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ALL FOR A SMALL FRY

It has been six years since the go signal was given to start one of the most intensive research programs inside Southeast Asia on any single aquaculture species. The milkfish research project, launched in 1975 and considerably boosted by an initial US $826,000 IDRC (International Development Research Centre) grant and still ongoing with a 3-year renewal term backed up by $ 421,000 more, is being undertaken by the Aquaculture Department of the SEAFDEC. Its main purpose is to "ensure an adequate and reliable supply of milkfish fry, in addition to those gathered from natural sources, and extend and stabilize the period of fry availability throughout the year." The realization of this objective rested mainly on the domestication and breeding of adult fish.

What has been done so far? Here is a brief review of the highlights on milkfish breeding work at the SEAFDEC Aquaculture Department from 1975 to the present. Actually 2 highly significant scientific events have occurred: (1) induced spawning and artificial fertilization of captured wild adult milkfish breeders and (2) natural sexual maturation and spontaneous spawning in cages of pond-grown milkfish that have been kept in captivity since they emerged as fry.

Of the first achievement, Dr. Q.F. Miravite, former executive director of the Aquaculture Department, in a report to IDRC, wrote that the project started virtually from scratch as there was very little known of milkfish except for some earlier morphological studies. The scientists in the project, Miravite relates, were faced with very basic questions such as where and how to catch a milkfish breeder (sabalo) alive and, having caught one, how to keep it alive in captivity, how to handle a 6-10 kg extremely wild fish without injuring it, how to distinguish sex, what to feed captured fish, and most importantly — what kind of hormone(s) and how much should one use to induce spawning.

During the 1976 spawning season of sabalo, 259 adult milkfish were collected

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Fry gatherers off the coast of western Iloilo in Panay Island. In the Philippines and Indonesia, thousands of them take to the waters with a variety of fry gathering gears "winnowing the sea in timeless fashion." Inset: bangos postlarva, 72-hrs after hatching, yolk completely absorbed and with a speck of food items seen in gut.

ALL FOR A SMALL FRY . . .
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of which 19 percent died of injuries sustained during capture and transport. Of the survivors, 16 were injected with purified salmon gonadotropin. Two females ovulated and produced hydrated eggs. The eggs could not be fertilized because none of the male sabalo responded to treatment and thus produced no sperm.

In April 15, 1977 the first artificial fertilization of milkfish eggs anywhere was achieved. The fertilized eggs were incubated and the resulting larvae were reared to fingerling stage, past the critical period which researchers have established to be the first 56 hours from hatching. This was made possible by the discovery of proper feeds on which the milkfish fry could be sustained after they exhaust their yolk and become independent. Only 37 reached fingerling stage out of a few thousand fertilized but it proved that milkfish could be bred in captivity. During the 1978 season, researchers were able to carry 38,000 fertilized eggs through the larval stage and many of the fingerlings produced from this trial are now being reared in earthen ponds at the Department's brackishwater research station in Leganes, Iloilo.

When and if these artificially bred fish sexually mature – researchers expect this to occur by 1981 when they shall have been more than 3 years old – the milkfish life cycle shall have turned the full cycle under completely controlled conditions.

Meanwhile, a parallel course towards the same objective was set at just about the same time the artificial breeding program started. Milkfish researchers thought that the fish may not be able to mature sexually in captivity. At least it has never been observed to do so. To find out, a young researcher, Alfredo Santiago, Jr, who was then in-charge of the Igang substation set up maturation pens for prawn and milkfish in the sheltered coastal waters of the area. First, he brought in pond-grown prawns from the Leganes brackishwater station. This was in April 1975. Subsequent stocking of prawns was continued through 1976. Then, in May 1975, he stocked the first 258 milkfish grown also at the brackishwater ponds of the Leganes station. Over the next three months, six more batches of similarly pond-grown milkfish were stocked until there were 840 of this initial "captive broodstock."

