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Aquaculture Department Girds for 1980 and the Next Decade

The last year of this decade, 1980, will be marked by the introduction of major changes at the Aquaculture Department of the Southeast Asian Fisheries Development Center.

Following the 12th SEAFDEC Council of Directors meeting held in Bangkok from 5-10 November, the Aquaculture Department has firmed up its new program thrusts and started implementing the organizational changes that would support the revised program.

The new research and development direction is embodied in the 10-year plan for aquaculture research developed by the Department in August this year (see AA II (10), October 1979). Revolving around the station concept to facilitate the management of research activities through decentralization, the Department's research program shall now be consolidated under three aquaculture systems areas, namely, brackishwater aquaculture, freshwater aquaculture and mariculture research. Activities under these will be primarily conducted in three stations, all of which are now existing and will be further developed to accommodate the proposed programs. The Leganes Station where the Department's brackishwater pond system is located will handle brackishwater researches; Binangonan, the site of the freshwater fisheries station, will handle freshwater research; while the main station in Tigbauan situated on a coastal area, will be the center for research in mariculture as well as the base for most of the essential laboratory work related with the three programs. In consonance with decentralization, station managers will be appointed to head the three research stations.

Some 30 hectares more of experimental brackishwater ponds in Leganes are going to be developed while a support facility — the scientific supply house at Tigbauan station — has been slated for completion.

SEAFDEC Aquaculture Department trainor and researcher Porfirio Gabasa (rt) clarifies prawn hatchery problem for ranking official of the Butuan City and Agusan del Norte fish producers association. The mobile training course for the association's members was held in Butuan City recently. This was followed by a similar course in the southeastern Mindanao province of Davao.

Projects for 1980

A partial list of already approved projects shows that there are 49 individual studies falling under 11 projects to be conducted in the Tigbauan research station; 24 studies falling under 8 projects to be done in the Leganes station; and, as of now, 8 studies under 7 projects to be implemented at the Binangonan freshwater station, for a total of 81 studies/26 projects.

Meanwhile, additional research proposals are still in the evaluation pipeline and will probably be included in the 1980 program upon the recommendation of the Department's technical evaluation and advisory committee and with the approval of the chief.

In addition to these projects, the Department will be doing collaborative research work with other national research institutions particularly the Freshwater Aquaculture Center of the Central Luzon State University on seed production, cul-

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ture techniques and aquaculture engineering; the Brackishwater Aquaculture Center of the University of the Philippines on nutrition and feed development, aquaculture engineering, soil and water management, and pest and predator control; and the Bureau of Fisheries and Aquatic Resources on limnological studies of Philippine lakes.

Special Projects

A fresh venture — designed to hasten the spread of aquaculture technology generated in the Department to other SEAFDEC member countries — is the establishment of aquaculture substations. The idea was hatched at the SEAFDEC Program Committee meeting held in August 27 to 30. A mission, led by the chief of the Aquaculture Department, has subsequently toured Thailand, Malaysia and Singapore to find out the suitable sites for such aquaculture substations. Consultations with representatives of these countries have been held and the idea has been approved in principle by the Council of Directors. Only the institutional arrangements and linkage mechanisms remain to be ironed out.

Another highly promising area of involvement is the network of aquaculture centers in Asia being proposed to be established by the UNDP/FAO. Proposed to compose the network are the Aquaculture Department, the National Inland Fisheries Institute in Thailand, and the Freshwater Fish Culture Research and Training Center in Bhubasewar, India. A fourth center, most likely one in the People's Republic of China, has been recommended.

Initially, the Department has been requested, in connection with this project, to train 25 aquaculturists yearly and to conduct collaborative research in the culture of milkfish, mullets and shrimps in brackishwater ponds. The Philippine government, host of the Aquaculture Department, has asked the Department to participate in the proposed network.

Outreach

Training, extension and the publications programs essentially form the outreach function of the Department.

