographic map is consulted first followed by actual evaluation of the intended farm site. Different positions of the modules are normally prepared and evaluated, and the most efficient set-up is selected. The major pond components are properly identified, using nomenclatures such as NP for nursery pond, TP for transition pond, FP for formation pond, and RP for rearing pond (Figure 1). Where pond ratios vary considerably, modifications can be made (Figure 2).

From initial stocking, the fish are reared for at least 30 days in each module. The fish are moved periodically from one module to the other by inducing them to swim against the current ("pasulang"). Subsequently, vacated compartments are again prepared for about 15 days for the incoming stock.



NP - nursery pond
TP - transition pond
RP - rearing pond

FIGURE 1 Lay-out of milkfish farm using progression or modular system (Baliao et al. 1997)



Module	Area (ha)
1 TP1, FP1, RP1	4.7
2 TP2, FP2, RP2	7.0
3 TP3, FP3, RP3	6.0
4 TP4, FP4, RP4	21.7

FIGURE 2 Example of a modular farm system with irregular compartments: MERALCO CorFarm, Brgy. Getulio, Buenavista, Guimaras (Baliao et al. 1997)

With this system, extra croppings are obtained (from 6 to 8 per year) without necessarily over-taxing the natural food supply. One important requirement of the modular system therefore is sufficient buffer stock of milkfish fingerlings (at least 25 grams each) in the stunting ponds. If the fishfarmer uses bigger fingerlings for stocking, he can produce marketable fish in three months of culture, and have 6-8 croppings in one year.

Basically, the objectives of the modular system are to:

- optimize yield per unit area
- sustain natural food productivity during the culture period
- control population of unwanted species
- program production, and
- improve cash flow

POND PREPARATION

The amount of *lab-lab* grown in the pond is dependent on the manner of pond preparation. *Lab-lab* is grown chiefly by a combination of organic and inorganic fertilizers.

Preparation of pond for *lab-lab* starts one or two months before stocking the fingerlings. In order to obtain the best growth, eradication of unwanted species and maintenance of good water quality is necessary.

The following are the basic procedure in the production of *lab-lab:*

1 Drain the pond completely and allow to dry for about 1 to 2 weeks until soil cracks. Prolonged drying is not advisable as it makes the soil hard and powdery.

First step in pond preparation: drying the pond bottom until it cracks

2 Eradicate unwanted species by using organic pesticides such as tobacco dust, derris root, and / or a combination of fertilizer and lime. When using tobacco dust, spread over moist bottom 300 to 400 kilograms per hectare, and allow to stand for about a week. The application of a combination of hydrated lime and ammonium sulfate fertilizer (21-0-0) is done by broadcasting lime-ammonium mixture at a ratio of 5:1 on wet areas of the pond bottom during a sunny day. Reaction of lime and fertilizer releases heat and ammonia which effectively kills unwanted species in the pond.

Application of hydrated lime-ammonium sulfate to eradicate unwanted species

3 Apply chickenmanure at 2 tons per hectare. Flood to a depth barely covering the pond bottom, then apply 15 kg per ha of urea or 45-0-0 two to three days later to speed up the decomposition of chicken manure. Method of application is by broadcasting.

4 Increase depth gradually over a period of one to one-and-a-half months, adding 3 to 5 centimeters to the water level each time until the stocking depth of 30 to 40 cm is reached. An abrupt increase in depth causes *lab-lab* to detach and float. Install fine mesh screens at the gates to prevent re-entry of wild species.

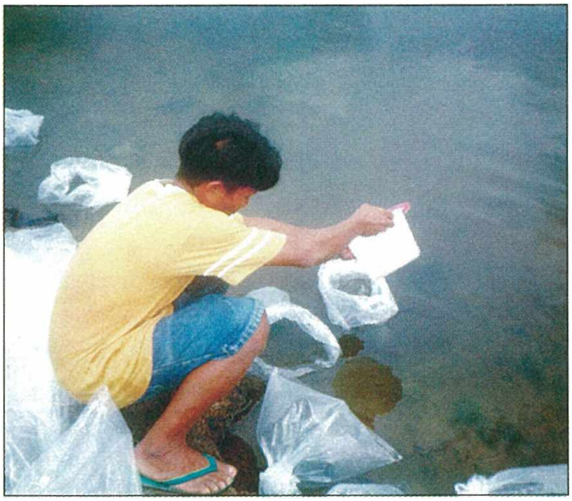
5 Subsequent application of 16-20-0 at 50 kg per ha or 18-46-0 at 20 kg per ha may be made at 1 to 2 weeks interval to bolster growth of *lab-lab.*

Fertilizer application using inorganic fertilizer by broadcasting to bolster growth of lablab.

