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GROW-OUT MANAGEMENT FOR MARINE SPECIES

Today, changes representing the combined forces of hard-earned experience, scientific research and modern methods of management are taking place in fish culture. The past few years witnessed the emergence of a wide range of culture systems. The development of effective culture management systems, i.e., stock manipulation and management, production of natural food, feeds and feeding, water quality management, and disease and predator control is a good example of technological advancement. Culture management practices, however, vary not only between species but also between socio-economic and cultural settings.

This article gives an overall picture of grow-out management for marine species.

Item One: Stock Manipulation and Management

One most important management practice is the stocking of the appropriate species and quantity of fish. A culture unit can support a limited quantity of fish because of limited space and amount of natural food. The latter is especially true in extensive and modified extensive farming systems where the cultured species is dependent on natural food organisms. A sound stocking practice, therefore, is a balance between fish population and available food. However, information on the quantity of natural food available in a given period of time can not be defined; consequently, stocking practice is based on experience. To resolve this problem, the multi-stage stocking or the progressive stocking technique is recommended.

In this practice, fish of uniform size are stocked and the culture is carried out in three or more ponds. The fish are transferred from the first pond to the next, taking at least 30 days in each pond. Vacated ponds are prepared for 15 days. In milkfish, a total cycle of about 45 days permits 6 croppings per year without overtaxing the natural food supply in the pond.

This stock manipulation scheme also enables the fish to be transferred to another preconditioned pond before conditions in the first pond stocked deteriorate. It will also prevent cannibalism. One of the key factors to high survival in the culture of carnivorous species either in ponds, pens, or cages is grading of the fish at an early stage of culture. For instance, monoculture of sea bass needs monthly grading for the first two months if the fish were stocked at an initial size of less than 20 g. Hence, during the harvest-transfer of the stock, grading could be effected to come up with homogenously sized fish in ponds.

However, if the species is difficult to handle during the harvest-transfer, (i.e., high stocking density, artificial feeding), it is more convenient to use the straight-run technique of stock manipulation. This means that the fish are stocked and reared in the same rearing pond until harvest, e.g., modified extensive, semi-intensive, and intensive culture of prawns. Mortality, as a result of stress due to handling and transfer, is avoided.

Recommended stocking rates for different species for culture are shown in Table 1.

Item Two: Production and Maintenance of Natural Food

In ponds, production and maintenance of natural food growth is the primary concern. The amount and kind of natural food utilized by the species cultured depend upon the manner they are produced in the grow-out ponds. These, in turn, depend on how ponds are prepared. Under favorable conditions, natural food is grown using a combination of organic and inorganic fertilizers, and the kind of natural food grown depends on the species cultured. For instance, *lablab* and plankton are the best natural food for milkfish and mullet in ponds. *Lablab* is good for nursing prawns but not recommended for grow-out of prawn. Plankton is natural food base grown in ponds for modified extensive, semi-intensive, and intensive culture of prawns. Filamentous

Table 1. Recommended stocking rates for different species

Species	Culture system	Stocking density in pond (ind/ha)
Milkfish	Extensive	1000[1]
	Semi-intensive	6000
	Intensive	9000
Sea bass	Extensive	1000
	Modified Extensive	5000
Grouper	Extensive	1000
	Modified Extensive	2000-6000
Rabbitfish	Extensive	3000
	Modified Extensive	3000
P. monodon	Extensive	3000
	Modified Extensive	50 000
	Semi-intensive	100 000-150 000
	Intensive	200 000-250 000
P. indicus & *merguiensis*	Extensive	50 000
	Modified Extensive	50 000
	Semi-intensive	100 000

[1]Also in pen.

green algae, locally known as *lumut,* is good for rabbitfish but not for milkfish. *Lumut* contains a substance which inhibits trypsin in the milkfish gut, thus preventing the fish from digesting filamentous algae. *Lumut* is also grown in ponds where prawns are extensively cultured and where carnivorous species, such as sea bass and grouper, are reared. Reports indicate that "lumut" is best associated with animals preyed upon by carnivores.

Lablab is a complex of small plants and animals in the pond bottom which is initially seen as a brownish, greenish or a yellowish film. As it grows, additional layers develop, forming a flabby mat at the pond bottom. Plankton, on the other hand, is the collected term for all organisms suspended in the water column. This consists mainly of phytoplankton (plants) and zooplankton (animals).

