

Observations on Freshwater Aquaculture and Extension in Malaysia, Thailand, Japan and Taiwan¹

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As part of the Philippines' plan to accelerate the country's rate of aquacultural development, a study team was sent to neighboring Southeast Asian countries to observe advances for improving and developing aquaculture in the Philippines. The 3-man team, of which I was a member, toured Malaysia, Thailand, Japan, and Taiwan. The following is a brief account of observations from the trip and interviews with authorities from selected fisheries agencies, with emphasis on freshwater aquaculture.

The contribution of freshwater aquaculture to the total annual fish production of the four countries is relatively small—1 to 2% in Malaysia and Japan, 10% in Thailand, and 17% in Taiwan. The 17% figure for Taiwan includes aquaculture production from brackish and marine waters. Most of the cultured species in Taiwan are high cash crops or gourmet species which are sold for local consumption or exported at a high price.

Developments or practices in freshwater aquaculture in the four countries visited may be categorized as (1) pond culture of common or indigenous species, (2) culture of high-priced species, (3) integration of animal and fish production, and (4) cage culture in inland waters.

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Pond Culture of Common or Indigenous Species

In all countries except Japan, the most common fish cultured in ponds are common and Chinese carps. Indigenous carp species are also being cultured in each country. This is a notable contrast to Filipinos' preference for tilapia. Malaysians, composed of Chinese, Malays, and Hindus, generally prefer carp to tilapia as food. Next to carp, *Tilapia*, especially *T. niloticus*, was popular in the three countries. One species of catfish found in Thailand was *Pangasius suchi* which is claimed by Thais to be a good pond and cage fish and is preferred over Chinese carps. The various species are being raised either in monoculture or more often in a polyculture system with fertilization and feeding. The culture period is a minimum of 6 months but usually extends 8-9 months. In much colder places like Japan, it takes up to 2 years or more to grow carp to 1 kg from stocking size of 50 g. Polyculture of Chinese carps, common carp, and *Pontius gonionotus* or "Tawes" produces about 2.3 tons in 8-9 months in Malaysia in a system using fertilization and supplemental feeding of natural vegetation. The cost of carps, however, is relatively low in all the countries visited, varying from US\$1-2 per kg.

Culture of High-Priced Species

Macrobrachium rosenbergii or giant freshwater prawn (Ulang), eel, and mullet are the leading species cultured because of the high price they command. *Macrobrachium* culture especially was one of the major thrusts in the countries visited except Japan. The price per kg is as high as US\$6-7.7 in Thailand and US\$10 in Malaysia. Although propagation and culture

of the prawn seem to be known in Malaysia, the magnitude of operations is still limited compared to that in Thailand and Taiwan. In Thailand the prawns are raised on 100 small-scale commercial farms with average size of 1/6 ha scattered through 23 of 71 provinces. The approximate total area of prawn farms is 120 ha, 20 ha of which is initially being served by the newly established 14-ha *Macrobrachium* Research Station in Chachoengsao Province. Added to this is a 75-ha prawn farm under construction with production ponds averaging 1 ha each. Aside from pond culture the prawns are also being stocked in reservoirs. In Taiwan, the prawn hatchery visited has an annual production of 3 million larvae/juveniles and has been operating throughout the year for 3 years.

Commercial and intensive eel farms were observed in Japan and Taiwan. Fifty percent of world's consumption of eel is in Japan and the other 50% is concentrated in Europe. Eel culture started 80 years ago in Japan and the present annual consumption is 45,000 metric tons valued about US\$346 million. Of the total eels consumed, 2/3 are produced in Japan and 1/3 imported from Taiwan. The eel industry in Taiwan expanded rapidly 5 years ago and it is now one of the country's largest industries in terms of production. One of the eel farms visited in Taiwan was a 4-ha all-concrete, highly intensive system producing 25 tons of eel per ha annually or 100 tons per 4 ha. To make use of plankton blooms due to enrichment of water from wasted or uneaten feed and fecal matter, culture of red tilapia with eels was initiated.

The cost of eel per kg is about US\$10 in Japan and US\$8 in Taiwan. This high price is warranted by the high quality feed (raw fish such as mackerel and sardine) and the 12- to 18-month-long rearing period beyond the elver stage of 0.2 g to marketable size of 150-200 g each.

The most preferred and appropriate species of eel for culture in Japan is *Anguilla japonica*. Other species coming from Europe such as *Anguilla anguilla* and *Anguilla rostrata* are difficult to raise or have low survival. Consequently, the price of elvers of European species is about 25 times lower than that of *A. japonica*.

