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IN THIS ISSUE:

SEAFDEC "Better life through aquaculture"

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GROW-OUT CULTURE MANAGEMENT FOR FRESHWATER FINFISHES

Several types of grow-out culture systems for freshwater finfishes have been developed in the Southeast Asian region. Most common are the earthen and concrete pond culture and the pen and cage grow-out culture in lakes and reservoirs. Each has its own requirements for species of fish to be cultured, water management, fertilization, feeding schemes, etc. Following are relevant management techniques commonly applied to the more popular cultured species in the region.

Item One: Pond Grow-out Management

Pond preparation. Initially, the pond bottom soil is sundried to eliminate undesirable species. Some undrainable ponds are treated with inorganic pesticides for disinfection purposes. Submerged and floating weeds are removed as these compete for nutrients in the soil and water, occupy space intended for fish, and tend to reduce fish harvesting efficiency.

Pond draining and drying are important for the following reasons:

1. **Nutrient regeneration.** Organic matter mineralization or the conversion of some nutrients by aerobic process is hastened.
2. **Control of unwanted fish population.**
3. **Reduced oxygen demand of sediments**. Aerobic oxidation and decomposition of organic matter are accelerated. Better pond sediment substrate for benthic fauna is created.
4. **Control of vegetation.** Weeds that hamper fish culture operations are eradicated.
5. **Disease control.** Fish louse *Argulus* and the parasitic copepod *Lernea* are controlled.
6. **Pond maintenance.** Removal of excessive sediments and debris in the pond bottom are facilitated.

Fertilization. Fertilizers enhance natural food productivity in the pond. The amount and type of fertilizer required by a certain pond vary according to the water and soil qualities in the pond, bottom mud, and type of fish for culture among others. It is best therefore to conduct soil and water tests on the site so that proper recommendations on the type and amount of fertilizers can be given.

There are two types of fertilizer: organic and inorganic. Organic fertilizers are animal manures and plant wastes containing about 40-50% carbon by dry-weight basis. These materials usually have low NPK (nitrogen, phosphorus, potassium) content, and are thus applied in large quantities. The most commonly used organic fertilizers are poultry, pig, and cattle manure. In China, night soil or human excreta is also used to fertilize carp ponds.

Inorganic fertilizers are simple inorganic compounds which primarily contain at least one or two elements of the NPK. Commercial inorganic fertilizers used for pond culture are the same as those for agricultural crops.

Water quality management. Good water quality is a prerequisite for the propagation of desirable aquatic organisms. In the pond, it enhances higher survival, better growth, and increased reproduction.

Important parameters to be considered in order to maintain good water quality are the following:

1. **Dissolved oxygen (DO).** It is probably the most critical water quality variable in fish culture. The primary sources of DO under a fish culture system is through photosynthesis and from atmospheric oxygen diffusion. Loss of oxygen is caused by plant (micro and macro) and fish respiration and oxygen diffusion back into the air. Concentrations of DO are lowest in the early

morning just before sunrise, increasing to its maximum level in late afternoon, then decreasing during the night. The desirable level of DO in the pond is about 5 ppm or higher. Fish cease to feed or grow well if DO level remains at 3-4 ppm.

Oxygen depletion in the pond is caused by (a) excessive water fertility due to fertilization and/or feeding, resulting in high plant respiration and phytoplankton die-offs and (b) too high stocking density. Consumption of DO by fish and other organisms for respiration accounts for the greatest loss of DO.

Low DO level in the pond can be predicted by the color (brownish) of the water and fish behavior (surfacing especially in the early morning).

Low DO level in the pond can be corrected by (a) emergency aeration technique and (b) mechanical aeration. The former is done by flushing high DO water into low DO pond. It is effective and inexpensive where adequate supply of high DO water is available as in streams, wells, or adjacent ponds. Mechanical aeration makes use of paddlewheel that circulates and splashes water into the air and the air blower which injects air either at one side of the pond or through a perforated pipe.

2. **pH.** It indicates whether the water is acidic or basic (alkaline) in reaction. To determine a typical pattern, water pH is usually measured early in the morning (6 am) and in the afternoon (6 pm). pH values of about 6.5-9.0 at daybreak are considered best for fish production. The acid and alkaline death points for fish are approximately pH 4 and pH 11, respectively. Although fish may survive, slow growth of fish occurs with morning pH values between 4 to 6 and 9 to 10.

3. **Ammonia (NH_3).** In freshwater ponds, ammonia occurs as a product of fish metabolism and decomposition of organic matter by bacteria. There are two types of ammonia in water: the un-ionized ammonia and the ammonium ion. The un-ionized form of ammonia is toxic to fish, while the ammonium ion is not, except at extremely high concentrations.