Lablab Production. The pond is prepared as follows:

1. Level the pond bottom.
2. Drain the pond completely and allow to dry until the soil cracks. Drying the pond is the cheapest way of eradicating unwanted species aside from allowing the release of obnoxious gases from the pond bottom.
3. Till the pond soil after drying. Tilling helps in loosening hard bottom and in the mineralization of organic matter.
4. Apply lime at the rate of 1 ton/ha. However, a higher dosage may be necessary in very acidic and newly constructed ponds. Soil analysis should be done to determine the amount of lime needed. Lime is commonly used in ponds as a soil conditioner and not as fertilizer. It is broadcast over the dry pond before the application of fertilizer. It also neutralizes soil pH, thus neutralizing the harmful effects of acids. Refer to Table 2 for lime requirements.
5. Apply fertilizer. Fertility of the pond soil influences the growth of natural food. Fertilization during pond preparation and culture period is necessary to provide continuous supply of nutrients to plants and indirectly to animals.

There are two types of fertilizers used: organic and inorganic. The first refers to fertilizers of plant and animal origin while the latter is of mineral origin. Chicken manure is the most

Table 2. Amount of lime (ton/ha) needed[1] to raise pH to 7.0

pH	Agricultural lime ($CaCO_3$)	Hydrated lime ($Ca(OH)_2$)	Quick lime (CaO)
6.5	2.5	1.9	1.4
6.0	5.0	3.7	2.9
5.5	7.5	5.6	4.3
5.0	10.0	7.4	5.8
4.5	12.5	9.3	7.2
4.0	15.0	11.1	8.7
Efficiency	100%	135%	173%

$$^{1}\text{Lime needed} = \frac{\left(\dfrac{\text{Desired pH} - \text{Actual pH}}{0.1} \times 0.5\right)}{\text{Efficiency of Lime}} \times \text{Area}$$

commonly used organic fertilizer. It is applied at a dose of 2 tons/ha. Application may be done immediately after liming by the broadcast method.

Inorganic fertilizers commonly used are ammonium phosphate (16-20-0) and urea (45-0-0). A mixture of these fertilizers at a ratio of 2 ammonium phosphate and 1 urea at the rate of 75 kg/ha is recommended as basal application immediately after chicken manure to hasten the breakdown of organic fertilizers.

6. Increase water depth gradually, 3-5 cm each time, until a depth of 25-30 cm is reached. An abrupt increase in depth causes *lablab* to detach and float.

Plankton Production. These procedures are followed:

1. Drain and completely dry the pond.
2. Apply lime at the rate of 1 ton/ha.
3. Admit water to a depth of 30 cm.
4. Apply organic fetilizer (cow, carabao, or chicken manure) placed in plastic sacks tied and submerged in water like a tea bag (T-bag). About 16-20 sacks or T-bags (content: 3 kerosene cans/bag) are needed per hectare for cow or carabao manure and 10 sacks or T-bags (content: 2 kerosene, cans/bag) are needed per hectare using chicken manure.
5. Fertilize with 20 kg urea and 20 kg diammonium phosphate per hectare. Plankton such as diatoms or brown algae should grow after 3-5 days. Absence of phytoplankton growth after 5 days indicates the need for more fertilizer. Add one-half the amount recommended every 2 days thrice or four times until the pond water turns brown. When the brown color is attained, fill the pond with water to a depth of 50 cm. Gradually increase the depth of water to 80 cm. Test the transparency of water with a secchi disc. If transparency registered a minimum of 20 cm or a maximum of 35 cm, the pond is ready for stocking. Remove T-bags, place them temporarily on top of dike and reuse them once transparency increases.

Lumut Production. Growing *lumut* is not a problem. This macrophyte abounds even when organic content of the soil is low. Profuse growth of *lumut* is attained at a water depth of 50 cm, although at 80 cm, growth is hindered.

Too much growth of *lumut*, however, becomes a problem in ponds as it could restrict water circulation, fish movement and living space, and may contribute to oxygen depletion and fish kills when it dies. It has been suggested that *lumut* must cover a maximum of 10-20% of the pond area.

Maintenance of Natural Food Growth. Stocking over a period of time removes higher amounts of nutrients from the soil, thus depleting the soil of pond nutrients needed for the growth of natural food. If these nutrients are not replaced, the crop will be affected, thus the need for fertilization.

For the maintenance of *lablab* growth, one-half of the rate recommended for basal application should be applied as dressing every 15 days after stocking or after every last day of water replenishment during spring tide.

For plankton, close monitoring of water transparency is required. If transparency registers less than 20 cm, immediately drain and replenish about 30% of the water volume to prevent the danger of plankton bloom which causes oxygen depletion and mass mortalities. If transparency registers over 35 cm, plankton growth is depleted, hence, reuse T-bags and apply 5 kg of urea and 5 kg of diammonium phosphate. Remove T-bags once transparency returns to recommended levels.