The 1980 training courses offered to international participants are: aquaculture research methodology, aquaculture management for milkfish, aquaculture management for prawn, and management and operation of a small-scale prawn hatchery. For local trainees are the following: prawn culture, management and operation of a small-scale hatchery, mussel and oyster culture, and several on-site farmers' training courses.

Meanwhile, the Department is developing a mechanism for extending technology to the private industry sector whereby the private progressive fish farmers will have a more active participation in assisting the less productive traditional farmers.

The publications and communications program will be further bolstered. It is now made up of the extension manuals, the regular semi-technical monthly newsletter, the quarterly research report, the fish farm news, and the annual report as well as periodic media releases.

Linkages

Several institutions of national, regional or international character have linked up on certain projects with the Department. The Department proposes to continue its linkage arrangements with nine of these: the International Development Research Centre in Canada on milkfish research and staff development; Oceanic Institute of Hawaii on staff exchange specifically related to milkfish research; Government of New Zealand on mariculture research, staff development, short-term training and extension activities; Danish International and Development Agency on Limnological research and staff exchange; Indian Council for Agricultural Research on staff exchange for special training in aquaculture; Overseas Development Ministry of the United Kingdom on brackishwater aquaculture research and staff development grants; Cuban State Committee for Economic Cooperation on scientific, technical exchange and training in aquaculture; Bureau of Fisheries and Aquatic Resources on national short-term training and extension programs; and the University of the Philippines on graduate manpower program and collaborative research. ●

Message

In these days of increasing populations and economic crises, aquaculture plays a significant role in national development particularly in combating malnutrition and increasing dollar reserves. The economic viability and potentials of producing aquatic organisms through culture have been recognized internationally, and research to improve technology and hasten aquaculture development has been vigorously pursued by many research institutions for the past years.

The Southeast Asian Fisheries Development Center, through its Aquaculture Department, has been involved in aquaculture development through research, training and extension services in the region. Efforts of the Aquaculture Department will continue to be harnessed to help out the region feed its malnourished with animal protein and to help in nation-building. The continuing support of the SEAFDEC Council, the SEAFDEC member-countries, the donor agencies and countries to the Department in enhancing its objective is hereby gratefully acknowledged.

In behalf of the Aquaculture Department, I extend my Yuletide Greetings to friends, colleagues, agencies, countries and all others who have extended cooperation and assistance to our efforts in aquaculture development in the region. May all these cooperative activities in aquaculture bear merrier and happier Christmas seasons for the peoples of Southeast Asia and the rest of the world in the years ahead.

ROGELIO O. JULIANO
Chief
Aquaculture Department

Integrated Crop-Livestock-Fish Farming in Malaysia*

A tricommodity integrated farming system involving fish, livestock and crops is being practised by a limited number of farmers in Malaysia. For fish farming areas, especially, the potential for the promotion and development of this system is great; about half of the total existing and potential areas for fish pond production of more than 29,000 hectares can be utilized for integrated farming.

Widely practised in Malaysia is the combination of pig-rearing, fish culture and vegetable gardening which is however confined to the pork-consuming segment of the population. However, a great potential exists for developing other combinations such as those involving ducks and chicken, which are acceptable by all the communities in Malaysia.

Present Systems

There are four general systems of integrated farming now in practice: *livestock and crop*; *fish and crop* particularly fish and padi (rice), fish and vegetable, and fish and fruit tree culture; *fish and livestock* such as fish and pig, fish and duck, fish and geese, fish and cattle, and fish and goat culture; and *fish-cum-livestock-cum-crop culture* like fish-pig-vegetable, fish-duck-vegetable, fish-pig/chicken/duck-vegetable, and fish-goat/buffalo-vegetable culture.

Systems involving two commodities are well-known in Malaysia. On the other hand, tricommodity integrated farming is employed mostly by some Chinese farmers in which pig or duck rearing is carried out with fish culture and vegetable gardening.