For pond fishes, the toxic levels of un-ionized ammonia range from 0.6 to 2.0 mg/l. High concentrations of total ammonia-nitrogen usually occur after phytoplankton die-offs at which time CO_2 is also high and pH is low (acidic). However, it is seldom that concentrations of ammonia in ponds are high enough to adversely affect fish growth.

Clay turbidity. Suspended materials brought about by turbidity reduce light penetration required for photosynthesis, thereby reducing oxygen generation and phytoplankton production. When resulting from plankton organisms, such turbidity is desirable in the pond. However, when turbidity is due to suspended clay particles, it becomes undesirable. A persistent clay turbidity of 30 cm or less may prevent development of plankton blooms.

Clay turbidity can be avoided by applying organic materials such as cut hay or grasses or manure in the pond at 0.05 kg/m^3 of pond water for a turbidity of 25 ppm and 0.4 kg/m^3 for turbidity of 200 ppm. Another technique is to apply alum (aluminum sulfate, $Al_2 (SO_4)_3.14H_20$) which causes suspended clay particles to coagulate and precipitate from the water column within a few hours. The rate of application is from 25 to 30 mg/l of water. Lime can also be used to prevent persistent turbidity; however, continuous application of lime causes an increase in water pH.

Fish management. One of the most important considerations in pond management is the stocking of the appropriate species and quantity of fish. A fishpond can only support so much fish according to the available space and amount of food present. This limitation is referred to as the "carrying capacity" or the "maximum standing crop" of a pond. However, the carrying capacity of the pond can be increased by fertilization and supplemental feeding. Aeration and running water systems usually increase the amount of DO thus increasing the carrying capacity of a pond.

The stocking rate of a pond can be further increased by polyculture system (culture of different species with diverse feeding habits in one pond) and by stock manipulation (stocking of fish of different ages or sizes).

Pond culture involves different management systems and stocking practices. These are:

Monoculture. It is the stocking of a single species in one area which could be monosize, multistage, or multisize stocking. Monosize stocking means to stock one species at one time and to harvest all fish upon reaching marketable size. Too high stocking density will mean slow growth and/or survival rates, whereas too low stocking density will result in inefficient utilization of food in the pond.

To avoid the disadvantages of monosize stocking, a multistage stocking is used where fish of uniform sizes are stocked in progressively larger ponds as more space is needed. The density of fish is adjusted based on body size as they are transferred to larger ponds. The smaller ponds are then prepared for the succeeding batches of younger fish.

Multisize stocking is the stocking of fish of different age groups. Feeding habits of fish vary as they grow, i.e., fry feed mainly on plankton while adults feed on a variety of feed sources. This enables periodic harvesting of marketable-sized fish.

Monosex stocking. This practice is most applicable to tilapia where excessive reproduction needs control. However, this requires considerable expertise in manually separating the sex of tilapia or in the application of hormones for sex inversion.

Double cropping. It is the stocking of two species in the same pond but during different seasons or time of culture (in cases where the two species have different culture seasons depending on the availability of seeds for stocking).

Polyculture. It is the stocking of different species having complementary feeding habits thereby efficiently utilizing the different feeding niches of the pond. A very good example is the Chinese carp culture in ponds using bighead, silver, and grass carps.

Item Two: Pen Grow-out Management in Lakes

The fishpen industry in the Philippines was started in 1970 primarily for the culture of milkfish in Laguna de Bay. The culture of milkfish in pens in the lake proved to be more successful than that in brackishwater ponds. Today, however, it is not only milkfish that is being cultured but also tilapia, bighead and silver carps, and the common carp.

The size of pens varies from <1 ha to >100 ha. The principal materials used in constructing fishpens are bamboos and nylon nets. Palm tree (*anahaw*) trunks are staked along the periphery of the pen to give additional strength against strong winds and waves especially during typhoons. The shape of the pens also varies but most are rectangular or square. However, most operators agree that circular or oval pens are more advantageous because (1) less material and labor costs are needed, (2) dirt, obstacles, and water hyacinths carried by winds and waves do not stay in one place but find a way out of the pen, and (3) fish do not get trapped in the corners during strong winds and rains but swim around in schools.

Source of fingerlings for stocking. Fingerlings of milkfish, carp, and tilapia are stocked directly in the fishpens. Nurseries of these species are established elsewhere. For milkfish, major sources of fingerlings are Malabon (Metro Manila) and Bulacan. Fish fry are collected from the wild. Bighead and silver carp fingerlings are produced by several hatcheries built mostly around the vicinity of the lake. Tilapia hatcheries and nurseries are found all over the lake. The sizes of milkfish and carp fingerlings for stocking range from 6-7 cm. For tilapia, 5-cm fingerlings are used for stocking.

Time of stocking. The best time to stock fishpens is between March and June which coincides with the highest production of natural food in the lake. Temperature ranges from 30 to 33°C which favors fast growth of fish. Also during this time of the year, phytoplankton reaches a production of about 30 g/m^3/day. Primary productivity ranges from 0.5 to 9.0 g C/m^3/day.