Frequently inspect ponds for possible leakages in dikes to prevent leaching of nutrients and entrance of unwanted species, as well as the escape of stock. A water depth gauge installed in ponds helps detect leakages.

Item Three: Feeds and Feeding

Feeds and feeding are critical in the success of fish culture. It involves the choice of a suitable feed and the implementation of the feeding program in order to achieve best results in terms of fish growth and profit.

Feeds. Commercial feeds for prawn and finfish are now available in the market. However, various brands of prawn feed in the market are site-specific. For instance, in a study conducted at the SEAFDEC/AQD Leganes Brackishwater Station, one notable observation indicated that a brand which yielded good results in one site did not perform well in another site. It is therefore worth trying different brands in the pond to get the brand suitable for the site.

The intensive culture of milkfish at stocking density of 9,000 ind/ha and feeding with artificial diet yielded higher production compared to other culture systems. But with the cost of feed and the fluctuating price of milkfish in the market, fishpond operators must be extra cautious in adopting this scheme.

The average body weight of rabbitfish could be increased twice if fish is fed with commercial feed containing 25% protein level rather than natural food alone. Artificial feeding could be resorted to for rabbitfish raised in cages where natural food could not be grown.

Feed is the major constraint confronting the culture of sea bass and grouper. At present trash fish is the only known feed stuff used in sea bass and grouper culture. A very recent development is the introduction of moist feed and other artificial or formulated diets which is still in the experimental stage. With the insufficient supply and high cost of trash fish in some areas, carnivorous species using trash fish diet must be cultured in regions where trash fish is cheaper or cultured together with a species that can serve as food, e.g., sea bass and tilapia polyculture, grouper and tilapia polyculture.

Feeding. In feeding, the questions raised are when, how, and where to feed, and the rate and frequency of feeding. The answers to these questions are very important considering that about 60% of the operation cost goes to feed. Feeding should, therefore, be maximized to get maximum results.

When to feed. In the modified extensive system, the food for the fish comes from natural food available in the pond and the food introduced to supplement natural food. In this system, stocking density is more than the carrying capacity of the pond, hence, the natural food in the pond is not sufficient until harvest. Supplemental feeding is given when the supply of food organisms is insufficient or when the growth of natural food is poor due to unfavorable water and climatic conditions. Food depletion in milkfish ponds usually occurs after 1 to 2 months of rearing. In a modified extensive culture of prawns, at a stocking density of 5/sq m and with plankton as food base, food depletion occurs after 45 days of culture, hence, supplemental feed is given 1-1/2 months after stocking. In sea bass, grouper, and rabbitfish reared under conditions of modified extensive culture system, supplemental feed is usually given a day following stocking as with all species intensively cultured in ponds or in cages.

How to feed. The application of feed is a vital operation that should be done properly; if not, pollution of the culture water and wastage of feed will result.

In sea bass, tapping of a feed container in the water induces them to form a school as sea bass are attracted by sound. After the fish have formed a school, small amounts of feed are spread into the water within the school of fish. Sea bass seldom eat the feed when it sinks to the pond bottom, therefore, feeding should be slow. When the fish are filled to satiation, they disappear, thus feeding should be stopped. Feeding time and place should be fixed.

In milkfish, mullets, and prawns, feeds are broadcast but a certain amount (10% of the ration for a particular feeding time) are distributed equally in feeding trays to monitor feed consumption. At least 10 feeding trays are distributed equidistantly from each other on the four sides of the pond. The feeding trays are to be regularly inspected 2 hours after feeding and 1-2 hours before the next feeding schedule so that the amount of feed could be constantly adjusted for the next feeding schedule according to the demand of the fish. The amount of feed to be given for the next feeding schedule is reduced by 5% if feed is consumed; otherwise, it is increased by 10%. Feeding is most efficient if feed is consumed after 2 hours and before 4 hours after feeding.

Feeds for grouper in ponds or in cages may be placed conveniently in feeding trays.

Where to feed. The behavioral feeding characteristics of cultured fish must be considered. Prawns go near the dike to feed, hence, feeds should be broadcast near the dike and trays placed at least three meters away from the dike. However, with high stocking density as in semi-intensive and intensive cultures, feeds should be evenly broadcast at the center of the pond (except at the drain canal) since not all the prawns can be accommodated along the sides; the rest still remain distributed in other areas of the pond. In semi-intensive and intensive prawn culture where feeds are broadcast at the sides and center of the pond, homogenous size of prawns are harvested.

