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Philippine Aquaculture Scenario Revisited *

Planners once thought that to improve the lives of people in communities it was enough to provide them with some money in the form of bank credit and knowledge about new production technologies. That view has been changing and rural development efforts in fisheries have been transforming into one geared towards the organization of resources and their management.

Most government organizations in charge of keeping fisheries development turning are abreast with the actualities of today's requirements. However, their capabilities to cope with the needs of the future are often restrained by lack of more definite knowledge about the outcome of what they make out of the present situation. Increasing production of protein food for the mass population requires that government and its adversaries prepare some form of forecast by which objectives and standards may be set based on accurate benchmarks.

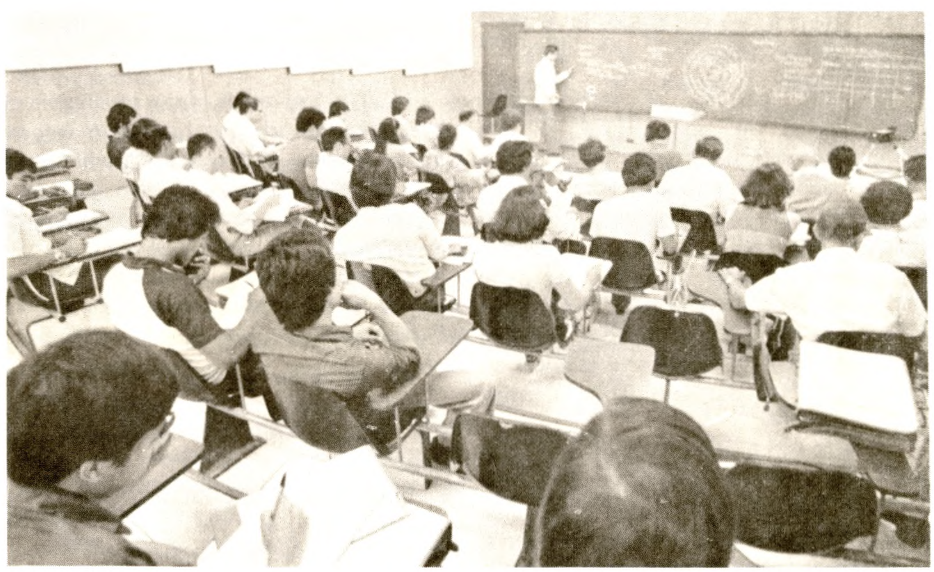
From a study I prepared 2½ years ago, a five-year scenario was projected based on the opinions of 20 Philippine-based experts in the field of aquaculture. The trends and tendencies emanating from the interview were obtained using the Delphi approach. This technique has the peculiar advantage of eliminating the bias of using the viewpoints of only one expert and of avoiding the bandwagon effect of majority opinion often found in panel consensus or conference-type discussions.

The methodology for a list of opinions begins with a first round of interviews wherein two questions are asked of the participants, namely:

(1) What do you think will be the most important technological development in the field of aquaculture, for brackishwater, for freshwater, for marine or seafarming, five years hence (1978 to 1982)?

(Continued on page 2)

*E.N. Encarnacion, Aquaculture Economist and officer-in-charge of the technology verification and packaging program, SEAFDEC Institute of Aquaculture.



The second offering of the Aquaculture Business Project Development and Management (APDEM) course was attended by 53 participants more than half of which are private fishpond operators and aquaculture investors. Participants started the 3-week program with an overview of the agri-business concept with Professor Edward Tayengco of SEARCA as resource speaker. SEARCA and SEAFDEC sponsor APDEM.

Research "Latebreakers"
on page 4

1. Milkfish matures in floating cage
2. Spawning of captive milkfish

Aquaculture Scenario . . .

(from page 1)

(2) What do you think will be the most effective means by which the technological developments in aquaculture (you have just stated) can be transferred, diffused, or disseminated to the end user?

As can be seen, the questions are and meant to be open-ended in order to elicit a broad range of responses. The responses of the experts are then analyzed for possible area of consensus. A consensus is deemed to have been reached if at least fifty per cent of the experts agreed. In areas where there are no consensus, a second round of interviews is conducted. It should be noted in this connection that the identities of the experts are unknown to each other to avoid premature influencing of the opinion making process.