Pen preparation prior to stocking. Most fishpens have a nursery compartment within the grow-out pen. Before the fingerlings arrive, the nursery as well as the grow-out pens are netted using a seine net for predator fish and other species like snakeheads, catfish, etc. which could wipe out the stock. The peripheral nets are checked for damages where the fingerlings could pass and escape.

Fish stocking in the grow-out compartment. The fingerlings are released from the nursery compartment by lowering one side of the net until all the fish have gone out. In Laguna de Bay, the stocking density of milkfish or tilapia is regulated by the Laguna Lake Development Authority (LLDA) at 25 000 ind/ha. For a polyculture system utilizing tilapia, silver carp, bighead carp, and common carp, a stocking density of 40 ind/m^3 is suggested, spread out at the ratio of 30 tilapia: 5 silver carp: 4 bighead carp: 1 common carp. Selective harvesting of tilapia may be done at intervals of 4-5 months since tilapia reach marketable size (100 g) earlier than the rest of the stock.

Feeding. Fish are not usually given supplemental feeds as long as primary productivity is high, especially during summer. However, during times when food production is low, fine rice bran may be broadcast on the water surface at 10-15 sacks/ha.

Pen maintenance. The area is inspected daily for possible damage to nets. Security around and inside the fishpen especially during nighttime should be provided to check on poachers. Guardhouses should be strategically located around the fishpen.

Harvest. Fish can be harvested when they attain a minimum size of about 100 g (10 pieces to a kilo) for milkfish and tilapia and 1.5-2.0 kg each for bighead and silver carps. Fish are harvested by purse seine, gill net, or cast net. About 15-20 people are needed to operate a purse seine.

Item Three: Cage Grow-out Management in Lakes

The cage may be a floating or stationary type. The former is suitable for deeper portions of the water body while the latter is best for the shallower portions. The floating type of cage is moored to keep it in place. Size of cage varies from a small 3m x 3m x 1.5m to a large 9m x 16m x 1.5m or 18m x 20m x 1.5m.

Fish stocks. In the Philippines, tilapia are the most commonly used species for cage culture. Tilapia are stocked at 10-30/m^2 of cage depending on the season. In Laguna Lake, 5-cm tilapia fingerlings are stocked at 20/m^2 during the months of April to July when natural food is abundant. In 75-120 days, the fish may attain a size range of 150-180 g each. A lower stocking density is recommended during September to February when natural food density is low. However, stocking density can be increased if supplemental feeding of rice bran is used.

Maintenance of cages. The nets are periodically cleaned of algae and freshwater sponges that attach to the net as well as to the bamboo posts. These materials tend to clog the nets and thus limit water circulation in and out of the cage. During inclement weather, cages which are provided with cover may be submerged at least a foot beneath the water surface to prevent damage from strong waves.

Harvest. Total harvest of fish may be done when majority of the stock have reached the desired size for market. Partial harvest is done only for fish of harvestable size while the smaller ones are allowed to grow further.

Source: Armando C. Fermin, "Grow-out Culture Management for Freshwater Finfishes" (lecture notes in *Aquaculture Management* training course, April 1990), SEAFDEC/AQD, Tigbauan, Iloilo.

COMPARING NUTRIENTS IN WILD AND FARMED FISH

Do farmed fish measure up to their wild cousins in nutrient? They certainly do in protein. It is important that farmed fish should not be compromised in this respect because protein is one of the most important nutrients from fish. As shown in Figure 1, protein content is not an issue. Both farmed and wild fish have essentially the same amount of protein, although figures are from only a few species.

Fat content, however, differs widely. Figure 2 shows that for every species of fish studied to date, farmed fish are fatter than their wild counterparts. As a result, farmed fish are higher in calories. For example, 100 g of wild rainbow trout would have about 110 calories while the same portion of farmed trout would have 155 calories on a raw weight basis.

While amount of fat is important, the composition of fat is where the action is. Fish swam into the headlines on their content of omega-3 fatty acids - substances with the potential to reduce one's chances of developing or dying from heart disease. These beneficial omega-3s are unique to fish and shellfish. What makes aquaculture unique is the opportunity to harvest fish with a virtual guarantee of abundant omega-3 fatty acids.

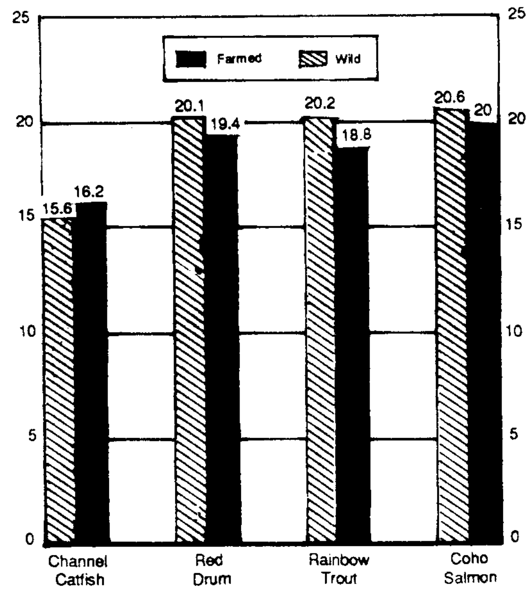


Fig. 1. Protein content (g/100 g fillet) in wild and farmed fish.