Prospects

A survey of known multi-commodity farming systems shows the possibility of popularising tricommodity integrated farming among farmers in fish farming areas of the country. A study on the status of integrated farming involving fish and livestock conducted by the fisheries department in 1979 showed that out of 12,000 acres (4,808 ha) of fish ponds in operation, some 67.2 ha are being utilized for fish-livestock mixed farming i.e. fish-cattle, 18.1 ha; fish-chicken, 5.03 ha; fish-duck, 16.43 ha; fish-geese and other livestock, 4 ha; and fish-pig culture, 23.7 ha.

Fish-pig culture

In this combination, the waste water from the pigsties is channelled into fish ponds to fertilize the ponds. Pigs are fed with soft diet composed of boiled succulent vegetable feeds consisting of any one or combination of the following crops: sweet potato haulms and tubers, cassava leaves and tubers, banana stem, kangkong *(Ipomoea reptans)* and *Colocassia* and *Dioscorea* spp.

A case study on fish-pig culture made in 1952 in Penang showed a yield of 3,260 pounds of fish per acre (equivalent to 3,655 kg per ha) per year. The fish species used were grass carp, common carp, silver carp and Tilapia.

Fish-chicken culture

Fish species like grass carp, bighead carp, Indonesian carp and the Malaysian freshwater prawn *(Macrobrachium rosenbergii)* could be cultured with chicken. The system has been tried out on an experimental scale at the Malaysian Agriculture Research Development Institute (MARDI) station in Malacca.

In the trial, a poultry shed was built above the fishpond and in four months some 242 kg per acre (equivalent to 598 kg per ha) of *Macrobrachium* and an equal amount of fish were obtained. The chicken attained weights of 1.2 to 1.8 kg each over the same period. It has also been reported that in Sarawak, 100 chicken may be able to keep an acre (0.4 ha) of pond in constant productivity.

Fish duck culture

Disused mining pools are utilized for culturing fish consisting of grass carp, silver carp and bighead. Adjacent to the pools, the farmers cultivate vegetables, rear pigs and some ducks. MARDI, Malacca experiments indicate that polyculture of prawr and fish with duck is feasible. In this case, the fish were not given feed supplement.

Fish-cattle culture

In this system, cowbyres are built in the vicinity of fish ponds so that cowdung from the byre is easily transported to and applied in the ponds at specified intervals. The common practice in Malaysia is to apply cowdung at the rate of 450 *katies* per acre per year or an equivalent of 272 k g/ha/year.

Recycling Methods

The recycling method commonly observed in Malaysia is described as follows:

"Chinese farmers who carry out intensive vegetable gardening replenish soil nutrient losses by integrating pig rearing into their farming system. This way, they effectively manage to conserve fertility within the confines of their small holdings. The pig manure is used to fertilize the vegetable garden and the pond and to replenish nutrients in his *padi* land.

"Pig is the essential biological factor in the production cycle while water is the physical factor. The pigs need water for drinking and have to be bathed twice a day; the vegetables need watering; padi needs to be irrigated and fish live in the water. The ponds in which the fish are reared also produce aquatic plants used for swine feed. Trimmings from vegetables grown for human food are fed to pigs and poultry. Vegetables are chopped up for feed. Livestock dung is widely used as fertilizers for vegetable gardens and fish ponds."

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*From the paper, "Tricommodity Integrated Farming in Malaysia," presented by Ali Bin Ismail at the symposium on Agribusiness Systems for Integrated Crop-Livestock-Fish Farming held at the Philippine Council for Agriculture and Resources Research, Los Baños, Laguna, Philippines, 19-25 November 1979.

Sawdust Shows Promise as Shipping Medium for Prawns

An experiment at the SEAFDEC Aquaculture Department main station in Tigbauan has shown the possibility of using saw dust to ship live prawns.

In the laboratory trial reported by a Japanese International Cooperation Agency prawn expert, Hideo Mochizuki, sawdust of white lauan was used instead of cedar which has been found suitable for *Penaeus japonicus.* Mochizuki worked at the Aquaculture Department as a prawn specialist.