In the meantime, the prawns (*Penaeus monodon*) that had been stocked in the maturation pens seven months before were found to have matured and spawned in captivity. This was the first such observation on prawn and spurred by what happened with the crustaceans and hoping that the milkfish may do the same thing, Santiago brought in a second age group of fish the following year. By February 1976, 947 milkfish have been successfully stocked from this group. In July 1976 a third and final batch of 478 fish was put in and the long wait commenced. Mature sabalo that have been captured were determined to be 5 to 7 years of age. This then would be the period that the SEAFDEC workers were prepared to wait before the captive fish provided any hint as to whether or not they would mature sexually in captivity.

In the meanwhile, Santiago left on a study grant to take up a doctoral program in fishery. The one who took over released all the fish in the penned cove so that the batches which were of different age groups got all mixed up.

Meanwhile, SEAFDEC engineers and biologists who had been purposely sent to Japan to train in fish broodstock maturation and cage culture technology arrived and started, in August 1977, working on a design for a floating cage to contain the captive broodstock. Several circular cages were built and floated by July 1978. Into these cages were transferred all the milkfish that were then scattered all over the cove.

The substation manager at this stage was researcher Adriano Atencio and the cage designers were Engineers O.K. Yu and A. Vizcarra and biologist H. Sitoy.

In April 1979, a fishery scientist, Dr. F. Lacanilao was contracted by IDRC as fish physiology expert under the second phase of the IDRC-assisted milkfish research project. He took over management of the Igang substation and leadership of the milkfish broodstock subproject.

In the meantime, experiments on hormonal manipulation were started. The object of the trial was gonadal maturation. Some of the stock were not treated. In other words they were left as control.

In August this year, the captive milkfish stocked between April 1975 and July 1976 "came of age." It was later observed that the untreated specimens or the controls were the ones that spawned spontaneously, which is to say, without human intervention.

This significant achievement – discovery may be a more precise term – has been the result of various team and separate individual efforts that spanned a period of over five years. The series of stages that led to the discovery could be compared to a staircase in which the next step is built on the previous one. The result proved that milkfish could mature in captivity, or despite captivity. The significance of this to research is enormous. They showed that high level expertise, sophisticated technology,

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Fry gatherers separate the almost invisible fry from debris and other organisms.

REQUIREMENTS FOR THE DESIGN LAYOUT AND CONSTRUCTION OF A PRAWN HATCHERY *

This has been written from the viewpoint of a biologist as a guide to engineers on what to consider in the design and construction of a prawn hatchery. For instance it does not give specific recommendations on pumps and pipe sizes as these are relative to the type of installation desired and the peculiarities of each site and would best be determined by an engineer. Generally, while engineers are well versed on structural aspects of construction, it would be useful for them to have an appreciation of the constraints imposed by the biological requirements of the organism being cultured or the procedures in hatchery operation — unless of course they have also been trained in the relatively new field of aquaculture engineering. An ideal hatchery would be the output of close coordination between a hatchery technologist and an engineer.

Larval Rearing Procedures

Gravid prawns obtained from the wild or from a captive broodstock are allowed to spawn in small spawning tanks. The eggs are either allowed to hatch in the same tanks after washing or collected on a filter screen and transferred to a hatching tank. The newly hatched larvae called nauplii (singular: nauplius) are then stocked at a predetermined density in larval rearing tanks.

Nauplii initially subsist on stored food reserves, but on the third day as they reach the zoea stage they start to feed. At the start, food consists of microscopic, one-celled marine algae (phytoplankton) of which two main types are in use — diatoms such as *Chaetoceros* and *Skeletonema* and flagellates such as *Tetraselmis.* The phytoplankton could be propagated either in the same tank as the larvae by adding minute amounts of nutrient chemicals and starter culture or in separate algal tanks of similar capacity as the larval rearing tanks. Fishfood in these algal tanks may be concentrated through sand filters (in the case of diatoms only) or pumped directly to the larval rearing tank. On the ninth day the larvae would have metamorphosed into the mysis stage. Zooplanktons are now added to their diet. Most popular is *Brachionus plicatilis* which belongs to a group of animals known as rotifers. Higher survival is obtained if nauplii of the brine shrimp (*Artemia salina*) is added to their diet during this stage.