In the second round of interviews, the experts are given copies of the opinions of the other experts and are asked to indicate areas of agreement or disagreement and their corresponding reasons. As in the first round, the source of opinions is kept anonymous. The responses are analyzed once again and areas of consensus are identified. Thus, this discussion outline includes the areas of consensus reached either in the first or second round of interviews.

We now proceed to a brief description of the emerging tendencies identified by the experts.

(1) Policies will determine the pace of aquaculture development in the next five years.

(2) The pattern of technological developments in aquaculture in the Philippines will be geared towards the task of achieving self-sufficiency in fish in the short-term, an import-substitution industry by itself. It will also involve the raising of farm income to upgrade the social conditions of poor fishfarmers in the long-term, a step ahead of building organized farming systems to support an export-oriented but still labor-intensive fishery industry.

(3) Milkfish farming will still dominate the scene and fishfarmers will look forward to increased productivity per unit area utilizing intensive farming techniques.

However, some fishfarmers will begin to look at other species. As more and more are drawn into the culture of high-priced species such as shrimps, prawns, crabs, etc., the government will not forget its social responsibility to the poor, but will provide more incentives to entrepreneurs who can culture low-priced species.

(4) Because the price of milkfish will not go down, it will be more difficult for the government to admit that milkfish is a fish for the poor. This means that research will be concentrating more on substitute species, such as tilapia and Asiatic carp.

(5) Milkfish spawning techniques may have been developed then, but adaptation by the private sector will not have commenced due to legal and standardization impediments; hence for fingerlings, fishfarmers will still depend on those caught from the wild by fry collectors and gatherers.

(6) Because hatcheries for milkfish spawning require large-scale capital investments, it will only be the government that can afford to establish hatcheries. Fry requirements of the industry will prompt the government to put several hatcheries in different parts of the country, but not necessarily for milkfish spawning alone.

(7) The beginning of the small-scale or backyard type shrimp hatcheries will be in the making, although these will not be very intensive at first.

Shrimps such as *Penaeus merguiensis, P. indicus* and *P. semisulcatus* maybe the more important species due to manageability in artificial breeding compared to *P. monodon.*

(8) In order to assure the fishpond industry with a steady supply of fry, the government will initiate several measures.

Intensified efforts at prohibiting the export of fry, and the establishment of nursery seed banks are expected.

(9) Better methods of growing fry to fingerling will be developed utilizing the use of intensive feeding, optimum aeration, and safer water management schemes for the production of milkfish fingerlings. This method will also be adapted for other species, with several variations based on the bio-physico-chemical properties of the species.

(10) Handling and transport techniques for fry and fingerlings will be perfected.

(11) New methods of aquaculture fertilization in fishponds will be discovered through the examination of the difference between the nutrient requirements of microscopic and macroscopic plants in the form of a ratio. Advancement in fertilization techniques will be concentrated on organic fertilization, recycling of wastes, and in the integration of agriculture with aquaculture.

(12) More farmers will practice supplemental feeding as a result of changing attitudes toward more efficient utilization of ponds through polyculture and multicropping.

(13) More fishfarmers will come to realize that the business of fisheries is not a survival thing, rather it should be run as a commercial enterprise. Intensification of production by the vertical use of ponds and pond bottoms will be practiced; this will greatly increase the multiplication of pond organisms leading to an improved fishfarm pond management.

(14) In spite of research innovations, there will still be a problem of standardizing aquaculture techniques. Consequently, private enterprise will be more involved in the efforts of the government in the rehabilitation and modernization of fishponds throughout the country because of the opportunities for fast profits.

(15) Fishfarmers will band together and will seek the help of technocrats. This means that fishfarm associations will be revitalized and their activities intensified to cover other functions such

(Continued on page 7)

Editor's Note

The article printed here was written in May 1978 originally as a term report when Mr. E.N. Encarnacion was still a scholar at the University of the Philippines. Since then, it has been used as a basis for papers at the SEAFDEC International Training Programs and in the APDEM workshop to enlighten trainees on the prospects of the aquaculture industry. To bring the article up to date, the author adds a retrospective commentary in which he considers the realization of most of the predictions found in the original paper. He describes and interprets how an unbiased consensus-making body could forecast trends more accurately than other methods of qualitative analyses.