He reported:

First, sawdust was dried well under the sun. The well-dried sawdust was packed in plastic bags and kept in a refrigerator.

In the experiment, about 10 to 15 grams of sugpo were placed in a plastic basin with aerated seawater. Ice was added gradually to the basin until temperature was lowered to 18 degrees centigrade. The prawns were then packed in the refrigerated sawdust with a temperature of 15 degrees centigrade. These were placed in carton boxes lined with styrofoam board.

Some 300 grams of ice were sealed in a plastic bag and placed on top of the saw dust. The cardboard box was sealed with tape and kept at room temperature — about 28 degrees centigrade — for 24 hours.

When the box was opened the saw dust temperature was found to be about 17.2 degrees centigrade or only 2.2 degrees higher than when it was packed in.

After washing with seawater at a temperature of 18 degrees centigrade, the prawns were again placed in a plastic basin containing aerated seawater at 20 degrees.

Ninety-three percent of the prawn recovered and started swimming in the basin an hour later.

The significance of being able to ship live prawns is that they command a premium price, especially in the foreign market and particularly Japan. ●

Integrated crop . . .

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Potentials and Benefits

At present more than 4,800 ha of fish ponds are operating in Malaysia. An additional 24,300 ha could be developed for freshwater fish culture and it has been estimated that half of this, plus the existing 4,800 ha of ponds, could be utilized for integrated farming with crops and livestock particularly chicken, ducks and pigs. Several types of fruit trees and short term crops now popularly grown by local farmers could be integrated into the farming system. These include mango, banana, oranges, lime, cassava, *Colocassia* spp., *Ipomoea reptans,* sweet potato, and other leafy or fruit bearing vegetables.

As to the benefits from a tricommodity system, 71 percent of the country's population is rural-based. Eighty-eight percent of the household in the poverty group is in the rural areas and more than two-thirds of this is in the agricultural sector. It is this sector of the population that would be most benefited by a program to promote tricommodity integrated farming systems.

As there is a high concentration of small holdings below 10 acres (4 ha), a program that would fully and efficiently utilise available farm resources would definitely benefit the farmers.

Immediate benefits include a higher farm income, a higher availability of cheap source of protein for the rural dwellers, higher productivity among small land holders, and an increase in the supply of feeds for the farmer's livestock.

Program Proposal

There is at present no specific government program designed to provide incentives for farmers to adopt integrated farming systems, especially those involving three commodities. The program proposed by Mr. Ismail is in line with the recommendations of the Malaysian Agricultural Policy that has been promulgated by the Ministry of Agriculture. It includes the following recommendations:

The integration would include (a) fish-chicken-crop, fish-duck-crop, and fish-pig-crop culture.

For *fish-chicken-crop culture,* it is recommended that the stocking rate of chicken be 100 heads per acre (250/ha) per 4 months. The average weight of the chickens in four months is expected to be 1.8 kg. Stocking rate of fish per acre is as follows: (a) 5,000 *M. rosenbergii;* (b) 250 grass carp; (c) 120 big head carp; and (d) 100 Indonesian carp for a total of 540 fish per acre per crop (equivalent to 1,350 fish/hectare/crop). Fish is harvested every 9 months. A conservative production rate of one-half (0.5) ton per acre per harvest (equivalent to 1.25 tons/ha/harvest) is estimated.

Some short term crops may be integrated into this system such as cassava, kangkong *(Ipomoea reptans)* and banana. In this system, chicken manure is used to fertilize the crops and the fish ponds.

With *fish-duck-crop culture,* the recommended stocking rate is 100 ducks per acre per 4 months (250 ducks/ha) at 2 crops a year. Stocking rate of fish is similar to the fish-chicken culture system. Fruit trees, short term crops and vegetables may be cultivated. In Hongkong, it has been

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power is the ability of producers to restrain their productivity in the market when prices are down. She points out that small farmers in general would have little or no ability to withhold products from the market; they are in effect at the mercy of price fluctuations. On the other hand, she says, the large producers can withhold fish when prices are depressed which gives them relative freedom from market influences. In fact, the big farmers can even determine to a certain extent the direction of price changes by coordinating the selling of their fish harvest, Librero suggests. Thus, the medium and small producers are at the mercy of price changes and variations of supply and demand. They have to sell at current market prices since an in-flow of cash is imperative to pay wages and meet other monetary obligations, Librero explains.