On the 15th day postlarval stage is attained. Prawn fry or postlarvae are cultured for at least five more days before they are transferred to nursery tanks or ponds. Here, they are nurtured for about a month to make them sturdy for stocking in grow-out ponds. Some hatcheries merely prolong their stay for 20 to 30 days in the larval rearing tanks without any transfer. Throughout the postlarvae's stay in the larval rearing tank, feeding with algae, rotifers and brine shrimp is continued but minced fish, shrimps, clams, or mussels or pelleted diets may be added as supplement.

Hatchery Components

Seawater Supply System. Source should be clear, unpolluted, and not subject to excessive freshwater dilution from a river discharge so that salinity most of or throughout the year does not fall below 28 ppt. Depending on the topography and bottom characteristics of an area, the water intake could be drawn directly from the water column, through a free-end intake, from a near-shore well, or from a submarine well. While the engineering design for any system could be worked out, the primary determining factor in the selection of a system would be the cost; secondary considerations are the relative advantages or disadvantages of each system from the viewpoint of the operator.

A free-end intake pipe should be fitted with a removable screen to prevent large fish and other organisms from being sucked into the pipe. The screen should be periodically cleaned or replaced. Fouling organisms such as barnacles, sponges, squirts, oysters and mussels will be a constant problem. One solution is to tap a small entry point into the intake line immediately before the pump. This could be fitted with a 5 mm diameter plastic tubing for dripping sodium hypochlorite solution (such as Chlorox, Purex, etc.) at weekly intervals, and could be closed when not in use. Anti-fouling paints and other similar compounds should never be used since the active ingredients in such compounds would also be toxic to prawn larvae.

Water drawn from wells will be relatively free from larvae of potential foulers. Pumps to be used should be corrosion resistant. Plastic impellers and housing are preferable but are generally found only in small capacity pumps. Large pumps for seawater use would normally be provided with brass parts. All brass in contact with seawater should be coated with epoxy paint or other plastic compounds.

Seawater Treatment System. Water for hatchery use should be filtered. A sand filter will be adequate for most purposes. Capability to be backwashed is essential in order to maintain optimum filtering efficiency. Where cleaner water is necessary, small-in line filters with replaceable filter cartridges along the line leading to the point of use can be provided. Chlorination with sodium hypochlorite followed by dechlorination with sodium thiosulphate is the cheapest way to sanitize seawater during storage. The necessity and advisability of doing so is normally at the option of the hatchery technician.

Seawater Storage Tank. An above-ground storage tank for filtered seawater eliminates the need to pump water to the various culture tanks as water could be delivered by gravity. The storage tank should ideally have a capacity that is 50 percent of daily consumption.

Aeration System. Aeration is essential not only to provide essential gases to the organisms being cultured but also to provide proper water circulation. Blowers or compressors could provide aeration. A blower delivers a large

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*Wilfredo G. Yap from the Paper discussed at the second offering of Aquaculture Business Project Development and Management (APDEM II), July 28 to Aug. 16, 1980.

Rice-Fish Culture Research in Asia*

Fish provides one of the most important and cheapest sources of animal protein to the majority of people living in Asia. Daily fish consumption per caput is from 2.0 gm to 16.0 gm. in some Asian countries. Though the main supply of fish in these countries comes from capture fisheries, fish production from ricefield areas forms an important source of protein supply for the rural people in most Asian countries. Coche (1976) estimated that only 0.65% or 136,000 hectares of the total area of 21 million hectares of irrigated ricefields in Southeast Asia are used for culturing fish.

Reports from various countries in Southeast Asia indicate that there was a general decline in fish production from ricefield areas. In Malaysia production in 1970-71 was only a third of that of previous years. In Japan production of fish reached a peak of 4,437 metric tons in 1943 and then declined to only 250 metric tons in 1963. Similar trends were reported in other countries. The decline in ricefield fish production was mainly due to advanced agricultural practices like spraying of pesticides weedicides and fungicides with high yielding rice varieties. The adoption of multiple cropping of rice leaves little scope for fish culture for it does not provide sufficiently long spells of wet fallow periods. Invariably, these led to the drastic reduction of fish caught from ricefields.