ANNOUNCEMENTS

Giant Prawn Conference a Success

Dr. Michael New, FAO Senior Fisheries Biologist (Aquaculture) in Thailand reported a very successful international conference on Macrobrachium farming. Thirty-five countries mostly from the equatorial belt were represented by 163 registered participants as well as a number of observers, he said. This number plus 200 others mostly Thai fishfarmers who attended and vigorously participated on the Thai-speaking conference day makes Giant Prawn 1980 international conference one of the largest single species international aquaculture meeting ever held, reported Dr. New.

Abstracts of the 56 papers presented in or submitted to the conference are available at a price of US $10 to cover printing and postage, it was announced. Write: Giant Prawn 1980, c/o UNDP P.O. Box 618, Bangkok 2, Thailand.

The conference was held in Bangkok on 15-21 June. It was hosted by the Royal Thai Government's department of fisheries, Ministry of Agriculture and Cooperatives and co-sponsored by the International Foundation of Science, the FAO-UNDP South China Sea Fisheries Development and Coordinating Programme, the FAO-UNDP Programme for Expansion of Freshwater Prawn Farming in Thailand, the FAO Regional Office for Asia and the Pacific, and Rockefeller Foundation.

Trout Farming Manual

The TROUT FARMING MANUAL written by Dr. John P. Stevenson and a review of which was printed in the April 1980 issue of Asian Aquaculture is available from Fishing News Books, 1 Long Garden Walk, Farnham, Surrey, England. Price is £9.75 and 95p for post/packing.

The Induced . . . *(from page 5)*

Table 1. Summary of induced breeding experiment

Fish No.	1	2
Estimated (actual) body wt (kg)	3(3.7)	4(3.4)
Initial egg diameter (mm)	0.80 ± 0.04	0.76 ± 0.02
Date of 1st injection	7/24/80	7/28/80
Time	0930 hrs	2000 hrs
Dosage	30 mg SPH + 10,000 I U HCG	40 mg SPH + 5,000 I U HCG
Date of 2nd injection	7/25/80	7/29/80
Time	1930 hrs	2000 hrs
Dosage	30 mg SPH + 10,000 I U HCG	40 mg SPH + 10,000 I U HCG
Date of stripping	7/25/80	7/30/80
Time	0930 hrs	1st stripping: 0800 hrs
No. of eggs	(There were about 600,000 eggs but only 24.4% were fertilizable)	6,500 eggs
Fertilization rate		8.6%
		2nd stripping: 1000 hrs
		96,100 eggs
		38%
		3rd stripping: 1200 hrs
		95,200 eggs
		10%

Note: About 319,200 eggs were spawned in the tanks.

Literature cited

Juario, J.V., M. Natividad, G. Quinitio and J. Banno. 1979. Experiments on the induced spawning and larval rearing of the milkfish, *Chanos chanos* (Forsskal) in 1979. Aquaculture Dept. SEAFDEC, Quart. Res. Rept. 3(2):1-3.

Juario, J.V., J.E. Banno, G.F. Quinitio and M. Natividad. The effect of exogenous hormone treatment on milt consistency in newly caught mature milkfish. (In press).

Kuo, C.M., C.E. Nash and W.O. Watanabe. 1979. Induced breeding experiments with milkfish, *Chanos chanos* (Forsskal), in Hawaii. Aquaculture 18: 95-105.

Lacanilao, F. and C. Marte. 1979. Sexual maturation of milkfish in floating cage. Manuscript.

Liao, I.C. and T.I. Chen. 1979. Report on the induced maturation and ovulation of milkfish *(Chanos chanos)* reared in tanks. Tenth Annual Meeting, World Mariculture Society, Hawaii, 22-27 January 1979.

Tseng, L.C. and S.M. Hsiao. 1979. First successful case of artificial propagation of pond-reared milkfish. China Fisheries 320: 9-10 (In Chinese).

Sexual Maturation of Milkfish in Floating Cages *

Milkfish kept in floating cage have sexually matured. This occurred at the SEAFDEC Aquaculture Department's Igang Substation in Guimaras Island off Iloilo Province in central Philippines in July 1980. They were 3.5-5.5 years and weighed 2.1-3.8 kg, with ovary of 63-199 g and testis of 13-64 g. Fecundity was about 600,000. Spontaneous spawning in cage happened on August 3 and 7, and developing eggs were collected. Resulting larvae are presently being reared. Subsequent developments important in aquaculture research and practice are suggested.