One of the drawbacks of raising *A.*

japonica, however, is the scarcity of elvers, another reason for eels' being expensive. Due to scarcity of elvers, eel research is intensive with an annual appropriation of approximately US\$8,000 at the Shizuoka-Hamanako Branch Experiment Station, Shizuoka Prefecture. The station has succeeded already in hatching eggs, with elvers living up to 2 weeks. Because of this initial success in hatching, current activities include collecting large quantities of eels to be used for induced spawning.

It was noted that the factors necessary to intensify production are present in Japan and Taiwan. Such factors are dependable electricity, formulated feed, fish seed, capital, and market. Production cost may be high but the people are still willing to pay for the product.

At this stage the Philippines cannot afford to increase production of fish through intensification and feeding as practiced in these other countries unless the species is intended for export. Much research on fish nutrition and feed development has yet to be done. At present, inputs for increased production per unit area for national consumption may be economically obtained only through polyculture and supplemental feeding.

Livestock-Fish Integration Projects

The integration of fish culture with raising of animals such as pigs, ducks, chickens, and other fowl was observed in Malaysia, Thailand, and Taiwan. The set-up is still experimental in Malaysia, whereas backyard and commercial farms are evident in the other two countries. Initial findings in Malaysia indicate that duck-fish integration has shortened the culture period of fish by 2 months. The number of ducks per ha of fishponds is about 500. In Thailand, wastes of 62 to 100 pigs fertilize 1 ha of pond and produce 200-to 250-g *T. niloticus* or 2.5 tons per ha in 6 months. Production of 5-6 tons/ha from polyculture of Chinese carps with about 100 pigs per ha was claimed in Taiwan.

Although the system seems to work well and is claimed to be profitable, the information obtained about the relationship between the number of animals and area of fishpond served differs widely between countries. The 500-ducks/ha used in Malaysia is far

less than the 3000 ducks and 500-600 geese serving 0.3 ha of fishpond in Taiwan. A new project seen in Taiwan stocked as many as 300 to 350 pigs per ha. The wide variations in the figures indicate the need for proper documentation of the system. Reliable data for this system would be very valuable in the Philippines for maximizing efficiency of land use, especially in small landholdings such as the size prescribed under the Land Reform Program (7 ha). (Recognizing the need for baseline data, ICLARM and CLSU have undertaken a joint project in integrated animal/fish farming to obtain quantitative guidelines for the practice in tropical countries.—Editor.)

Cage Culture in Inland Waters

Fishermen's cooperatives in Japan and Taiwan in cooperation with fisheries agencies play an active and vital role in the management of lakes and reservoirs. They manage the waters and share management responsibility with the government by enforcing regulatory fishing measures such as catch limit, fishing gears used, and observance of fishing seasons.

Extension of aquaculture technology through cage culture of fish in natural and artificial waters was seen in Thailand, Japan, and Taiwan. Culture of carps, *Pangasius suchi*, and *Macrobrachium rosenbergii* in cages in rivers and reservoirs is common in Thailand. Carps are also commonly cultured in cages in Japan. In addition to carps, tilapia species are grown in cages in Taiwan.

In Uthai Thani, 210 km north of Bangkok, there are about 100 families that each have 2-3 cages measuring 10 m x 2 m deep. *Pangasius suchi* in cages grows to 1.5 to 2 kg in 2 years at stocking size of 10 cm. Cages measuring 3 x 7 x 2 m are usually stocked with up to 2000 fish and fed mixed rice bran, kitchen leftovers, and "Pak-bong" (kangkong). In Japan, the growth rate of common carp in a 5 x 5 x 1.5-m-deep net cage stocked with 1000 fish and fed commercial feed is 1 kg in 2 years. The net return seems low because of the low price of carp, long growing season, and high cost of feed. Cage culture in Taiwan is still in an experimental stage. Stocking 8000 tilapia at 30 g/fish in in an 8 x 9 x 2-m

cage produced fish with an average weight of 338 g after 110 days with feeding. In the same cage 3000 common carp initially weighing 150 g each were stocked. In 4 months' time the fish averaged 2000 g each. However, the carp were infested with parasites and this made farmers prefer tilapia species over the former for cage culture.

Dissemination of Technology

The aquaculture extension approach in the countries visited is also being taken in the Philippines at present. Brief notes on extension activities in each country are as follows:

1. In Malaysia, the extension service for freshwater fishpond operators consists of putting up hatcheries, subsidizing production of seedlings, and training.