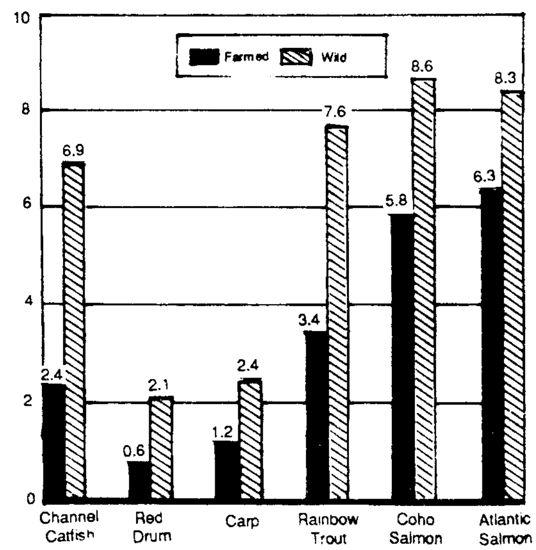


Fig. 2. Fat content (g/100 g fillet) in wild and farmed fish.

Omega-3s in wild and farmed fish. What happens to omega-3 levels in farmed fish is shown in Figure 3. Wild channel catfish, red drum, and carp, skimpy in omega-3s at the best of times, fare about the same on the farm. Even fattening the fish did not substantially boost the total amount of omega-3s. Undoubtedly this result reflects the type of oil in the feed. For these species, present farming practices do not reduce omega-3 levels but neither do they enhance them.

Salmonids are a different story. Naturally rich in omega-3s, wild coho and Atlantic salmon have more omega-3s than their captive cousins, in spite of having less fat. This observation reflects the ability of salmon to selectively retain these particular fatty acids.

Farmed rainbow trout, on the other hand, have more fat and more omega-3s than their wild brethren, undoubtedly because of their cuisine. Rainbow trout make it clear that with aquaculture, omega-3 fatty acid content can be retained and even boosted.

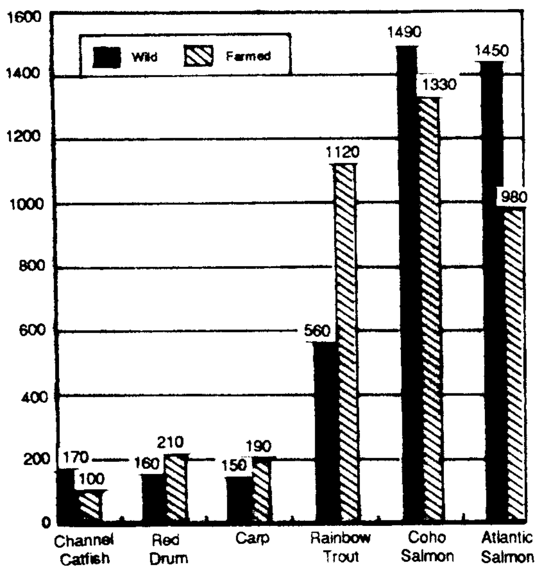


Fig. 3. Omega-3 fatty acid content (mg/100 g fillet) in wild and farmed fish.

To what extent omega-3 fatty acid content be manipulated in salmonids or other species is debatable. In fact, it is uncertain how many fish farmers, researchers, and government regulators consider this issue.

"Omega-3 fatty acid content in farmed fish is highly dependent upon the diet," explained Dr. D. Higgs of the Department of Fisheries and Oceans in Vancouver, British Columbia. "In coho salmon, omega-3 fatty acid content can be increased by changing the amount and kind of oil fed to the fish. For chinook salmon, a wide range in omega-3 fatty acid content was observed according to the feed."

But species differences cannot be ignored. If omega-3 levels of salmonids are boosted, can it be done for other species, especially those requiring very little omega-3s? Dr. T. Lovell of Auburn University in Alabama (U.S.A.) says it is definitely possible with channel catfish. He is unsure whether it is advisable. He fed levels of menhaden oil to channel catfish, up to 6% of the diet, and observed steadily increasing amounts of omega-3s in the fish. The fish, however, had a fishy flavor that was generally disliked by tasters. Greater amounts of unsaturated fatty acids also increased the likelihood of rancidity.