The floating cages (3-10 m diameter by 2-3 m deep with nylon netting) are located on a 7-m deep water with sandy-muddy bottom, and protected from the open sea by small islands. Annual ranges of temperature and salinity were 25-31 C and 28-35 ppt. Ranges for March-July were 27-30 C and 30-34 pp. Transparency was 2.5–4.5 m.

The maturation occurred in a 10-m diameter by 3-m deep cage (3-inch mesh netting) with 108 fish. The fish came from a nearby tidal cove (2.8 hectares, 1 to 3 m) which was enclosed and stocked with milkfish juveniles from ponds in 1975-1977. In March 1979 some 630 fish were recovered from the cove and 352 were stocked in the cage. Average weight was 1.3 kg. They were fed twice daily at 1.5% of body weight with commercial fish pellet containing 26% protein. While in the cove they were occasionally fed with the same feed. In June 1979, the feed was changed to Crustacean Feed Pellet (42% protein, manufactured by Universal Robina Corporation, Metro Manila) given at the same rate. Some fish were removed from the cage and transferred last October, December, January and March reducing the number of fish to 108. The remaining fish were not subjected to any handling stress since March 1980.

Sampling for gonadal development was done on the 12th, 23rd, and 28th of July 1980 using speargun or hook and line. These did not excite other fish in the cage. A total of 27 were sampled (including two mature females and one mature male which were turned over to Dr. Juario's sabalo breeding team for induced spawning experiment). Gonads or eggs samples were processed for histology. The results are summarized in Table 1.

(Continued on page 6)

* Reported by Dr. Flor Lacanilao and Ms. Claire Marte, researchers, Milkfish Broodstock subproject, SEAFDEC Aquaculture Department, Tigbauan, Iloilo, Philippines.

The Induced Spawning of Captive Milkfish

Attempts have been made to induce spawning of milkfish reared in ponds and concrete tanks (Kuo et al., 1979; Liao & Chen, 1979; Tseng & Hsiao, 1979). Only Tseng and Hsiao were able to fertilize eggs from an eight year old mature female from which were obtained about 120 larvae. This report summarizes the induced spawning experiments on milkfish that have sexually matured in floating cage (Lacanilao & Marte, 1980).

On 23 July, one female and on 28 July, a male and a female were transported from Igang to Tigbauan by Dr. F. Lacanilao. The fishes were sexed by exteriorizing gametes through a polyethylene cannula and the stage of maturity of the eggs was determined from their average diameter. Since the average egg diameter from both females was greater than the critical diameter beyond which spawning injection is effective (Juario et al., 1979; Kuo et al., 1979) both females were used for induced spawning experiments. The milt withdrawn from the male was viscous and sperm motility was low; so the male was injected with 1 ml of Durandron Forte '250' (Organon). Juario et al., (in press) observed that 12 hours after injection of 1 ml of Durandron Forte '250', a long acting androgen, the milt of newly caught wild males becomes thin and copious, sperm motility increases and the males are maintained in good "running" condition for a maximum of 8 days.

The reaction of the experimental fish to hormone injections are shown in Table 1. The same dosage found to be effective in inducing wild adult milkfish to spawn was used. For Fish 1, a time interval of 12 hours between injections was used; for Fish 2, 24 hours, since the latter was found to be in good condition. Both females responded to the hormone injections; based on fertilization rates or number of fertilizable eggs, the response of Fish 2 was apparently better. Fish 1 was stripped of its eggs about 12 hours after the second injection. Only 24.4% of the stripped eggs were transparent and fertilizable; the rest were semi-transparent and opaque. The eggs were not fertilized since there was no male. Fish 2 was stripped three times at 2-hour intervals – 10, 12, and 14 hours

Jesus V. Juario and Marietta Natividad, fish hatchery project leader and milkfish project coordinator, and research associate, respectively, SEAFDEC Aquaculture Department.