Currently a limited published literature on the overall situation of rice-cum-fish culture in Asia is available and this accounts for the rather confused state of this neglected but important part of rural activity. Out of 13 Asian countries only the Philippines Indonesia Malaysia and India have current research program on rice-cum-fish culture. Sri Lanka, Taiwan, Burma, Bangladesh, Nepal, Singapore, Hong Kong, Japan and South Korea do not have any programs and have expressed no interest in this field. While there is no current research program on rice-fish culture in Thailand, the researchers from this country have expressed interest in participating in any future research programs which may be either organized or funded by an international agency.

In the Philippines the ongoing research programs on rice-cum-fish culture were started at the Freshwater Aquaculture Center (FAC) of the Central Luzon State University in 1974 and are continuing projects with the technology undergoing nation-wide pilot demonstration. The present thrust along with the pilot phase is on the effect and evaluation of pesticides in ricefields, the production of fingerlings in paddies socio-economic studies and further improvement in fish production.

In Indonesia, research projects at the Research Institute for Inland Fisheries in Bogor have been reactivated since 1976 under the Fish Farming Integration Program financed by the Government of Indonesia. The program has been conducted through surveys and case studies and has primarily focused on the status of their farming system. Experiments on improved methods and techniques of lowland rice fish culture are to be carried out more intensively at the Experimental Station in Depok, Jakarta and two other field stations in East and West Java.

In India, the allied practices of culturing brackishwater prawns and fishes in low lying ricefields of West Bengal and Kerala were quite common. The current research program are on the seasonal utilization of ricefields for fish culture which is fast gaining importance in recent years. In terrace farming areas of the State of Bihar, the lower strata with high accumulated seepage of nutrients have recorded high fish production in ricefields

Prof. T.J. Pandian of Madurai University reported that the use of pesticides in recent years had greatly hampered the possibility of fish culture in paddies. At present his group of researchers are doing laboratory research work on the dose effect of various insecticides on the metabolism, feeding, growth and reproduction of a number of fishes which can be cultivated in the ricefield. They are now conducting research on the rearing of the ricefield-cum-canal living fishes like *Macropodus cupanus* and the younger stages of *Channa striatus* (snakehead). They are also looking into the problem of enzymatic pathway through which the insecticides affect the normal activities of these fishes.

In Malaysia screening of various pesticides for use in rice cultivation has been and is still being conducted by the Department of Agriculture and the Malaysian Agriculture Research Development Institute (MARDI). Toxicity studies of some of these pesticides on fish under laboratory conditions are now being conducted by the Faculty of Fisheries and Marine Science, Universiti Pertanian Malaysia. The possible use of chemosterilants and juvenile hormone analogues in insect pest control is being conducted at Universiti Sain Malaysia. The Freshwater Fisheries Station,

*From "Review of the Status of Research and Development Activities in Rice-*cum*-Fish Culture in Asia" prepared by Baharin Bin Kassim, Ang Kok Jee and Tan Cheng Eng Universiti Pertanian Malaysia, Faculty of Fisheries and Marine Science, Dec. 1979.

MARDI, Batu Berendam, Malacca has on-going research programs on the breeding and culture of air-breathing fishes. As a whole, Malaysia is interested on any future research program on rice-fish culture. Most of the research projects on ricefield fishes in the past were on bionomics, toxicities and effects of insecticides on ricefield fishes, harvesting and production.

PROBLEMS AND CONSTRAINTS IN RICE-CUM-FISH CULTURE

Asia produces about 90 per cent of rice in the world. In 1971 the total rice yield of the whole world was 307 million metric tons in a cultivated area of 135 million hectares in 107 countries covering all the five inhabited continents. In 1975 rice yield was 343 million metric tons in a cultivated area of 136 million hectares from only 44 countries including all the major rice producers in Asia. The increase in the area of rice cultivation and the harvesting of higher yields is occurring throughout Asia. The emphasis on higher yield and more efficient production of rice involve the application of modern technological inputs such as heavy utilization of inorganic fertilizers and pesticides. It involves also the introduction of new varieties of paddies which can be harvested within very short periods. This modern method of paddy farming upsets the natural ecological balance in the ricefield. As a result there is a corresponding reduction of fish harvested from the ricefield in most countries in Asia. Countries like Japan, Korea, Taiwan which had important ricefield fisheries at one time are now having little or no fish production from the ricefields. The reduction in fish production from ricefield has been reported in many countries in Asia. Some ricefields in Thailand such as those in Songprakan Province have been converted into *Trichogaster pectoralis* (snake-skin gourami) culture because of better economic returns.