Like sea bass, milkfish can be trained to feed at one point of the pond. Therefore, feeds. could be broadcast at either side of the pond while for sea bass, feeding is done at a fixed point in the pond within the area occupied by the school of fish.

Feeding rate and frequency. Food intake of the fish decreases with increasing size. However, the feeding frequency increases with increasing size of the fish.

For prawns, the recommended feeding rate decreases from 10% of the prawn biomass for the first month of culture, 8% for the second month, 5% for the third month, and 3% for the 4th month. Feeding frequency recommended is 2x for the first month in which the ration for the day is equally divided during the 7 a.m. and 5 p.m. feeding time, 3x for the second month, 4x for the third month, and 5x for the fourth month. After the first month, the biggest percentage (40%) of the daily ration is given at 5 p.m. since prawns are generally known to be nocturnal feeders.

Feeding for sea bass is based on the weight of the fish. With weight of 60 g and less, feeding rate is 10% of the fish biomass; 61-90 g, 8% 91-105 g, 6%; and 105 g and above, 4% of the fish biomass. Feeding frequency is twice daily. Half of the feed ration for the day is given at 7-8 a.m. and another half at 4-5 p.m.

In grouper, the recommended feeding rate is 10% of the total fish body weight per day at a frequency of twice daily while in milkfish, the rate recommended is 5% of the fish biomass per day at a frequency of 2-3x daily.

The amount of feed needed for the day is computed using the following formula:

Amount of feed = (Survival)(Average body weight)(Feeding rate)

Survival is computed by dividing the total number of samples (TNOS) caught using a cast net by the number of throws (NOT) of cast net made. The resulting quotient is divided by the area of the cast net (AOCN) multiplied by the total pond area (TPA), thus:

Survival = (TNOS/NOT)/(AOCN x TPA)

Cast net sampling is popularly used as a reliable method of determining representative population of fish; however, this should be done at random and early in the morning when the fish are known to be well distributed in the pond.

The total feed required for one growing period of a fish is computed as follows:

Total feed = (Projected survival)(Projected ABW)(Projected Feed Coversion Ratio)

Item Four: Water Quality Management

Water quality is one of the most important factors that affect fish production. Good environment is necessary for optimum growth and survival.

Dissolved oxygen. The D.O. level in the pond or any fish-rearing unit affects the appetite of the fish or its food intake, and consequently its growth.

The existence of a desirable level of dissolved oxygen, 3-10 ppm, in the pond indicates that the pond system is functioning efficiently. Dissolved oxygen concentration below the minimum range is harmful to the fish. In ponds, the principal cause of massive fish kills is a decrease in the oxygen level which has been attributed to the following:

1. *Weather conditions.* Sudden change of weather conditions such as extremely calm and hot weather in the morning and a sudden rainfall in the afternoon causes oxygen depletion in ponds. The reduction in oxygen content of the water is due to the thermal and salinity stratification in the pond water. The D.O. supply of the lower layer of the water is not enough to sustain the respiratory needs of the fish, planktons, and other living organisms in the pond resulting in massive fish kills. At the sight of oncoming rain, a flushboard should be kept at a water level to enable rainwater to flow out of the pond since rainwater floats over saline water.

2. *Plankton bloom.* In ponds where planktons are grown as food base for the fish, calm weather allows these to float on the water's surface where intense sunlight kills them. These plankton die-offs greatly reduce the photosynthetic input of D.O. in the pond and greatly increase the respiratory load. When this condition occurs, immediately change the water. If die-offs happen during the lowest tide when no water could be drawn for water change, the principle of water agitation or water movement to generate oxygen could be used. Agitate the pond water in the affected pond using paddles. Freshen water for all ponds during the incoming high tide.

A desirable color of pond water is light brown. A secchi disc can determine the transparency of the pond water. A desired transparency depth is a minimum of 20 cm and a maximum of 35 cm. A transparency less than 20 cm indicates that there is a plankton bloom, therefore, the water should be changed immediately.

Salinity. Current choice species with potential for large-scale culture are euryhaline fish species, i.e., these could be cultured in impoundments on a wide range of salinity. However, there is a maximum point beyond which growth of fish is retarded. For instance, at 45 ppt milkfish growth is retarded. This usually happens during summer months, hence, it is recommended that water exchange be more frequent. Salinity of seawater bodies in the Philippines does not exceed 36 ppt, a safe level for seawater fish culture, and also, favorable for *lablab* growth.