The Induced . . . *(from page 4)*

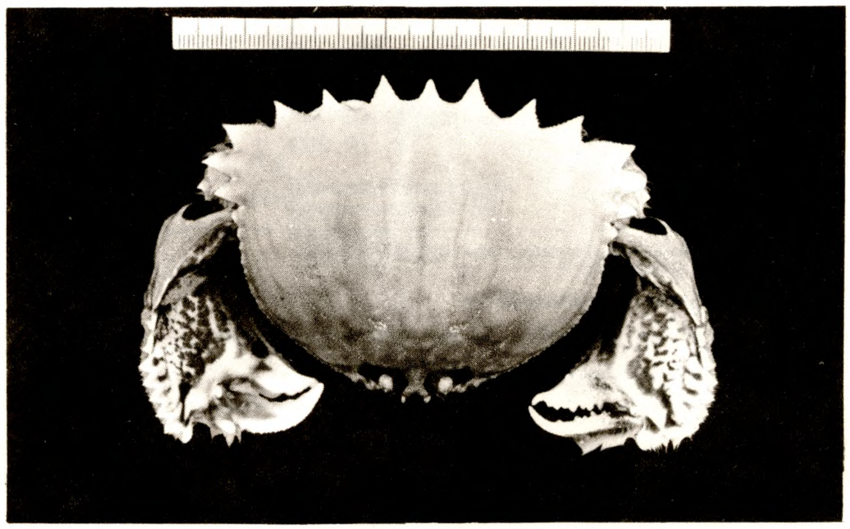
after the second injection. A plug was inserted through the genital pore after partial stripping to prevent further release of eggs. Fertilization rate was highest (38%) among eggs stripped 12 hours after the second injection. Since we had only one male, before stripping, the male was sacrificed; its testes were removed and the milt was extracted and mixed with 50 ml of Ringer's solution. The suspension was then used to fertilize the eggs that were stripped at 2-hour intervals. Hara (personal communication) found that milkfish sperms could be kept viable and motile in Ringer's solution and could fertilize eggs if stored in the refrigerator at 5°C for at most three days.

Most of the fertilized eggs that were stripped at 0800 and 1200 hours stopped developing at the blastula stage; a few of them reached the yolk plug and primitive streak stage. Those that developed further did not hatch. On the contrary, only a few of the fertilized eggs that were stripped at 1000 hours developed to the blastula stage only. A number of them developed to yolk plug and neurula stage and about 50% developed even further. However, of the 36,000 that were fertilized and were developing, only 86 larvae hatched out. Tseng and Hsiao (1979) had similar observations. They obtained only 120 larvae from the so many eggs that were fertilized and were undergoing development. According to them, there were many eggs with embryo but these failed to hatch; furthermore, they obtained a number of abnormal larvae. It could well be that this very low hatching rates is indicative of poor egg quality. The effect of different diets for milkfish broodstock on the hatching rate of fertilized eggs should therefore be evaluated in the future.

The larvae are now being reared using Brachionus alone from day 3 to 10. Results of larval rearing experiments in 1979 and 1980 show that it is not necessary to use the trochophore larvae of oysters to obtain better survival. In fact Natividad observed that introduction of oyster larvae to the rearing tanks hastens deterioration of water quality.

(Continued on page 3)

Edible Crustaceans in the Philippines*



21. *Calappa philargius* (LINNAEUS)

English name: Box crab

Philippine name: *Kumong*

The carapace length, about two thirds of its width, reaches some 10 cm. The clypeiform expansions of the carapace give this crab a very peculiar appearance. Four pairs of walking legs are completely concealed in flection. The chelipeds are very large and compressed and can be held close against the front of the body.

A large tooth on the movable finger of the right cheliped is used to break gastropod shells to eat its contents. Generally, box crabs belonging to the genus *Calappa* are characterized by a remarkable wing-like or clypeiform expansions.

The colors in life are as follows: ground color yellowish purple; a remarkable purple ring encircling the eye socket; a prominent violet spot on carpus and propodus of each cheliped.

The habitat of this crab is sandy to gravel-shell ground down to 100 m deep.

There is no existing fishery for this crab; it is usually caught accidentally by gill nets, baby trawlers or small push nets. It is eaten by rural people, particularly at Aparri, in the northern tip of the Philippines.

This crab distributes from Japan through Korea, Taiwan, Philippines, Java, Singapore, Mergui Archipelago, India, to Sri Lanka, Persian Gulf and Red Sea. (Scale represents 10 cm).

* by Mr. H. Motoh; 21st in a series

Sexual Maturation of . . . *(from page 4)*

Table 1. Summary of maturation data of 27 milkfish sampled in July 1980 from a 10-m diameter by 3-m deep floating cage with 108 fish of 3.5-5.5 yr.