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Edible Crustaceans in the Philippines*

23. *Metapenaeus elegans* DE MAN

English name: Fine shrimp
Philippine name: Hipon suaje, Pasayan

Maximum body length is about 10 cm. The number of dorsal teeth is 9 to 11 (mostly 9 including an epigastric one) and the first 2 on the carapace. The rostrum is as long as two-thirds of carapace length and is slightly curving up at tip. The last dorsal tooth is usually located near the tip of rostrum. The carapace has well developed antennal, orbital and hepatic spines. Dorsal carina starts at half of 4th somite, becoming progressively more prominent to the 6th somite. Telson has no lateral spines.

The whole body is mostly glabrous. Ground body color is pale pink with numerous minute dark brown mottles. Rostrum, antennal flagella, dorsal carina and outer margins of uropod are pinkish brown. Pereiopods are yellow with few brown mottles at proximal and white at distal portion. Pleopods are yellow with few brown mottles at proximal and light pink at distal portion fringed with white hairs.

This species distributes in Malaysia, Singapore, Sri Lanka and Philippines. It is a medium-sized shrimp suitable for rural consumption together with *M. ensis.* Retail price is about ₱20/kg. (Scale represents 10 cm.)

*By H. Motoh, 23rd in a series.

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Several problems contributed to the decline in ricefield fish production. Some of the main problems that have been mentioned by the research workers from the region are:

(1) the advserse effects of advanced agrarian practices on fish culture like the application of pesticides, weedicides and fungicides with the advent of high yielding varieties of paddy.

(2) the concept of multiple cropping in rice cultivation leaves little scope for fish culture because of the short duration of water in the ricefield.

(3) land-water use conflict.

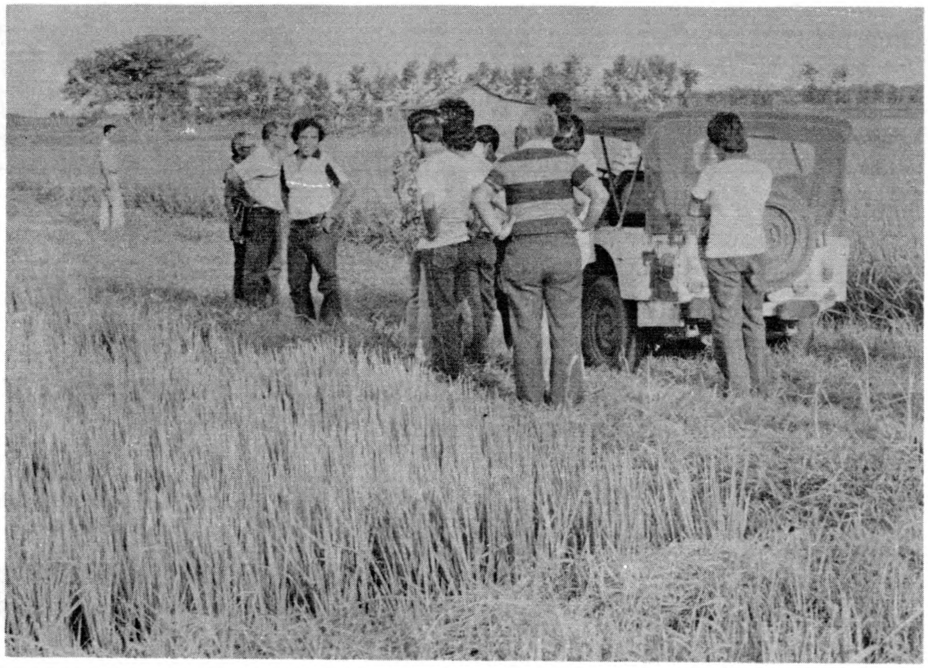
(4) lack of suitable technology.

(5) socio-economic problems such as marketing and acceptability of the fish by the population.