Effects of different fats. Scientists working on Atlantic salmon raised in net pens observed that oil in the fish closely mirrored the composition of the oil in its diet. Oils used were that of herring, menhaden, soybean, or beef tallow. All fish received sufficient omega-3 fatty acids from herring or menhaden oil to meet their requirements and conserved these acids efficiently. Even those fed beef tallow had as much omega-3s in their flesh as those fed herring oil. In addition, those fed the most omega-3s had the most omega-3s in their flesh. This indicates that Atlantic salmon selectively concentrate omega-3 fatty acids when adequate levels are fed and will increase storage if given more. Similar observations have been reported for chinook salmon.

Studies show that farmed salmon thrive on a wide variety of fats provided their requirements for essential omega-3 fatty acids are met and that large excesses of other fatty acids are avoided. Blends of fish oils with various vegetable and animal fats appear suitable for fish growth and human nutrition interests. This is especially important in view of the limited supplies and high costs of fish oils. Further, the final fatty acid composition of fish raised in aquaculture can be adjusted through dietary changes in 4-6 weeks prior to harvest.

Does it taste better? Fiddling with fats may be all well and good in the laboratory but do such specimens pass the fork test? Does menhaden oil or tallow make the fish taste fishy or beefy? According to a study, the different fats had no effect on the flavor and palatability of coho salmon. Similar results have been reported by others studying rainbow trout. Not so for channel catfish. Catfish reared on menhaden oil were reported "fishy tasting" and less appealing to most tasters. The catfish industry believes one of the reasons behind the success of farmed catfish has been its mild, distinctively unfishy flavor. No sensible catfish grower is going to risk success for a nutritional advantage he may not be able to sell.

Farmed fish can look different from wild fish but not all consumers are discerning. Wild salmon often have a deeper red color and firmer flesh. But color also varies with species. Farmed salmon has been described as paler, milder, and softer in texture. Color can be manipulated by feeding the same pigments as found in the crustaceans normally eaten by wild fish yet pale - fleshed fish have their own market advantages. When color was disguised by means of colored lights, taste panelists scored wild and farmed coho salmon equally high. Except for knowledgeable consumers, most people lack the experience to distinguish between wild and farmed fish either by taste or appearance. Some might argue that the widespread availability of farmed fish may be setting the standard for the species.

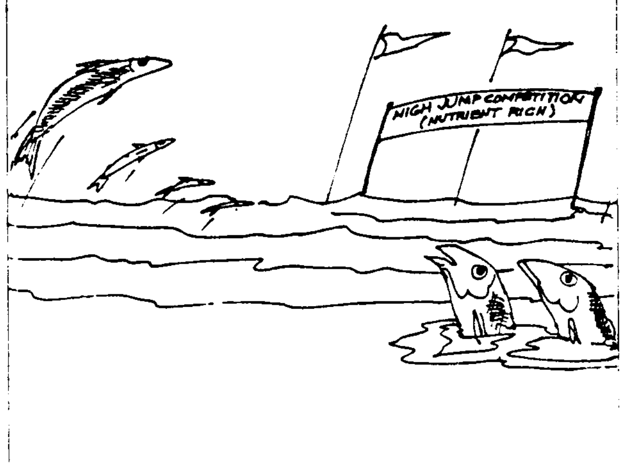
What lies downstream? *Unusual feed fats*: Acceptability of animal fats and increased availability of vegetable oils like canola, low in saturates and generous in linolenic acid increase the diversity of fats suitable for fish feeds. Blends of animal fats with vegetable oils appear feasible. Partially hydrogenated fish oil which has no omega-3 fatty acids is another possibility. Increasing the variety of fats and oils used may ease the pressure for costly marine oils. Adjustment of the fatty acid composition of the fish prior to harvest by using different "finishing" feeds may improve the nutrient profile for the fish consumer.

Omega-6 fatty acids: Fish lay unique claim to omega-3 fatty acids but their response to omega-6 fatty acids cannot be ignored. Research showed that salmonids concentrate omega-6 fatty acids, particularly linoleic acid, in much the same way as omega-3s. The result may or may not be desirable for human nutrition. Many people favor boosting omega-3 fatty acid content since people consume so few of them. If at the same time omega-6s - which interfere with omega-3 uptake - is increased, the nutritional advantages may be limited. Such an argument may be largely theoretical in view of the enormous consumption of omega-6s- from other foods.

Saturated fatty acids: Keeping an eye on the saturated fatty acid content of farmed fish is prudent, given the negative implications of these fatty acids for heart disease. In chinook salmon, a study found that even when widely differing amounts of saturated fatty acids were fed, the young fish tended to retain rather similar levels of saturated fatty acids. Saturates in the fish were related to the amount consumed but large differences in dietary levels were reflected by much smaller differences in the body levels.