Consequently, since a cash surplus is virtually absent and obtaining loans from private banks is not possible, small producers must continuously respond to market

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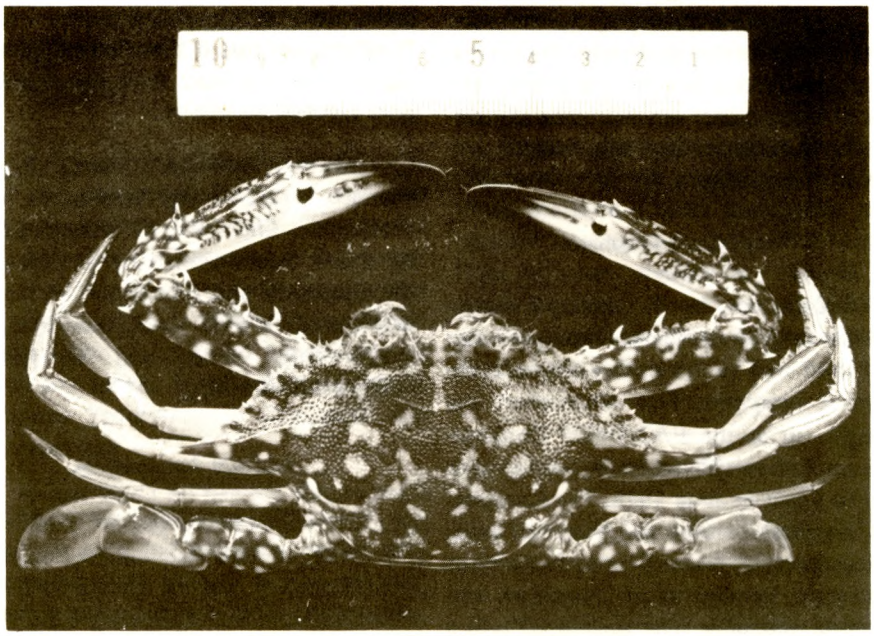
estimated that 2,000 ducks provide 30 tons of dropping annually.

In *fish-pig-crop culture,* the recommended stocking rate for pigs is 12 heads per acre (30/ha) of 2 crops a year. Stocking rate of fish per acre is as follows: (a) 50 grass carp; (b) 200 big head carp; (c) 100 silver carp; (d) 500 Lee Koh or *Cyprinus carpio,* for a total of 850 fish per acre per 9 months or an equivalent of 2,125 fish per hectare per 9 months.

The average weight of each pig after six months is about 130 *katies* or 214 kg. Crops recommended for integration include cassava, *Colocassia, Dioscorea, Ipomoea* and bananas. These are used for human food and livestock feed. ●

Edible Crustaceans in the Philippines*



12. PORTUNUS PELAGICUS **(HERBST)**

English name: Blue swimmer, Bluey or swimming crab.

Philippine name: Alimasag (Tagalog), Sugasuga (Cebuano), Kasag (Cebuano), Lambay (Cebuano), Lampay (Cebuano), or Dawat (Cebuano).

Carapace usually attains 7 cm in length and 16 cm in breadth including lateral and spines. It weighs about 200 g. Carapace is convex and covered with small granules. Frontal margin has four spines in addition to orbital spines, and antero-lateral border is armed with nine sharp spines including post-orbital spines which is characteristic of the genus *Portunus.* Chelipeds have strong spines and the surface is scabrous. The last pair of legs is flattened for swimming.

A striking difference in color is shown between male and female. When alive the ground color is yellowish green in female. In male it is decorated with an irregular blue network.