Among the problems mentioned above, pesticides extensively used in paddy cultivation seem to be one of the biggest problems. Many pesticides used in rice cultivation such as endrin, dieldrin, thiodan, DDT and Gamma-BHC are toxic to fish. In Malaysia thiodan was the most frequently used followed by malathion and Gamma-BHC and Sevin. The other insecticides such as gusathion, labaycid, dieldrin, endrin, agrothion and durban were less frequently used in ricefield.

The concept of multiple cropping in paddy leaves little scope for fish culture because of the short period of inundation in the ricefield. This especially affects the captural system of paddy fisheries which is largely based on wild fish populations entering the ricefields with the irrigation water. These fish then grow and multiply within the ricefields. In a double crop areas the fields are flooded for a period of four months or less as opposed to six to eight months in single crop areas. In Malaysia, less fish production was recorded in such areas and it has been suggested that farmers should change from captural system to cultural system of fish production to ensure that they continue to derive income from fish production.

Other constraints facing fish culture in ricefields include the insufficient and uncertain supply of desirable species for culture, the lack of suitable culture technique for the existing paddy cultivation tehnique and the shortage of experienced extension and technical workers.



APDEM II participants take a look at the CLSU/FAC rice fish demo-farm.

IDENTIFICATION OF RESEARCH AREAS

Though there is consensus among the authorities in the region that there is a general decline in fish production in ricefields, there is still potential for future development. In the Philippines, India and Indonesia concerted effort is being made by the authorities to maximise production of fish under the rice-cum-fish culture system. Pillay (1973) noted that if only 30% of the existing 35.6 million hectares of irrigated ricefields in Asian countries were used for fish culture even at a very low rate of production, a yield of about 2.2 million metric tons can be realised.

To achieve this many steps may have to be taken in order to solve the problems and overcome the constraints mentioned earlier. The following areas of research should be given priority in future research programs.

(1) Greater research emphasis on the effects of insecticides to fish and insect pests. The residual effects of the various insecticides on the fish and the environment should be clearly defined. Perhaps an alternative pest control using biological means should be considered. The short and long term studies on the effect of pesticides on the fish and other aquatic organisms in the ricefield ecosystem should be undertaken.

(2) Research into the evolution of new varieties of fish which are hardy, fast growing and have high tolerance to pesticides through genetic selection should be undertaken.

(3) Research into the cost-benefit analysis on the existing technology and farming system should be initiated at experimental and pilot scale levels. The information obtained from this will be very useful for future development programmes.

(4) Research into the land water-use conflict should be carried out in order to optimize utilization of land and water. This would involve proper engineering designs of ricefields which can be used both for paddy cultivation and fish culture.

(5) There is also a need to study the stocking rate/density, optimum size at stocking, fish species and combination of fish species to be introduced into ricefields.

CONCLUSION AND RECOMMENDATION

Among the 14 countries covered by this study only Thailand, Malaysia, the Philippines, Indonesia and India have indicated interest in any future programs funded by an international agency. These five countries however, have a total of 49,495,546 hectares of land under rice cultivation (Thailand - 4 million hectares; Indonesia - 4.5 million hectares according to Ardinawata 1957; the Philippines - 1.4 million hectares accord-

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REQUIREMENTS FOR...

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volume of air at low pressure while a compressor delivers a low volume at high pressure. A blower runs continuously while in use, a compressor runs intermittently since it is equipped with a pressure tank. The compressor automatically switches on when the pressure drops below a pre-determined level. High volume rather than high pressure is desirable for hatchery use. A blower capable of moving air through a 2-meter column of water will be adequate for hatchery work. Blowers not designed for oil-free operation have a tendency to blow oil particles into the air line producing oil slick on the surface of the water. A filter may be placed at the outlet before the air is distributed.

In setting an aeration system you can choose between a centralized system to serve the entire hatchery complex or a localized system consisting of several smaller blowers each intended to serve a specific area of the hatchery complex. The specific areas which can be isolated from each other, or which would benefit from such isolation, will be dealt with as they are discussed. It is sufficient at this stage to point out that localizing the air source to specific areas would make possible partial shutdowns of areas not in operation.