STOCKING IN NURSERY OR TRANSITION PONDS

Newly-arrived fry are normally contained in double-lined oxygenated plastic bags with salinity ranging from 15 to 25 ppt. The fry are usually emptied into plastic basin to sort out predators. The fry are stocked in the pond in the early morning or late afternoon when the temperature is cool to prevent temperature shock.

If salinity of the water in the transport bag and that of the nursery pond are approximately the same, the fry may be stocked directly into the nursery pond. Stocking rate is from 30 to 50 fry per m^2. However, if the salinity difference is over 5 ppt, acclimation should be done to prevent salinity shock during transfer, especially if the fry is moved from a lower to a higher salinity. To acclimate, gradually add pond water inside transport bags until salinity is equalized.



Milkfish fry

Stocking the nursery or transition ponds

The fry grow to fingerling size (3-5 g) after 30 to 45 days of culture with average survival of 60 to 70%. Newly-grown fingerlings may be stocked right away in the rearing pond. The rest of the fingerlings maybe be held temporarily for 6 months to one year in transition or stunting ponds at the density of 10 to 15 fingerlings per ha. In the transition pond, the fingerlings subsist on natural food like *lab-lab, lumut* or plankton with or without supplemental feeds.

STOCKING IN THE REARING PONDS

As soon as the remaining ponds are ready for stocking, fingerlings are caught from the nursery or stunting ponds and held in a fingerling seine. This seine may be set in a canal where it is carried slowly and closely to the pond where the fish are to be stocked. If this is not possible, place a few hundreds of fingerlings at a time in plastic bags and carry to the pond. For longer distances, oxygenated plastic bags will be necessary to ensure good survival of fingerlings.

It is best to count the fingerlings to prevent under or over stocking. The fingerling seine should be positioned near the mouth of the gate where flowing water can sustain the fish that are crowded in the seine. Stocking in rearing ponds should be done during the cooler part of the day. Release fingerlings at the mouth of the gate where water is normally deep. Do this slowly to prevent environmental shock.

Stocking density in the modular pond system is 3,000 fingerlings per ha based on the area of the last module. Meaning, in a 1:2:4 pond proportion, the last module being 4 hectares will be multiplied by 3,000 to come up with 12,000 fingerlings. The fingerlings will be first stocked in the first module having a 1 ha area. In cases where the set of module is not regular, say, 1:3:5 pond proportion, the rule is to add the pond hectarage (1 + 3 + 5) which is equivalent to 9 hectares in this particular set. A factor of 1,714 is multiplied by 9 ha, giving a total of 15,426 fingerlings to be stocked in the first module.

CARE OF STOCK

The main concern after stocking is the maintenance of optimum water condition for both the fish and the natural food. When using *lab-lab* as the food base, it is necessary to apply fertilizer (16-20-0) at the rate of 1 bag (=50 kg) per ha every 12 to 15 days to maintain good growth of natural food. If the tide allows, replenish about 1/3 of the pond water before every fertilizer application.

In hot months, more frequent flooding is needed to compensate for evaporation. Depth is kept at about 40 cm, at most 50 cm. During rainy months, it is necessary to drain the uppermost freshwater layer in the water column to prevent sudden drop in salinity. Towards the end of the culture period, *lab-lab* may be prematurely depleted because of overgrazing, poor water conditions, or persistent inclement weather. Supplemental feed may be given at a daily rate of about 5% of the estimated total biomass of the fish, using artificial feeds like rice bran or bread crumbs.

Abnormal occurrences such as the fish appearing to be gasping at the surface or swimming in circles may at times be experienced. These are believed to be indications of stress associated especially with insufficient dissolved oxygen. Water should be replenished at the first opportunity. [In extreme cases, mass kills can occur especially in the morning of a very calm and windless day.] If replenishing water is not possible, water from an adjoining pond may be made to flow so that water is agitated. Pumps may also be used in such an emergency. Sudden rain or thunderstorm during a hot day may also present dangers. Sudden change in water temperature may result to fish kills. Adverse weather conditions should be anticipated. Extra precautions should be observed to minimize possibility of dike wash-out, flooding and the like.