The crab lives on sandy or muddy sand bottoms from shallow brackish water to depths beyond 40 m. The edible crab is caught with crab traps, gill nets and trawlers from the interior portion of a bay to off-shore.

The species inhabits the Indo-Pacific waters from Japan, Philippines, Tahiti, Australia westward to Red Sea and East Africa.

It is commonly sold in fish markets at P25/kg. ●

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*by H. Motoh, 12th in a series

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pressures and are caught in the web of economic forces over which they have little or no control.

The large producer-small producer structure brings out another situation. While the large commercial operators should be able to contribute to the fish supply in urban centers and the export market, the small family enterprises could provide fish and cash income for the immediate family as well as the fish protein needs of the rural neighborhood. This spins off several policy questions, the more important ones having to do with the emphasis of government support, the priority targets of institutional services especially credit and extension, and the research and development focus.

Small-Scale Emphasis

Aquaculture, by its nature, is attractive for large investments although it can lend itself well to integration in rural development programs. This observation was brought up at the FAO/UNDP Consultation on Aid for Aquaculture Development held in Spain in June 1978. The Consultation emphasized that the thrust of developing countries be on the development of small-scale farming to be integrated into the rural economy. The success of such a pattern of development, however, would depend much on the support services provided to the producers such as extension services, production and distribution of inputs, and marketing, the Consultation report warned.

Necessarily, these services must be provided by the government. While technical assistance allows the development of large commercial farms, small family pond development is dependent on a well coordinated promotion-extension program designed for the small farmer.

Research Orientation

With policy biased toward the small farmer, research would then have to follow. Agricultural researchers in developing areas had been at one time or other criticized for consciously or subconsciously gearing their work toward the needs of the relatively more affluent farmers. Critics have repeatedly pounded on the apparent bias towards studies that tend to favor producers who can in the first place afford the recommended levels of management and material inputs. This situation, however, has gradually improved in several national research systems with the development of commodity-oriented research programs that pay particular attention to the small farmer and which had been planned and formulated with, not for, them. Before the reforms and reorientation, the only saving word that could be said about R & D efforts was that if they helped more the big producers at least they also made the poor farmers less poorer.

Recently, however, a new concept has emerged — technology verification — to provide the fine-tuning of research results to shape recommendations according to the capability and limitations of farmers as dictated by their social, economic, and environmental milieu and the farming systems they are using.

ASEAN Aquaculture

Developing countries have great potential fishery resources but these can be exploited only if there is an expectation of reasonable prices and economic growth in these countries, remarked Librero at a workshop on aquaculture development strategies for Asia. She was discussing aquaculture development trends and considerations for developing the industry for the rural poor.

She stressed the point that without the expansion of the distribution, handling and marketing systems, increased supplies would very likely bring down prices to levels unacceptable to producers. Market and distribution development would reduce inefficiencies and unsatisfactory marketing margins, she added.

Librero also reviewed aquaculture development trends in the ASEAN countries.

Indonesia. Indonesia's aquaculture production (11% of the total production of 1.4 million ton) has been constant from 1969-73. Brackishwater and freshwater yields have stayed at 51-53 thousand metric tons a year with average production of 935 kg/ha in freshwater ponds and 390 kg/ha in brackishwater ponds. Poor management techniques, low capital inputs and lack of other infrastructure account for the low production.

The government is encouraging rice-fish culture but the use of pesticides is causing some problems. It was learned that 8 out of 10 fishfarms in East Java are owned and operated as single proprietorship and utilized both for raising fish and making salt.

Forty percent of brackishwater ponds did not use fertilizers, did not stock with fry, and yielded only from 250-300 kg/ha a year; half were stocked with purchased fry but the farmers did not use fertilizer and produced 300-500 kg/ha a year; only 10% used modern techniques, applied fertilizer, protected against pests and diseases, stocked with fry and produced from 600-800 kg/ha a year.