Larval Rearing Tanks. This is the heart of the hatchery. Depending on the hatchery system adopted, these tanks would range from 2-cu.m. circular tanks with conical bottom to 200-cu.m. circular or square tanks with flat bottom. Circular tanks with capacity of 10 to 20 cu.m. and depth of 1.0 to 1.5 m are practical production tanks. Serving the larval rearing tanks would be a number of 300-liter tanks for spawning and hatching.

Algal Tanks. Again, depending on the hatchery system used, these could range from 500-liter plastic tanks (for the culture of starters to inoculate the larval rearing water) to tanks as large as the larval rearing tanks for mass propagation of unicellular algae. A hatchery would need at least two algal tanks to serve each larval rearing tank so that algal culture can be programmed to assure a continuous supply of food. For reasons of economy and convenience, algal tanks for mass propagation could be designed in series with the tanks sharing common sidings. Since penetration of sunlight is important, algal tanks should be no more than 1 meter deep. A central sand filter for concentrating the diatoms is essential.

Brachionus Culture Tanks. Each Brachionus tank must be supported by another tank of the same capacity for the culture of Chlorella on which the Brachionus subsist. Design and specification would be similar to the algal tanks.

Maturation Tank. This is optional even unnecessary in areas where supply of wild spawners is no problem. However maturation facilities for holding captive broodstock would be essential in places with limited or highly erratic supply of spawners. Four-meter circular tanks with depth of 1 meter has been found effective in holding as many as 40 adult prawns with very low mortality. This tanks should be provided with a flow-through capability and a sub-gravel bed aeration system such as those found in glass aquaria used by hobbyists.

Algal Room. This is optional depending upon the scale of operation and the system adopted. The main feature of this room are shelves for holding one-liter bottles and gallons with a bank of fluorescent lights to provide continuous illumination. Here starter cultures of various algal species are maintained for inoculating algal tanks. This room will benefit from a localized blower. Air conditioning is recommended since the temperature ought to be maintained at 20°C for optimum growth of the starter culture. It also keeps contamination to a minimum.

Other Facilities. Power houses and pump houses will be necessary in areas without electricity. However it is more convenient and cheaper to locate a hatchery within easy access to electrical power lines. Freshwater use is minimal relative to seawater but should always be available. Other facilities to be included in planning the hatchery building are a shower and locker room for workers. Sleeping quarters provided with a kitchenette would make it convenient for technicians to work at night.

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ing to Mears *et ai.* 1974; Malaysia - 595,546 hectares according to Ghosh 1979). The Philippines, Indonesia and India have current research programs in their institutions and these are funded by their national governments.

The main decline in ricefield fish production in the region were attributed mainly to two factors viz. the extensive use of pesticides in rice cultivation and the introduction of multiple cropping resulting in short period of inundation in the field.

Noting that there is scope for expansion and further development of ricefield fish production through the overcoming of the two major constraints mentioned and further recognizing that although fish production under this method will only be a supplementary activity to rice production, the overall socio-economic benefit will be greater if both enterprises are carried out simultaneously rather tnan exclusively of one another. We recommend that an international agency like the FAO host an international workshop on rice-cum-fish culture to study the proposals and their implications. Donor agencies should be requested to provide the required level of assistance for long term and short term research on the immediate and long term effects of pesticides on the fish and the environment. We also recommend that funds be made available for the research of suitable technique of fish culture in ricefield areas so that compatible solution can be found to enable fish culture to play a more positive role in the multiple cropping system of paddy cultivation.

Literature Cited

Ardiwinata, R.O. (1957). Fish culture in paddy fields in Indonesia. *Proc. Indo-Pacific Fish. Coun.* 7:119-154.

Coche, A.G. (1967). Fish culture in rice fields: A world wide synthesis. *Hydrobiologia* 30:1-44.

Ghosh, A. (1979). Scope for paddy-cum-fish culture in India. Abstract *in* V International Symposium of Tropical Ecology edited by J.I. Furtado, Kuala Lumpur, Malaysia – 16-21 April 1979.

Mears, L.A. Agabin, M.H. Anden, T.L. and Marquiz, R.C. (1974). Rice economy of the Philippines. University Philippines Press, Philippines.