Fish might respond to saturates differently from polyunsaturates because the two types of fatty acids are used differently by the body. Saturates supply energy while polyunsaturates go into membranes and other metabolic processes. Using more saturated fats in fish feeds is likely to affect the processing and digestibility of the feed more than final fatty acid composition of the fish but that has not been demonstrated conclusively.

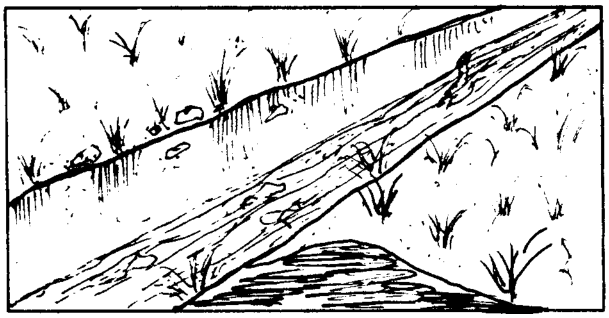
Author Nettleton challenges: "Aquaculture offers unparalleled opportunities for improving the quality and availability of fish throughout the country. The nutrient composition of wild fish offers one yardstick by which to evaluate the products of fish farming. The idea of enhancing the nutrient profile of an already excellent food through fine-tuning fat content and composition is a possibility at the forefront of both aquaculture and nutrition. It is an opportunity that demands full support for the necessary research."



"Waddaya mean the guy is a natural? Of course he is; he was raised in a fish farm."

Source: J.A. Nettleton. 1990. "Comparing Nutrients in Wild and Farmed Fish," **Aquaculture Magazine**, Vol. 16, No. 1, January/February.

FOOD AND PROFITS FROM ABANDONED WATERS



Is there a ditch beside your house? Learn from the Bangladesh experience and turn that stagnant water into a mini-fishpond.

Bangladesh abounds with canals, ditches and ponds which retain water during rainy months. Idle and overgrown with weeds, they become breeding grounds for mosquitoes. These unproductive bodies of water can be used to grow high-value fish and provide undernourished rural folk with much-needed animal protein and added income.

The International Center for Living Aquatic Resources Management (ICLARM) and the Fisheries Research Institute, Mymensingh, have developed a low-input technology, using rice bran as feed for tilapia cultured in seasonal ponds and ditches. Under the Bangladesh Agricultural Research Project Phase II funded by the US Agency for International Development, the technology is being transferred to farmers through collaborative efforts with the Bangladesh Rural Advancement Committee (BRAC), a nongovernmental organization. In 1989, 304 farmers in the Mymensingh district of Bangladesh began applying the technology to grow tilapia in over 300 idle ponds. Their average net profit in 6 months was 23 000 takas /hectare (US$1 = 34.50 takas).

One of these farmers is Mr. Jashimuddin, a landless farmer of Mymensingh district who works as a rickshaw puller earning 25-30 takas/day, barely enough to feed his wife and children. Although he has no land to cultivate, he lives in a small hut beside a ditch which was formed when earth was taken for house-building. The 120-m^2 ditch retains 40-80 cm of water and is usually covered with water hyacinth for 5 months during the rainy season.

When Jashimuddin heard about the technology for raising tilapia in such water, he approached BRAC for assistance and decided to become a farmer cooperator. The project provided him with technical assistance, while BRAC supplied inputs on credit. He cleared the ditch of water hyacinth and released 240 tilapia fingerlings. He fed them regularly with rice bran and 3 months later, he began catching fish occasionally for family meals. Finally, in October 1989, or 4 and a half months later, as the ditch dried out, Jashimuddin harvested all the fish, which totaled 25.5 kg.

Since it had previously been cleared of water hyacinth, the ditch was clean after the fish had been harvested. This enabled Jashimuddin to plant rice in November which he harvested 6 months later, in May 1990. When the ditch accumulates a foot of rainwater, he plans to start tilapia culture again. Thus, from a ditch which was not yielding anything before, Jashimuddin was able to get a crop of rice using very little inputs.

Bangladesh aims to transfer this low-input technology to many farmers so that large seasonal areas can be used for aquaculture to bring nutritional and economic benefits to the country's landless and marginal farmers.

Source: ICLARM press release, July 1990, ICLARM, MC P.O. Box 1501, Makati, Metro Manila 1299, Philippines.

ADVANCED TILAPIA PROCESSING METHODS

The Bureau of Fisheries and Aquatic Resources (BFAR) and the National Institute of Science and Technology (NIST) have conducted experiments on the possibility of canning tilapia. Below are two recipes for canned tilapia:

Tilapia Sardine Style

Materials/ingredients: tilapia, oil, tomato sauce, salt

Procedure:

1. Scale fish, remove head, fins, tail, and viscera. Wash thoroughly to remove blood and other foreign matter.
2. Cut the fish cross-sectionally to fit the size of the container. Soak in 5% brine for 30 min. Drain.
3. Pack the cut fish in tin cans.
4. Exhaust for 20 min. to remove air thus creating partial vacuum.
5. Drain off water extracted from the fish. Add 1 tbsp. hot oil, 2 pcs. pepper (*siling labuyo*), and tomato sauce.
6. Seal the can immediately with the use of a can sealer and process under pressure at 15 lb. for 45 min.
7. Cool under running water.
8. Dry the cans, label, and store properly.