Aquaculture in Indonesia has great possibilities for further development through area expansion and intensified utilization of present fishponds. Indonesia's potential area for expansion includes 1.76 million ha of freshwater swamps and flood plains, 27 thousand ha of small reservoirs, 3 million ha of paddy fields, and 6 million ha of brackishwater swamps and other tidal lands.

Malaysia. Although the fishing industry is not a major sector it is a significant source of protein, employment and foreign exchange. Fish represents almost two-thirds of the total meat and fish consumption. Eight percent of Malaysia's total 1973 production of 466 thousand tons was derived from aquaculture. There were some 8,900 ha devoted to fish culture. Seventy percent of the 7,300 ha of freshwater fishponds are in abandoned mining pools.

Most of the fish culture units — with an average area of one acre (0.4 ha) — are operated on a small non-commercial scale. About two-thirds of the fish farmers are Malays who are identified as belonging to the low-income group and described as living below the poverty line (M$25/household member). Aquaculture ih Malaysia has developed relatively much slower than marine fishing. In terms of employ-

ment, around 6,600 fish farmers are engaged in freshwater cultivation.

Existing constraints to aquaculture include inadequate seed supply, traditional techniques and management systems, fish shortage, diseases and predators, pollution and pesticides, lack of know-how in pond construction and engineering, and lack of technical personnel.

Singapore. Further development of inland water fisheries is hampered by the shortage of land. Intensive cultivation of fish in coastal waters, in cages or impounded areas has a limited potential. Singapore experiments however have shown high levels of productivity.

Thailand. Aquaculture output has expanded rapidly in recent years and in 1974 reached about 55,000 tons from 30,000 ha. In 1975 the total area for freshwater fisheries was estimated at 23,000 ha while about 12,000 ha was used for coastal aquaculture.

Production is expected to continue its rapid increase and is forecast to reach 223,000 tons by 1985. The total area available for culture is about 4.5 million ha of which paddy fields account for 4 million; large impoundments for 215 thousand; mangrove and tidal flats for 150 thousand; and ditches, irrigation tanks, rivers and canals for 155 thousand.

Librero cited a Kasetsart University case study on catfish to show trends and problems of freshwater aquaculture in Thailand. According to the study, catfish farmers were previously rice farmers, traders and others who, due to quick cash turnover, switched to fish farming even as they maintained their previous enterprises. The study showed that most farms were owned; average farm size was 0.42 ha.

Farmers used a high stocking rate of 657-2,000 fry per square wa (4 sq meters). This high fry density contributed only 20 percent to total cost but feed cost represented the major bulk of the expense — about three-fourths of the total cost.

Some farmers raised both catfish and snake head. But although the same type of feed was used, rearing time and feed conversion ratios were different. Fish farmers were faced with problems the most serious of which was disease, followed by low prices of produce. Other problems included the absence of market for the produce, rising feed cost and insufficient funds. These problems caused 50 percent of the farmers to give up their ponds. With high productivity they were still losing due to the limited market for catfish. The rapid increase in fish production resulted in excess supply, consequently reducing market price. Price fluctuation directly affected production and the income of fish farmers who reportedly harvested fish when the price was rather low.

A Davao fishpond owner attending the mobile training course airs problems on prawn broodstock development for SEAFDEC prawn researcher J. H. Primavera to recommend solutions to.

Philippines. Aquaculture contributes about 10% of the total fish catch. The total area of brackish water fishponds is around 176,000 hectares of privately owned and government-leased fishponds providing employment to some 150,000 fishpond laborers.

Present estimates indicate an annual yield of 600-800 kg/ha. However, techniques have been developed to increase output to three to four times as much. There is a wide variation in the productivity of fish farms among regions of the country ranging from a low 200 kg/ha to a high 2,500 kg/ha.

Venturing into fishpond operations tends to be tradition-bound with many of the operators becoming such because it was a family business. The average farm is approximately 16 ha, 13 ha of which are operational. The cultural techniques practiced in fishpond can be summarized as follows:

1. Almost all operators practiced past eradication. About three-fourths used pesticides either singly or in combination, and, generally, ponds were treated only once, usually prior to stocking;

2. Fertilizer was applied by two-thirds of the fishpond operators. Thirty-three percent used inorganic and 19 percent used organic fertilizer, while 28 percent used a combination of both organic and inorganic.