Malaysia has six freshwater fish hatcheries which partially supply the needs of pond operators. Seedlings of common carp and *Puntius gonionotus* or "Tawes" are given free at the rate of 3,200 fish/ha (1,500/acre) while seedlings of Chinese carps are distributed in limited quantity—1,235/ha (500/acre). Farmers have to pay about \$1.35 to \$2.00 per hundred if their need exceeds the limit prescribed for Chinese carps. The production of Chinese carp seedlings in the country is inadequate, so the present excess demand is being solved by importing from Taiwan.

Training of fishpond owners is given at two levels: the residential or live-in category which usually takes 3 weeks and is conducted in a training center where dormitory, meals, classrooms and other expenses are provided free; and the nonresidential level which usually lasts 4 days and is a follow-up or refresher course for those who have been trained previously.

The extension service has limited involvement in the development of commercial fishfarms. A semi-governmental agency called Fisheries Development Authority, however, is established for this purpose. Its function in developing commercial fishfarms embraces feasibility studies, production, and marketing. Although most of its past activities deal with marine fisheries, the agency is now beginning to cover fresh and brackish

water. Its initial activity in fresh water was to establish a fish and prawn production station which aims to demonstrate to the people and banking institutions that fish culture is feasible. Salaries of workers at the station are to be derived from the income of the station.

2. In Thailand hatcheries which cater to fish farmers and provide prawns, catfishes, carps and other species are available. Extension through training and individual visits is also being practiced. The Thais are now beginning to provide direct training to fish farmers in areas targeted for freshwater fisheries development.

3. There are 47 prefectures in Ja-

pan, each of which has a Fisheries Experiment Station that deals with different resources such as marine and inland waters. Depending on the resource, a prefecture may have one or all kinds of fisheries experiment stations. Training centers that conduct local and foreign training are also available. The farmers' needs for fish stock are also being subsidized by the government.

4. Taiwan has impressive intensive commercial aquaculture facilities. Private owners and government technicians seem to have direct contact with each other. It is unfortunate that details of the extension procedure were not obtained due to the language barrier.

ADB Boosts Fisheries in Pakistan and Thailand

Pakistan will soon be receiving a technical assistance grant from the Asian Development Bank to help the country prepare a fisheries development project. Objectives of the project are to step up exploitation of the country's large fish resources, improve nutritional standards of its people, generate higher incomes and more employment in the fishing industry, and increase foreign exchange earnings.

Under the terms of the agreement, nine experts will conduct a feasibility study to examine mechanization of coastal artisanal fisheries, introduction of a pilot scheme in offshore trawlers, improvement of the existing Karachi fisheries port, construction of a new port near Karachi, establishment of onshore and marketing facilities at the new port site, establishment of an FRP or ferrocement boat-building yard, and development of inland fisheries/aquaculture in selected areas. The team will also assess the need to augment earnings from fish

exports and to make more fish available to local consumers, especially the poor.

ADB has also approved a \$1.5 million technical assistance loan for developing two major deep-sea ports in southern Thailand, one in Songkhla, the other in Phuket. Of the eight principal ports in the south, Songkhla is the largest, handling about 35% of the southern region's sea trade. The area has been declared an investment promotion zone, and industrial development is being encouraged there.

Phuket is the other area with potential for growth, with plans for its future development resting on its two main assets: mineral resources and tourism potential. As a port, it is much smaller than Songkhla, accounting for just over 10% of the region's trade, but it has two advantages: greater proximity to Europe and the U.S. Atlantic Coast than any other port in the country, and a coastline suitable for deep-sea port development.

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Thirdly, the system must be simple. It must not be so complex that the difficulties in establishing and negotiating agreements, in acquiring information, and adopting and enforcing regulations, far outweigh the benefits that can be obtained from the system.

Fourthly, it may be advisable that whatever regional management agreement is established in the region, it should incorporate provisions for dispute avoidance and dispute settlement."

Five background papers, together with the full report of Dr. Christy's study, were used as a basis for discussions in the ensuing 3 days; these discussions culminated in a report suggesting approaches and action to help states manage their resources.

Background papers included:

The allocation of scads and mackerels, by Dr. Veravat Hongskul, Department Fisheries, Bangkok.

The allocation of tuna fisheries, by Dr. Inocencio Ronquillo, Bureau of Fisheries and Aquatic Resources, Manila.

Sharing of access among neighboring states, by Dr. Prajit Rojanaphruk, Treaty and Legal Department, Bangkok.

Implementation of agreements with foreigners, by Dr. Hasjim Djalal, Department of Foreign Affairs, Jakarta.

Implementation of regulations for domestic fishermen, by Dr. Khoo Khay Huat, Universiti Sains Malaysia, Penang.

The proceedings of the meeting, including an introduction, background papers, summarized discussion, and final report, will be published by ICLARM in 1979 and distributed widely throughout the region.