	Number of fish sampled						
	Immature		Maturing		Mature		Total
	F	*M*	*F*	*M*	*F*	*M*	
1. July 12			6	1	1	1	9
2. July 23	1	0	3	0	2	1	7
3. July 28			1	2	5	3	11
TOTAL	1	0	10	3	8	5	27
Mean BW (kg)	2.3	--	3.4	2.8	3.3	3.0	
Mean GW (g)	5.3	--	16.3	6.5	101.1	29.0	
Mean GSI (%)	0.23	--	0.49 (.32-.75)	0.23 (.09-.41)	3.33 (.99-7.15)	1.19 (.45-.3.05)	
Maximum Oocyte Diameter (mm)	0.15		(. 0.34 (.24-.48)		0.71 (.55-.85)		

Fecundity (Estimated from four mature fish = 545,000– 923,000

Immature: Perinucleolus or spermatogonia

Maturing: Yolk vesicle to secondary yolk stage or active spermatogenesis.

Mature: Tertiary yolk stage or spermatozoa-filled testis

The percentage of mature fish increased as the date of sampling progressed: 2 out of 9 on the 12th of July, 3 out 7 on the 23rd, and 8 out of 11 on the 28th. Additional samplings will be made on the remaining 81 fish in the cage this month. Meantime egg collectors have been set inside and outside the cage.

The two peaks of natural spawning season in the area are April and September (Kumagai, personal communication). The expected spawning of the fish in the cage, therefore, approximates the second peak of spawning season. It is also possible that the stock could have matured for the first spawning peak had they not suffered handling stress last March when some fish were transferred out of the cage.

Previous reports of sexual maturation in captive milkfish were in concrete tanks (Liao & Chen, 1979; Tseng & Hsiao, 1979) and coastal ponds (Kuo et al., 1979). These however, obtained low maturation rates (in tanks), very low incidence of induced spawning and fertilization (in tanks and ponds), and only one successful hatching (in tanks). The fish mature much older (5-8 years in tanks).

These new results that were obtained at SEAFDEC may clear the way for some important developments in aquaculture research and practice:

(a) Refinement of induced spawning technique, presently hampered by limited supply of wild spawners, can now move faster using spawners from broodstock. However, if mature fish spawned in the cage, induced spawning of milkfish may no longer have practical relevance.

(b) The simple requirements in the development of milkfish broodstock at SEAFDEC's Igang Substation should encourage research institutions and innovative fish farmers throughout the region to establish their own. This would accelerate the development of simplified technology for propagating captive milkfish.

(c) The indicated near-100% maturation of caged milkfish (Table 1) younger than captured spawners may insure a year-round supply of seeds if these are stunted in ponds, as practiced by local farmers. Consequently, induced maturation of milkfish may also lose its practical importance.

(d) Mature milkfish can be released from cages and may breed in the vicinity to help increase local fry catch. Some fish that got out of our cages after month of domestication continue to stick around the milkfish broodstock farm.

SEAFDEC's Igang Substation has milkfish stock of various ages. There are about 150 more of the same mixed stock of 3.5-5.5 years old being used for other experiments. Other stock are now 2.3 years (770), 1.3 years (320), and 5 months old (350). These include the milkfish that were the products of artificial breeding at the SEAFDEC Tigbauan Research Station in 1978 and 1979.

Literature cited

Liao, I.C., and T. Chen. 1979. Report on the induced maturation and ovulation of milkfish (*Chanos chanos*) reared in tanks. Tenth Annual Meeting, World Mariculture Society, Hawaii, 22-27 January 1979.

Kuo, C.M., C.E. Nash, and W.D. Watanabe. 1979. Induced breeding experiments with milkfish, *Chanos chanos* Forsskal, in Hawaii. Aquaculture 18:95-105.

Tseng, L.C., and Hsiao, S.M. 1979. First successful case of artificial propagation of pond-reared milkfish (in Chinese). China Fisheries 320:9-10.

Staffing . . . *(from page 8)*

chickens (layers and broilers) and 20,000 hogs. The owner and his family live on the farm with some hired help.

The same concept has been practiced by one fishfarmer here in Zarraga, Iloilo, Philippines. The center of the pond area is traversed by a wide water supply/ drainage canal and along both sides of the canal are wide dikes, one used as the farm road and the other used to establish a piggery for 2,000 hogs and a feed mill. Biogas digesters have been put up to produce gas for lighting and cooking purposes, and the digested manure is used to fertilize chlorella ponds and the fishponds. Milkfish and shrimps are grown in these ponds. The owner is versatile and has a wide range of expertise so that he runs the complex with only a few caretakers and helpers. The owner has also a shrimp hatchery and nursery complex in Tigbauan, Iloilo which is run by a son who had been trained in Japan.