3. One-fourth of the fishpond operators supplemented the natural food in the ponds and the most common food supplement was rice bran;

4. About 71 percent stocked fry while 30 percent used fingerlings; large farms tended to stock fingerlings more often than the small farms. Fry was stocked at the rate of 6,000 per ha; fingerlings at 3,900 pieces per ha.

Two observations from these socio-economic studies emerged: (a) productivity per ha increased with size, but only up to 10 ha. After 10 ha productivity started to slide. Net returns per farm and per hectare had the same relationship, that is, as farm size increased the returns increased only up to 10 ha and then went down as farm size increased further; (b) privately operated fishponds had higher productivity than government-leased ponds. Further analysis however is needed in order to make definite statements with respect to farm size and ownership of fishponds, Librero concluded. ●

Some Socio-Economic Dimensions of Developing the Aquaculture Industry of Southeast Asia

While technology makes possible vast increases in the actual and potential yields of food species, social and economic factors make the production and supply of food a complex problem, especially in developing countries.

For one thing, socio-economic structures are dynamic. As the head of the Inter-American Development Bank Fisheries Section, Julio Luna, says, no one can forecast with certainty population growth or migration trend between the rural and urban areas nor easily anticipate income levels, purchasing power and individual preferences that the population of developing countries will be showing in ten or more years.

In aquaculture, the structure of the industry itself poses a great deal of strategy problems to planners. In the Philippines as well as in other developing Asian countries, there are, according to a Filipino economist, Dr. Aida R. Librero of the Philippine Council for Agriculture and Resources Research, three general categories of fish farmers: large producers who regard fishpond operation as their sole means of income and thus view aquaculture as big business; middle range producers whose knowledge of the ecosystem is marked by some reluctance but who nevertheless have a dominant concern for expansion; and the small owner-operators whose livelihood consists of operating fishponds and who harvest whatever is available by virtue of natural processes that govern coastal and tidal conditions.

As to their capability to adopt technology, the large producers are characterized by a high capital intensity and a finely developed scientific knowledge of fish culture, the medium-range producers — due to limited capital and inability to muster enough management inputs and skills — find it difficult to expand, and the small ones hardly go beyond the traditional farming methods and must support themselves through additional non-aquaculture activities.

Market Influences

The market forces obviously affect these three categories of producers in diffirent ways. Librero brings in the concept of withholding power to explain how the different categories of operators are affected by the market forces. Withholding

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AQUACULTURE TRAINING COURSES FOR 1980

Here is the list of short term non-degree training courses offered by the SEAFDEC Aquaculture Department for 1980. Courses in the international program are open to foreign participants especially those from SEAFDEC member countries as well as to Filipinos while those under the national program are offered only to Filipino participants. The tentative schedules are as follows:

International Program

1. Aquaculture Research Methodology
   March 3 to May 28
2. Aquaculture Management
   a. for milkfish, June 2 to July 25
   b. for prawn, August 25 to Oct. 17
3. Management and Operation of A Small-Scale Prawn Hatchery, November 3 to December 29

National Program

1. Prawn Culture, February 4 to 9
2. Small-Scale Prawn Hatchery Operation, July 28 to August 22
3. Mussel and Oyster Farming, (specific dates to be finalized)
4. *In situ* farmers' training courses, places to be identified and schedules to be set.

For the *in situ* program, fishfarmers' associations and other development groups or entities may send a formal request to the SEAFDEC Aquaculture Department if they would like to have such training conducted for their members or for the fishfarmers in their area of operation. This type of training is held where the requesting party may wish it to be held. Costs of the program are usually shared by the Department and the requesting association or group. For details and applications, write to:

J. A. Agbayani, Jr.
Head, Training Division
Institute of Aquaculture,
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