Tilapia Escabeche Style

Materials/ingredients:

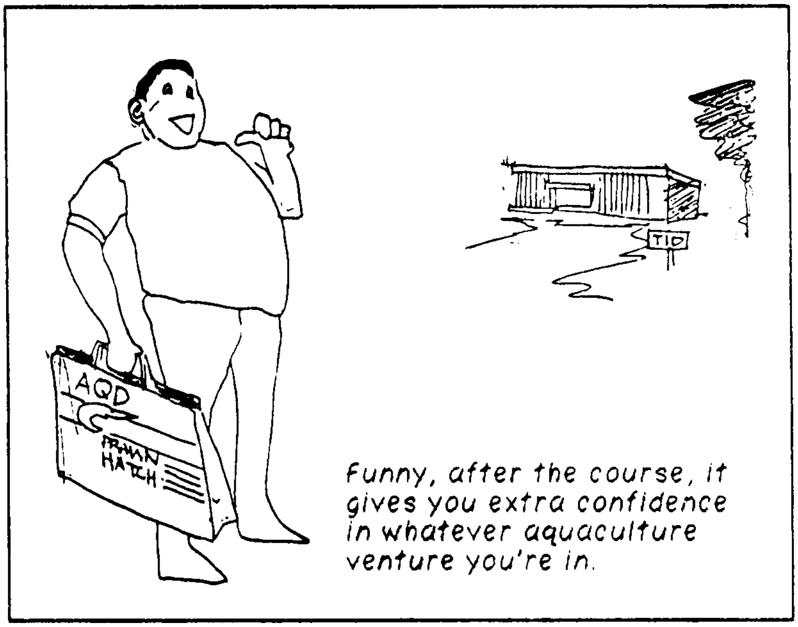
150 g	tilapia	7 g	ginger
20 g	onion	15 g	coarse salt
3 g	garlic	55 g	sugar
5 ml	cooking oil	0.8 g	powder whole pepper
240 ml	vinegar-water (1:4)	7 g	red pepper

Procedure:

1. Scale fish, remove head, fins, and viscera. Wash thoroughly to remove blood and other foreign matter.
2. Cut the fish cross-sectionally to fit the size of the container. Soak in 5% brine for 30 min. Drain.
3. Deep fry the fish in oil until golden brown.
4. Saute garlic, onion, ginger, and red pepper in cooking oil. Add vinegar, water mixture, salt, sugar, and powdered whole pepper. Allow mixture to simmer for 10 min.
5. Place the half-fried fish in cans, then add the boiled packing medium to approximately 1/4 in headspace from top of the can.
6. Exhaust for 20 min to remove air thus creating partial vacuum.
7. Seal the cans immediately with the use of can sealer and process under pressure at 15 lb for 45 min.
8. Cool under running water
9. Dry the cans, label, and store properly.

Source: **Post-harvest Handling and Processing of Tilapia,** Fisheries Extension Paper Series No. 6, Bureau of Fisheries and Aquatic Resources, 860 Quezon Avenue, Quezon City,1986.

SEAFDEC/AQD TRAINEES: COMING AND GOING



They came, they saw, they left prepared to "conquer" the tasks ahead. Year in, year out, coming and going - that's the story of the trainees who register for SEAFDEC/AQD's training courses.

On 13 March this year, SEAFDEC/ AQD's Training and Information Division graduated 13 in the *Culture of Natural Food Organisms*. Eight were from the Philippines - Evelyn Taberna, Gladys Resubal, Nimfa Medina, Violeta Ramos, Jeselita Ruinata, Ben Hur Viloria, Imelda Gisalan, and Diomedes Cimagala; two from Malaysia - Mohana Omar A/ L Kumaran and Lim Swee Kheng; and three from Thailand - Pramuan Onlamai, Yupaporn Chaisiha, and Decha Rodrarung. The course provided the participants basic knowledge and hands-on experience from small- to large-scale production of phytoplankton, rotifer, and brine shrimp.

On 27 March, 16 trainees enlisted in the *Prawn Hatchery & Nursery Operations*: El Cid Caballes, Rorry Baldia, Jaime Mora, Antonio Morales, Inocencio Cosare, Mary Lynn Abiera, Armando de Lima, Eden Japitana - Philippines; Mohd. Zakaria Morshidi, Daut Md. Ali, Tuan Md. Ariffin Tuasan Hussin - Malaysia; Nopadon Kakhai, Pajongjit Boonnoon, Yowwapa Kulangkooravired - Thailand; K.M.C.W.B. Wickramatillaka, W. Perera - Sri Lanka; and Jahagir Jaari - Iran. Course topics included site and species selection; design and construction of hatchery and nursery tanks; larval and post-larval rearing and feeding; harvesting, packing, and transport of fry; and hatchery economics. Ending on May 14, this is the 29th *Prawnhatch* session conducted by SEAFDEC/AQD.