Water temperature. The temperature of water affects the metabolism of the fish and, indirectly, growth rate. Fish typically have a series of growth curves related to water temperature and feeding rate. For example, milkfish given optimum food attain maximum growth at an optimum temperature of 25-32°C but would have reduced growth at 23°C. Fish farmers have observed low incremental weight gains of tropical fish during the cold months.

pH. This is one of the most common water quality problems since it affects the fish indirectly. The pH value is an indicator of the presence of metabolites, photosynthetic activity, and fertility of the pond water. It changes with the accumulation of residual feed, dead algae, and excreta. It is at its maximum when photosynthetic activity is vigorous and decrease when there is none. High pH value means pond water is too fertile, therefore, there is the possibility of a plankton bloom; also, toxicity of ammonia is increased. If the pH value is low, the water is infertile and plankton growth is also slow, hence, less oxygen is produced from photosynthesis. The toxicity of nitrite and hydrogen sulfide is also increased. The pH of pond water should be within the range of 6.5 to 8.5. Above or below this range, the water should immediately be changed.

Hydrogen sulfide. This is the by-product of decomposition, produced by the chemical reduction of organic residues which accumulate at the pond bottom. The bottom soil turns black and a smell similar to that of a rotten egg is discharged. Dissolved oxygen is decreased and pH is lowered. At a high concentration of 2 ppm, the fish will die. Hydrogen sulfide concentration could be reduced by changing the water and draining the pond bottom.

Biofouling. Marine cage culture has obvious advantages over other aquaculture systems. Good water quality is maintained with constant renewal of water by current flushing. Metabolic waste and fecal matter accumulate less. The only problem which can seriously affect water quality in cages is biofouling which may clog the mesh of the net walls, hence reducing water exchange. As a consequence, oxygen depletion and accumulated wastes could unnecessarily stress the cultured fish.

An efficient and cheap method of cleaning fouled nets is by manual removal of fouling organisms. Replacement of the net every two months also prevents biofouling.

Item Five: Control of Unwanted Species

Unwanted species are competitors which deprive cultured fish stocks of food, thus affecting their growth.

Control of unwanted species starts during pond preparation. Pond gates should be soil-sealed and screens should be installed after complete drying. Sometimes water-clogged areas cannot be completely avoided after drying. These may still harbor unwanted species which could later pose a problem in the culture system. Under such conditions, application of 5 parts quick lime and 1 part ammonium sulfate per sq m of water at a depth of 5 cm is recommended. This is effective in eradicating unwanted fish species aside from serving as pond conditioner and fertilizer. The application is most effective at noontime when water temperature is high. Broadcast lime first, then, immediately follow up application with ammonium sulfate. Despite these preventive and control measures during pond preparation, unwanted species such as tilapia and gobies are still found in culture ponds. For culture of carnivores, the presence of these unwanted species is not a problem, but it is for prawns and herbivores. As a control measure during culture periods, the application of teaseed powder is recommended for prawn culture, 60-75 days after stocking. To get the desired amount of teaseed powder (TP), use the following formula:

TP(kg) = [Vol. of water in pond x Rate of application (ppm)]/1000; where the volume of water in pond is computed by multiplying the area of pond in sq m by the depth of water in meter. For example, the area of the pond is 0.7 ha and the depth of water is 40 cm. The amount of teaseed powder needed is:

TP(kg) = [7,000 x 0.4 x 15]/1,000, hence, TP(kg) = 42.0

Dilute the powder the night before the scheduled application. The dilution should be spread evenly in the pond. The application is most effective when made during good weather and fish are exposed not less than 4 hours but not more than 6 hours after application. Abort the schedule if it is raining or if rain comes within 4 hours after application. Add or replace water after 6 hours of exposure. Prawns should not be fed within 12 hours after the application.

Source: Avelino T. Triño, "Grow-out Management for Marine Species" (lecture notes in Aquaculture Management training course, April 1990), SEAFDEC/AQD, Tigbauan, Iloilo.

BEST WAY TO MEASURE POND VOLUME

Measuring the volume of a pond can be laborious and the results may leave doubts as to its accuracy. And there should be little doubt when treating for fish diseases or unwanted aquatic weeds. Errors in measurements can result in the loss of valuable fish.

Boyd and Shelton studied this problem on 35 ponds at the Auburn University Fisheries Research Unit. They mapped each pond using areas and depth contours and computed volumes. Average depths obtained by mapping were considered to be accurate. Three other methods of arriving at average depth were compared to the above.

The first method, multiplying the maximum depth by 0.4, gave an average error of 12.6% more or less than the true average depth but usually underestimated it.