2. Fishpond, salt, artemia, and sugar farm complex

The writer has a 68-ha sugar farm in Barotac Nuevo, Iloilo. Adjacent to the

(Continued on page 7)

Aquaculture Scenario . . . *(from page 2)*

as distribution of fertilizer, feeds, fingerlings and technology.

(16) More cooperative-type fishpond estates will be established with government support mainly in economically depressed areas, similar to the agricultural Masagana 99 Program.

The scheme will work out because there will be a steady supply of technical support coming from the Rural Service Program of the government service, and soon from the private sector.

(17) Corporate farming will not develop unless a suitable area of at least 500 hectares can be made available to new investors. Delays in the issuance of Fishpond Lease Agreement will deter the advancement of the industry.

(18) Rice-fish culture and the stocking of tilapia in dams, reservoirs and fish cages will begin to take roots.

This will initiate an awareness among fishfarmers on the importance of fishpond engineering and design.

(19) The main thrust in seafarming will still be on oysters, mussels and seaweeds since these are all low in the food scale. The absence of proper hatchery techniques for marine species will hinder the expansion of seafarming in the Philippines.

(20) Land reform will not work in the fishpond industry. The government will not step into the business of less productive fishfarmers since it cannot manage consolidated fishpond estates.

This means that the government will only use moral persuasion to collectively integrate the small operators with the more successful large farmers.

(21) There will be a more stable and efficient marketing service to be offered to fishfarmers. This assumes that if the government will not be able to solve the marketing problems, the private sector will take over since this is also a highly profitable venture.

However, marketing infrastructures and marketing services will be concentrated at two to three fronts: one in Metro Manila to service the Central Luzon and Southern Luzon fishfarms, another in Western Visayas, and perhaps another in Central Mindanao. Thus, other regions will still experience marketing problems.

(22) In spite of the shortcomings in technology and management, the countryside development program relentlessly pursued by the government will show significant impact.

In five years, the fishpond industry picture will have to change; its production will grow by at least 6 per cent annually even as there will be signs of yield improvements in selected regional areas.

(23) Since the industry will show signs of recovery, more investments will be channelled towards integrated agro-fisheries business.

Here, technocrats will be more concerned with reducing risk exposure; banks will look more for the feasibility aspect rather than at collateral orientation; and fishfarmers will be more receptive in reporting their true and honest income due to outlook in economics of production.

(24) The Bureau of Fisheries and Aquatic Resources will improve its statistics, but only as a result of its linkage with other government, private and international organizations which are interested in contributing to Philippine fisheries development.

(25) Unlike the technological developments in cereal research, the task of selected breeding and hybridization of aquatic species will take a long time to develop, except for tilapia.

(26) Technology transfer will improve starting with a closer look at the proliferation of functions of agencies and the eradication of professional jealousies between research, extension and administration officials.

A stronger linkage between research and extension will soon develop, and there will be common directions and efforts.

(27) Technology packages for the fishfarmers and extension workers will be prepared jointly and solidarily by various government and private agencies.

These will not only take the form of a manual for fishpond operation, but will integrate all other inputs and services such as fry, fertilizer, pesticides, booster feeds, consultancy and credit.

(28) Although technology transfer methods will take many forms — from mass communication (radio, TV coverage), demonstration centers, lecture-seminars, training-workshops, to direct extension work — different types of fishfarmers will receive different combination of dissemination services.

(29) The extension service of the Bureau of Fisheries and Aquatic Resources will still be concentrating on the average fishfarmer, inspite of the national concern for the poorest sector of the population.

The small-scale fishpond operator who is inefficient and ineffective will be relocated under the fishpond estate program, or else, he will join other government country-side development programs.

(30) Capitalism will be allowed to come in with the establishment of more corporations engaged in aquaculture business ventures; but there will always be safeguards to control the growth and expansion of large scale integrated firms.