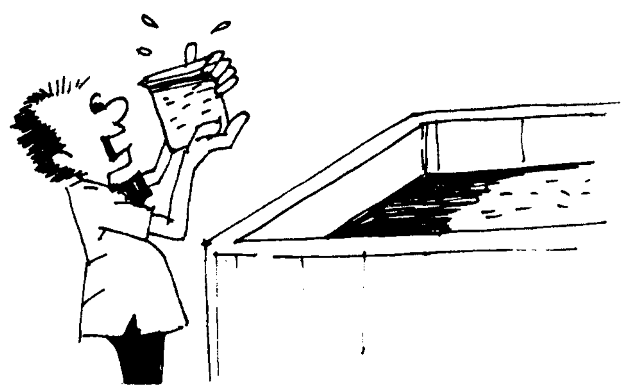
On 17 April, 13 trainees received certificates of graduation from the *Training Course in Aquaculture Management*. They were Dario Doctolero, Manolito Amon, Juanito Samson, Muriel Caquilala, Henry Ramiterre, Raul Millana, Claudio Fabre, Marcelino San Diego, Jr. - Philippines; Zakaria Bin Ismail, Mohammed Mohidin - Malaysia; Kiattisak Kositchaiwat, Boonyuen Prugsachoke - Thailand; and W.A.S. Wijesuriya - Sri Lanka. The course equipped the graduates with knowledge on "all aspects of the aquaculture operation from planning to project evaluation."

On 24 April, the *Training Course in Fish Health Management* opened with 17 participants:

Muthucumarasamy Sivananda, OO Mooi Gaik - Malaysia; Sanchai Tandavanitj, Wasan Sreevatana - Thailand; Francisca Galura, Rosalinda Dy-Contreras, Julita Lavaro, Kenneth Kennedy, Salvacion Eslabra, Myrna Saracin, Grace Bangud, Susan Caoile, Hope Marie Metal, Armando Puzon, Jr., Eleanor Resotay, Gary Grijaldo, Plutomeo Nieves - Philippines. At the end of the five-week course, trainees are expected to be able to recognize diseased shrimps and finfishes, identify cause of the disease, apply preventive and control measures, and use appropriate techniques for the preparation of samples for diagnosis.

FREE MILKFISH AND GROUPER EGGS; FRY FOR SALE

Research studies at SEAFDEC/AQD produce milkfish and grouper eggs as by-products. These eggs are given free to (1) graduates of SEAFDEC/AQD's *Hatchery/ Nursery of Marine Finfishes and Milkfish Hatchery* training courses, (2) government-run fishery schools that conduct their own researches, and (3) collaborative projects between SEAFDEC/AQD and the private sector. Beneficiaries must allow the institution's researchers access to data from the eggs obtained.



SEAFDEC/AQD management recently approved the following sales quotas and prices of research by-products:

Commodity	Quota/buyer/order	Price
Eggs		
Sea Bass	3 million	P2000/million
Milkfish	2 million	Free
Grouper	1 million	Free
Fry		
Sea bass	10 000	P1/cm
Milkfish	10 000	75% of the prevailing market price
Siganid	5000	50% of the prevailing market price
Grouper	1000	Prevailing market price
Shrimp	500 000	80% of the prevailing market price

Above figures are subject to change depending on the research needs of SEAFDEC/AQD and the prevailing cost of production.

ADSEA II AND PROSPECTS FOR SEAFARMING AND SEARANCHING

The Second Seminar - Workshop on Aquaculture Development in Southeast Asia (ADSEA II) will be held on 19-23 August 1991 in Amigo Terrace Hotel, Iloilo City, Philippines. ADSEA II will assess existing aquaculture technology for major cultured species in Southeast Asia, with emphasis on recent technologies developed from 1988-1991 by the SEAFDEC Aquaculture Department. As it was with ADSEA I in1987, ADSEA II will re-examine priority areas for future research among SEAFDEC Member Countries. The seminar-workshop will also attempt to formulate research and development strategies on seafarming and searanching for enhancing coastal resources and improving the livelihood of small-scale fisherfolk and fish farmers.

ADSEA II will feature plenary sessions of invited papers reviewing the present state of aquaculture development and seafarming and searanching technologies in Japan, Malaysia, Philippines, Singapore, and Thailand. Other invited papers will also feature the ecological, social, and economic impacts of seafarming and searanching projects. A workshop and general discussion will follow each presentation.

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