The second method, soundings along the transect lines, was better than the first. When one zero depth value was used at the end of each transect, the average error was 9.1 % and usually underestimated average depth. Without the zero depth value included at the end of each transect the average error was 9.3% and usually overestimated average depth. This method is also laborious, requiring 50 to 100 soundings or more to obtain this level of accuracy.

The third method, making soundings along an S-pattern, was the most reliable. The average error was just 5.4% above or below the true average depth. This method overestimated average depth twice as often as it underestimated. The advantage of the S-pattern method is that only 12-24 soundings are required per pond.

Therefore, it is recommended that average depth, area, and volume be measured and noted for future use. It's hard to get an accurate measure during emergency, so it's better to do it ahead of time. Also, it must be remembered that ponds tend to drop below full volume during dry periods so adjustments must be made for volume changes when a treated pond is not full.

Source: John Jensen, "Fish Stories," **Aquaculture Magazine**, Vol. 11, No. 2, March/April, 1985.

SETTING UP A BENCH MARK AT THE FARM SITE

In the absence of Coast and Geodetic Survey "markers" at or near the site of a proposed fish farm, a secondary bench mark must be established. The following steps describe this process:

1. The time and height of the high and low tides occuring during the day of the field work at the proposed site is determined in advance (before field work day).
2. During field work and about an hour before the calculated time of high (or low) tide,

establish on shore or at the location of the proposed main gate a tide pole to measure the high (or low) tide level.

3. At the computed time for high (or low) tide, mark on the tide pole the water surface elevation of high (or low) tide.

4. Somewhere at halfway distance between the tide pole and the proposed bench mark or at same strategic location, set up the engineer's level.

5. Set the rod at the high water tide mark on the tide pole and take backsight reading (BS).

6. Calculate the height of the instrument (HI) by adding the elevation of high (or low) tide with the backsight reading, thus: Elevation + BS = HI

7. Establish bench marks by driving wooden stakes onto the ground or by driving nails in permanent trees. Distinguish the bench marks by painting the wooden stakes or paint a ring around the tree where the nail is located.

8. Set the rod on top of the bench marks and take foresight readings (FS).

9. Calculate the elevation of the BM by subtracting the foresight from the HI, thus: HI - FS = Elevation. The computed elevation is the elevation of the bench mark.

Bench marks are set up at strategic locations. Since these are for future reference for elevations during construction, they should be properly described in the survey notes and identified in the field by dabbing the tops with a coat of paint. Permanent physical structures or objects such as stump of trees and top of big stones make good permanent bench marks.

Care should be exercised when marking the high (or low) tide mark on the tide pole, especially when watches are not set at the correct time. The highest water mark (for high tide) may be registered on the tide pole as indicated without regard to time.

Source: Engr. Victor Sunio, "Setting Up a Bench Mark at the Farm Site" (lecture notes in Aquaculture Management training course, April 1990), SEAFDEC/AQD,Tigbauan, Iloilo.

MODULAR POND SYSTEM OF MILKFISH PRODUCTION IN THE PHILIPPINES

Milkfish is one of the cheapest sources of animal protein in the Philippines. About 90% of 210,000 hectares of brackishwater ponds (BFAR 1986) is devoted to milkfish culture. In 1980, the annual yield in milkfish ponds was 800 kg/ha while the potential yield is estimated to be 2,000 kg/ha. The modular pond system of rearing milkfish in brackishwater ponds can significantly close the gap between actual and potential yields.

The modular pond system of milkfish culture from fingerling to marketable size is carried out in three stages using three adjacent ponds. The pond area in each stage increases progressively in the proportion of 1:2:4. After initial stocking, the fish are transferred from one pond to another, remaining at least 30 days in each pond Subsequently, vacated ponds are prepared for 15 days. The total cycle time of about 45 days permits up to seven croppings per year without taxing the natural food supply in the pond.

An initial experiment of two runs was undertaken in a 7-ha pond at the Leganes Brackishwater Station of SEAFDEC/AQD. This pond was subdivided into three compartments with a 1:2:4 proportion. Verification studies were conducted in three privately owned ponds located in Negros Occidental and Cebu, Central Visayas, Philippines. These ponds adopted similar proportion of pond compartmentalization. Standard stocking density of 3,000 fingerlings/ha based on the area of the last pond was used in all sites. All ponds underwent uniform pond preparation following the *lablab* to plankton method of growing natural food.

Economic analysis. The comparative profitability of all sites was based on a per hectare per run operation, and on a projection of six runs per year. The economic indicators used were return on investment (ROI), return on equity (ROE), and payback period. The costs used in the analysis were based on actual cost and quantity of inputs prevailing in 1987 in the different sites.