End of Part I

Next issue: **Retrospective Commentary**

Staffing . . . *(from page 6)*

farm is a 120-ha fishpond and 4-ha salt pond with a salt factory that produces industrial grade salt by the boiling process. The factory burns sugar cane tops, stubbles, and bagasse for fuel. The salt ponds concentrate the brine for the salt factory at the same time produce *Artemia* eggs and live animals for fish food. The fishpond produces milkfish and some shrimps. A poultry and piggery complex will complete the integration because manure which is needed in the ponds for natural food culture has gone up in price. Besides, biogas to be produced from digesters will save fuel costs. The sugar farm is operated by a manager and 3 supervisors. There are four tractor drivers and 2 truck drivers to run the machines serving 3 sugar farms and 2 fishpond areas (another 42-ha in the same municipality 3 km away). One backhoe digger serves the farms and the fishponds on road and canal maintenance. The tractors are used to pull trailers carrying fertilizers and other materials to the ponds, while the trucks are used to transport fish from the ponds to Iloilo City for packing and shipment to Manila, and to transport materials from the city to the farm. The big constraint in the operations is lack of electric power lines to connect with government power sources. The farm has to put up a 30 kw. generator and a smaller standby generator of 9 kw. The ponds have their own managers and caretakers (1 for every 10 ha). Production is scheduled so that the harvests from the two ponds alternate every month or two. *Artemia* and shrimp prices have become attractive that the salt factory may be converted into a hatchery, nursery and processing plant for feeds, fish, shrimp and *Artemia* eggs.

(End of Series)

Staffing of Aquaculture Business Projects*

(2nd and Concluding Installment)

Integrated hatchery, nursery and grow-out

This is a complicated operation. Regardless of size, the minimal number of personnel required will be:

1 manager; 3 hatchery technicians; 1 biologist with 3 helpers; 2 engine mechanics; 1 electrician; and 3–6 helpers in the hatchery.

These people will be able to operate a hatchery with a production capacity of 0.5–2 million postlarvae per month. As capacity is increased, the number of personnel proportionately increases. The nursery system will require a minimum of 3 supervisors and 3 helpers. Casual labor may be employed on daily basis to help in feeding and water exchange. One supervisor and 2 helpers will be needed to take care of broodstock culture or procurement. In areas far from sources of wild broodstock, a medium size shrimp trawl should be operated to assure constant supply of gravid females for the hatchery. The trawl may be manned by a master fisherman, an engineer and two crew members. The grow-out ponds will be operated by 2–4 supervisors and caretakers (1 caretaker per ha). The caretakers also serve as security guards. Casual labor will be hired as needed. A marketing supervisor takes care of packing, transport and sale. If processing is incorporated in the complex, the marketing supervisor will also be in charge of processing with the help of hired casual labor, with 1 assistant as a back-up. Some projects are designed to have daily harvests and daily stocking of postlarvae. A processing and cold storage plant will be needed for this type of operation.

A model 15 ha complex should have the following personnel:

1 – manager
3 – hatchery technicians
1 – biologist
3 – assistants to hatchery technicians
2 – assistants to the biologist
1 – broodstock supervisor
2 – helpers to broodstock supervisor
3 – engine mechanics (if electric power is available, 1 engine mechanic and 1 electrician will suffice)
1 – electrician
1 – nursery supervisor
3 – nursery assistants
1 – marketing specialist
10 – 12 – caretakers

The economy of scale will apply as hatchery, nursery and grow-out production capacity is increased. Should the project intend to manufacture its own feeds, the additional personnel needed are: 1 nutritionist, 1 assistant, 3 machine operators (hammermill, mixer and extruder), 3 oven-drier operators, and 3 helpers.

Integrated Farming Systems

1. Fish-livestock

Some enterprises have integrated fish culture with animal husbandry. In a small scale operation, a pond operator may run an area of from less than one hectare to 5 hectares with 2–3 helpers. The number of animals will not be many as to need more personnel. Around 18 pigs or 300 chickens have been calculated to produce enough manure to fertilize 1 hectare of fishpond for a year. Small pond areas are usually located away from electric power sources and it may be economically feasible for a small enterprise to put up its own power generating set. These enterprises are the "hit or miss" type, depending on the expertise of the owner.

A truly commercial project will cover an area between 25–200 ha. The number of chickens and/or hogs will depend on the project concept. A number of these projects are found in Taiwan. One project consists of 25 ha out of which 10 ha are 2-meter deep fresh water ponds stocked with different species of carp and tilapia. The project has its own feed mill, and the ponds have been designed into rectangular modules with very wide dikes. On the edge of the dikes are the chicken houses and pig pens. Manure collected daily drops into the ponds without predigesting. The ponds produce 6 tons/ha of fish and the farm has a population of 2 million

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