POND UTILIZATION AND PRODUCTION SCHEDULE

In the modular pond system, six crops a year is possible. As a rule, maintain a year-round inventory of the following:

- stunted milkfish fingerlings (10 to 20 g)
- organic fertilizer (chicken manure)
- chemical fertilizers (45-0-0 and 16-20-0)
- pesticide (21-0-0 or hydrated lime)

Below is a production schedule tried by AQD in one of its cooperating fishfarms:

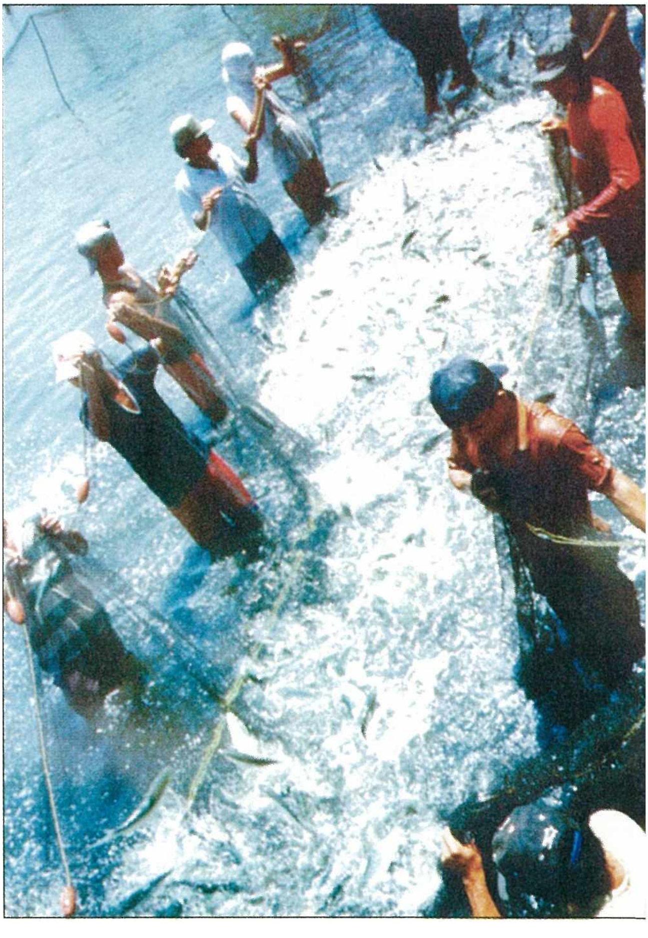
	TRANSITION POND	FORMATION POND	REARING POND
First crop	PP Feb 13-March 14 S March 15 CP March 15-April 15 T April 16	PP March 14-April 15 S April 16 CP April 16-May 16 T May 17	PP April 15-May 16 S May 17 CP May 17-June 17 H June 18
Second crop	PP April 17-May 2 S May 3 CP May 3-June 3 T June 4	PP May 18-June 3 S June 4 CP June 4-July 5 T July 6	PP June 19-July 6 S July 6 CP July 6-Aug 6 H Aug 7
Third crop	PP June 5-July 5 S July 6 CP July 6-Aug 7 T Aug 8	PP July 7- Aug 8 S Aug 8 CP Aug 8-Sept 8 T Sept 9	S Sept 9 S Sept 9 CP Sept 9-Oct 9 H Oct 10
Fourth crop	PP Aug 9-Sept 9 S Sept 10 CP Sept 10-Oct. 10 T Oct 11	PP Sept 10-Oct 10 S Oct 11 S Oct 11-Nov 11 T Nov 12	PP Oct 11-Nov 11 S Nov 12 CP Nov 12-Dec 13 H Dec 14
Fifth crop	PP Dec 15-Jan 15 S Nov 13 CP Nov 14-Dec. 13 T Dec 14	PP Jan 17-Feb 16 S Dec 14 CP Dec 14-Jan 15 T Jan 16	PP Feb 18-Mar 18 S Jan 16 CP Jan 16-Feb 16 H Feb 17
Sixth crop	PP Dec 15-Jan 15 S Jan 16 CP Jan 16-Feb 16 T Feb 17	PP Jan 17-Feb 16 S Feb 17 CP Feb 17-Mar 18 T Mar 19	PP Feb 18-Mar 18 S Mar 19 CP Mar 19-Apr 13 H Apr 14