Production. The four sites had an average final weight of 200 g/fish and survival rate of 93%. The average yield was 314 kg/ha/run or 1,886 kg/ha/year in six croppings.

Cost and returns. The average percentage of total cost to total revenue for all sites is 66%. This figure was equal to the 1984 figures in 7 milkfish-producing provinces in the country.

The average ROI, ROE, and payback period were 61%, 123%, and 1.37 years, respectively. The figures for straight-run method of culture are 56%, 112%, and 1.64 years for the same economic indicators. Marginal analysis using partial budgeting showed a net benefit of P2,621/ha/year using the modular system. The average investment per hectare is P18,550.

Aside from higher yield and profitability per hectare per year, the modular system offers several advantages: (1) better pond management in terms of pond preparation and predator control, (2) improved stock assessment, and (3) better production and financial planning.

The modular pond system can substantially increase milkfish production in the Philippines.

Source: Renato F. Agbayani et al., "An Economic Analysis of the Modular Pond System of Milkfish Production in the Philippines," a SEAFDEC/AQD best paper awardee in the 1990 Natural Research Symposium of the Bureau of Agricultural Research, Department of Agriculture.

FIRST IN SEAFDEC/AQD MILKFISH RESEARCH: MILKFISH SPAWNS IN CONCRETE TANKS

Milkfish (*Chanos chanos*), a traditionally cultured foodfish in the Philippines, Indonesia, and Taiwan spawned naturally for the first time in concrete tanks at the SEAFDEC Aquaculture Department's Tigbauan Main Station in a study conducted by Drs. Arnil Emata and Clarissa Marte.

The first documented natural spawning in concrete tanks occurred 24 Sept.-9 Nov. 1990 when nine-year old milkfish (2.7 kg average body weight, without hormonal treatment), reared in 200-ton concrete tank (9.7m x 9.7m x 2.0m water depth), spontaneously spawned 15 times. The fish are part of the Department's broodstock consisting of 15 females and 20 males.

There were 12,180 to 271,800 eggs collected during the spawning runs. Fertilization and hatching rates ranged from 50-98% and 38-99%, respectively. The highest number of larvae produced was 249,600. When reared up to post-larval stages following normal hatchery techniques, maximum survival rate was 24%.

This result clearly indicates that aside from 6-m and 10-m diameter floating net cages (AQD's Igang Marine Substation), 25m x 35m fishponds (in Taiwan), and 6-m diameter canvas tanks (in Indonesia), captive milkfish could spontaneously spawn in another holding structure - the concrete tank. The total number of eggs collected were exceedingly lower than those collected from floating cages and fishponds; hence, studies are being conducted to enhance production and collection of milkfish eggs.

Although the cost of maintaining broodstock in net cages is lowest, construction of concrete tanks in close proximity to the hatchery is more advantageous in terms of closer monitoring and coordination of broodstock and hatchery operations. Year-round and off-season maturation and spawning is possible under controlled environmental conditions. This can only be achieved if broodstock are reared in concrete tanks where conditions such as photoperiod and temperature can be manipulated. With refinements in technology, spawning of milkfish in concrete tanks could supplement those in floating cages to ultimately meet the increasing demand for milkfish fry.

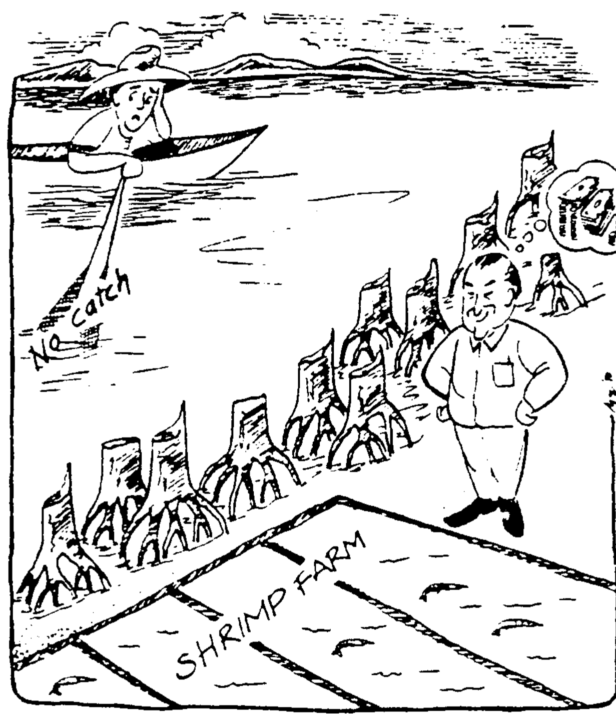
SEAFDEC/AQD ESTABLISHES PILOT SEAFARMING AND SEARANCHING CENTER IN ANTIQUE

The SEAFDEC Aquaculture Department is presently strengthening its Pilot Seafarming and Searanching Project which was recently established in Culasi, Antique, Panay Island.