Pillay, T.V.R. (1973). The role of aquaculture in fishery development and management. *J. Fish. Res. Bd. Canada* 30:2202-2217.

NEXT ISSUE: **SITE SELECTION AND CONSTRUCTION**

ALL FOR . . . *(from page 2)*

and expensive facilities, equipment and materials such as the hormones may not really be at all necessary to get them to lay eggs under a man-made environment.

Ironically, if they did not naturally mature in the cages they would have been used for artificial spawning experiments but their maturing has probably signalled the end of such spawning experiments. This is not say that the scientific techniques and lessons that had been done and learned in artificial spawning and hatching — have been all for naught. On the contrary, the scientific techniques could very well be refined and put into practical application in other species as well as in milkfish itself. The advent of cage culture in marine waters and the diversity of potentially cultivable fish species in the tropics make necessary artificial spawning technology.

Meanwhile, lessons with wide-ranging research and practical implications could be gathered from the environment, and probably the enclosures, in which the milkfish were held captive and in the way the fish had been treated. The location is sheltered with oceanic waters, and the food was a high-protein diet which can be formulated or probably bought off the shelf.

Information in greater details may be gathered from the article, "Sexual Maturation of Milkfish in Floating Cages," which appeared in Asian Aquaculture, Vol. 3 No. 8, August 1980, and the essay, "Basis for a Blue Revolution" by Q.F. Miravite published in *Give Us the Tools: Science & Technology for Development,* IDRC, Ottawa, Canada, 1979 which thoroughly reports on and analyses the implications of the milkfish research program, particularly the induced spawning efforts, of the SEAFDEC Aquaculture Department.

NOTES FROM OUR READERS

I would like to make a correction and an inquiry on the September and August 1980 issues of Asian Aquaculture which contained reports of our milkfish broodstock work at Igang Substation.

The September 1980 issue carried a picture of our cages at Igang, with the caption saying these were "designed and built by engineers of the Department". I would like to inform you that we have 27 cages of various sizes and shapes in that picture and 21 of them were designed by me. The nylon netting and the wooden floats of the other 6 cages were built by my staff at Igang and the Carpentry, under specifications provided by me. The only contribution of the Department engineers was the construction of these 6 cages' metal frames whose material, shape, and largest diameter had all previously been described in my "Proposal for the Establishment of Milkfish Broodstock", submitted to the Department on 3 October 1977 while I was still a consultant.

The August 1980 issue contained an article on our milkfish maturation results. I would like to ask why the names of the authors of said article were preceded with "Reported by," a phrase you never used before authors of other research papers in Asian Aquaculture.

Flor Lacanilao
Milkfish Broodstock Subproject
SEAFDEC Aquaculture Department

We acknowledge with thanks receipt of ASIAN AQUACULTURE and particularly for having sent us the whole set which will be of great interest to the scientists working on aquaculture at the Centre Oceanologique de Bretagne.

In June 4, 1980 we sent you by surface mail all the available issues (27 publications in different packages) of the following series: "Rapports Scientifiques et Techniques" and "Recueils des Travaux du COB." To complete our first delivery we also provide you two other documents dealing with your scope and these are papers of symposia held on aquaculture and mariculture.

Thus we think we have established a regular and useful exchange of publication according to our proposal.

R. Piboubes
Chef de la Section Documentation
Centre Oceanologique de Bretagne CNEXO
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In the past, while working in FAO, Rome, my name was on your distribution list to receive ASIAN AQUACULTURE but on my request it was deleted because I could borrow the issues from my colleagues. Now that I have transferred to Mexico, I miss the useful information published and I shall be obliged if my name can be reinstated.

Michael N. Mistakidis
Adviser in Aquaculture
Fisheries Research and
Development Project
Mexico

I have read with interest an article in "Australian Fisheries" of your attempts to popularise small scale farming of sugpo in the Philippines.

I feel there may be a way to farm prawns here as the area where I live is rich in all types of marine life and the local people have expressed interest after my mentioning your work to them.

I would appreciate it if you could forward your extension manual "Small Scale Sugpo Hatchery" and advise me of its cost and enter me in the subscription list of ASIAN AQUACULTURE.

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