LEGEND: PP - pond preparation; S - stocking; CP - culture period; T - transfer; H - harvest

HARVEST AND POST-HARVEST

So far, the most common and the best technique of harvesting milkfish is still the “pasulang” method or inducing the fish to swim against the water current. The fish are gathered in the catching pond or canal system during spring tide, and drag seines are used to collect them. They are scooped into chilling tanks or boxes where the temperature is low enough to kill them. In the chilling tank or box, a 1:1 ratio of ice to a kilogram of fish is enough to lower the temperature of the fish to about 4°C in two hours. The remaining fish on the now totally drained pond are collected by hand.

Milkfish are sorted according to quality (size, freshness, among others) and then packed into wooden boxes (“kahon”), metal tubs (“banera”), or bamboo baskets (“kaing”) ready for retailers and fish brokers. Harvested "bangus" may be sold fresh, dried, smoked, deboned, pickled or sent to cannery for processing or packed in cans like sardines.



Economics and costing

MODULAR POND SYSTEM

Item	Unit	Field trial data
Farm area	ha	7
Stocking rate per crop	pcs per ha	2,957
Number of pieces per run per 7 ha	pcs	11,828
Initial weight	g	11.12
Survival rate	%	93.30
Number at harvest	pcs	11,036
Final weight	g	252.76
Total weight per crop	kg	2,789
Harvest of 6 crops	kg	16,734
Days of culture	days	92
Growth gain per day	g	2.63
COST-AND-RETURNS		
Farm area	ha	7
Annual yield	kg	16,734
Selling price	₱/kg	50.00
Gross revenue	₱	836,700.00
Total cost of production	₱	276,111.00
Net profit before tax	₱	560,589.00
Less: Income tax	₱	196,206.15
Net profit after tax	₱	364,382.85
Return of investment	%	131
Payback period	year	0.76

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Acknowledgment

With special thanks to Romulo Ticar, Ronnie Ticar, Uldarico Derotas, and Jesus Amihan whose help contributed to the success of this Technology Verification Project. We also thank the cooperators Rodolfo Alvarez of Ilog, Negros Occidental; Ramon Montinola of Silay, Negros Occidental; Carlos Co of Carcar, Cebu and Engr. Carlito J. Rabang of the Meralco Corporate Farm Inc., Getulio, Buenavista, Guimaras for allowing us to field-test this modular method for milkfish production.

To Renato Agbayani and Neila Sumagaysay for reviewing the draft of the manual, and the Development Communication staff who edited, designed and produced it. We appreciate their efforts.

The Authors

SEAFDEC/AQD research publications on milkfish

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The modular method: milkfish pond culture

SEAFDEC Aquaculture Department
Tigbauan, Iloilo, Philippines
MARCH 1999

The Southeast Asian Fisheries Development Center (SEAFDEC) is a regional treaty organization established in December 1967 for the purpose of promoting fisheries development in the region. Its Member Countries are Japan, Malaysia, the Philippines, Singapore, Thailand, Brunei Darussalam, and the Socialist Republic of Viet Nam.

Representing the Member Countries is the Council of Directors, the policy-making body of SEAFDEC. The chief administrator of SEAFDEC is the Secretary-General whose office, the Secretariat, is based in Bangkok, Thailand.

Created to develop fishery potentials in the region in response to the global food crises, SEAFDEC undertakes research on appropriate fishery technologies, trains fisheries and aquaculture technicians, and disseminates fisheries and aquaculture information. Four departments were established to pursue the objectives of SEAFDEC.

- The **Training Department** (TD) in Samut Prakan, Thailand, established in 1967 for marine capture fisheries training
- The **Marine Fisheries Research Department** (MFRD) at Changi Fisheries Complex, Singapore, established in 1967 for fishery post-harvest technology
- The **Aquaculture Department** (AQD) in Tigbauan, Iloilo, Philippines, established in July 1973 for aquaculture research and development
- The **Marine Fishery Resources Development and Management Department** (MFRDMD) in Kuala Terengganu, Malaysia, established in 1992 for the development and management of the marine fishery resources in the exclusive economic zones (EEZs) of SEAFDEC Member-Countries.