The project is aimed at integrating seafarming and searanching as a solution to the declining fish production in coastal areas. Specifically, there will be: (1) marine culture of selected finfishes, molluscs, and seaweeds, (2) breeding of appropriate finfishes, molluscs, and shrimps for release into coastal waters, (3) placement of concrete artificial reefs for fish habitat enhancement, (4) organization of coastal fishermen into cooperatives to self-regulate fishing activity and manage their communal fishing ground, and (5) development of extension programs on seafarming and searanching for other provinces.

Culasi was selected from among five candidate sites initially identified in Panay and Guimaras: Culasi and San Jose, Antique; San Dionisio and Conception, Iloilo; and Nueva Valencia, Guimaras. The sites were evaluated using socioeconomic and physico-biological criteria. The socioeconomic creteria are dependence on fishing, fishing income, control of fishing practices, use of fishing credit, potential alternative livelihod, membership in fishermen association, and awareness of non-government organization (NGO). Comprising the physico-biological considerations are live coral cover, sea grass beds, hard bottom, area of 100 hectares, 10-30 meter depth, exposure to runoffs, water transparency, and shelter from southwest moonson. Culasi placed first in the first set of criteria, followed by San Jose, San Dionisio, Nueva Valencia, and Concepcion. It also placed first in the second set of criteria followed by Nueva Valencia, Concepcion, San Jose, and San Dionisio.

The pilot project, which calls for experts in the biological, physical, and social sciences as well as the participation of the local government and non-government organizations, has for its Project Leader AQD Chief Dr. Flor Lacanilao. The project is partly funded by the International Development Research Centre of Canada.



To cut or not to cut
(that is the question)

(*Tropical Coastal Area Management*, Dec. 1989)

SEAFDEC/AQD 1991 AQUACULTURE TRAINING PROGRAM

Courses[ab]	Dates[c]	Training Fee[d]
CULTURE OF NATURAL FOOD ORGANISMS (NATURALFOOD)	13 Feb - 13 Mar	₱5,200
AQUACULTURE MANAGEMENT (AQUAMANAGEMENT)	20 Mar - 17 Apr	5,500
PRAWN HATCHERY AND NURSERY OPERATIONS (PRAWNHATCH)	27 Mar - 14 May 28 Aug - 16 Oct	8,350 8,350
FISH HEALTH MANAGEMENT (FISHHEALTH)	24 Apr - 29 May	5,900
HATCHERY/NURSERY OF MARINE FINFISHES (MARFISHHATCH)	05 June - 24 July	7,700
MILKFISH HATCHERY (MILKFISHHATCH)	17 July - 16 Aug	6,200
SEA BASS HATCHERY (SEABASSHATCH)	14 Aug - 13 Sept	6,200
FISH NUTRITION (NUTRITION)	23 Oct - 05 Dec	6,900

[a]A course session may be cancelled due to lack of qualified applicants. [b]For telegram and telex communications, use abbreviated course title (FISHHEALTH, etc.). [c]Allow another 5 days for post-training tour (optional). [d]Basic training fee covers lodging (electricity and amenities billed separately; extended stay requires additional lodging fee) at SEAFDEC/AQD stations, cost of registration, training materials, field trips, honoraria for resource persons, accident insurance, and medical consultation. Other fees include a refundable breakage fee of P500 (for training courses with laboratory practicum). Average cafeteria meals cost P20-35. All fees must be paid in full on or before the start of the training course otherwise admission will be cancelled. Payment should be made in demand draft, manager's check, cashier's check, or telegraphic transfer payable to SEAFDEC Aquaculture Department, or in cash.

For application forms and further information, please contact: Training and Information Division, SEAFDEC/AQD, P.O. Box 256, Iloilo City 5000, Philippines; Telegram: SEAFDEC ILOILO; Fax: 63-33-81340; Tel. No.: 7-66-42, 8-12-61; or Liaison Office, SEAFDEC/AQD, 9th Floor, State Financing Center Building, Ortigas Avenue, Mandaluyong, 1501 Metro Manila, Philippines; Cable: SEAFDEC MANILA; Telex: 29078 SEAFDC PH; Fax: 0-2-7211342; Tel. No.: 721-5768, 721-5769.

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