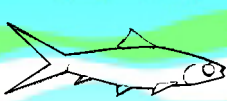


SEAFDEC Asian Aquaculture



IN THIS ISSUE

A beginner's guide to aquaculture

PAGE 9



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The Southeast Asian Fisheries Development Center (**SEAFDEC**) is a regional treaty organization established in December 1967 for the purpose of promoting fisheries development in Southeast Asia. Its Member-Countries are Japan, Malaysia, the Philippines, Singapore, Thailand, Brunei Darussalam, the Socialist Republic of Viet Nam, and the Union of Myanmar. Four departments were established in the Member-Countries; one of them, the Aquaculture Department (**AQD**) located in the Philippines, pursues aquaculture research and development

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Contributions

We accept articles that focus on issues, developments, and information on all phases of sustainable aquaculture for publication in this newsletter. Photographs and line drawings must be camera-ready, glossy B&W prints or colored slides. The newsletter editor reserves the right to edit contributed articles for brevity and style.

Gifts and exchanges

Publication exchanges with **SAA** are encouraged. AQD has publications exchange agreements with 800 institutions worldwide.

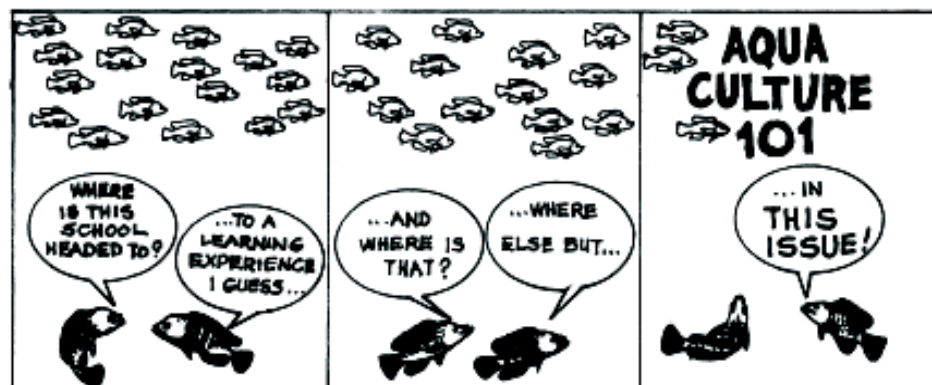
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Nota bene Mention of trade names in this publication is not an endorsement.



Our cover

A busy fish market in southern Philippines

Photo by RY BUENDIA

Nigerian ambassador visits AQD

His Excellency Chief Ray O. Inije, Ambassador Extraordinary and Plenipotentiary of the Federal Republic of Nigeria to the Philippines, went on a familiarization tour of economic and industrial sites in Iloilo City, including SEAFDEC/AQD on May 3. He was accompanied by the Embassy's Third Secretary, Mr. Y. D. Faruk.

Ambassador Inije (middle) and Mr. Faruk were briefed by researcher Denny Chavez (right)



AQD Chief reappointed for third term

On the Philippine government's recommendation through President Estrada, the SEAFDEC Council of Directors has reappointed the Chief of AQD for a third term starting April 8, 2000.

The reappointment of Dr. Rolando Platon is a nod to the current direction of AQD which is verification, packaging and commercialization of aquaculture technologies. Among the technologies already extended and picked up by private investors and local government units in the Philippines are tilapia culture in small freshwater reservoirs, culture of mudcrab in ponds and in pens in mangrove areas, grouper culture in ponds and cages, and oyster-mussel culture using the more environment-friendly raft method.

Dr. Platon has acquired for AQD a 15-ha brackishwater demonstration farm in northern Iloilo, a new pilot-demonstration complex for AQD's breeding and hatchery technologies, and a museum building (called FishWorld) for AQD's environmental awareness program. He has also established an Advanced

Aquaculture Technologies program whose biotech facility or laboratory will be made operational within the year.

In the next two years, AQD will look forward to more regional collaboration with its program partners in research, training and information dissemination.

AQD implements mangrove-friendly shrimp culture project

AQD is implementing this project as part of its Mangrove-Friendly Aquaculture Program. The shrimp project aims to develop sustainable culture technology packages, and is funded by the Japanese Trust Fund.

AQD will conduct research to further refine techniques already known to be successful, and then verify, demonstrate and disseminate these techniques. Initial research activities at AQD's Dumangas Brackishwater Station are on nutrient cycles and capacity of mangroves to absorb nutrients.

Verification and pilot demonstration activities are also being undertaken in Thailand in collaboration with the Department of Fisheries (DOF) and in Vietnam with the Research Institute for Marine Products (RIMP).

The activities in Thailand are implemented by a core of DOF experts headed by Mr. Siri Tookwinas; in Vietnam by RIMP experts with Dr. Varin Tanasomwang of DOF and Mr. Dan Baliao of AQD as consulting experts. Mr. Baliao also heads the activities at AQD's Dumangas station.

Semi-intensive culture in mangrove areas will be done in a 2-ha pond inside a 6-ha mangrove area in Phu Long, Cat Hai District, Vietnam. For Thailand, an intensive shrimp culture with mangrove irrigation and recirculating systems will be demonstrated. In the Philippines, a semi-intensive/intensive commercial-scale environment-friendly shrimp culture system will be pilot-tested.

The project also has a training component with on-site modules likely to be conducted in the project sites. Meanwhile, a compilation of "state-of-the-art" mangrove-friendly shrimp culture techniques is being published by AQD.

Training course for LGUs

Realizing the important role of the local government units (LGUs) in managing and protecting coastal ecosystems, AQD initiated a 2-year training program on sustainable aquaculture and coastal resource management (SACRM) for town agriculture/fisheries officers, legislative council members for fisheries and non-government organizations. The initial target is to train 400 LGUs from coastal municipalities in the western Visayas

☞ next page

LGU trainees from northern Iloilo with AQD's training-information head, RF Agbayani (3rd from left)



region. SACRM is a collaboration between AQD, BFAR and PROCESS Foundation Panay.

AQD trained the second batch of 20 officers from the Northern Iloilo Alliance (comprising San Dionisio, Concepcion, Estancia, Lemery, Carles, Ajuy, Balasan and Batad) from April 10-15. The first batch from the First District of Iloilo and the island province of Guimaras trained in October last year.

The course included cross-visits to AQD community-based projects on mangrove-friendly aquaculture in Kalibo, and Tangalan-Ibajay in Aklan; and dialogue with fellow LGUs in these sites to share experiences.

More towns seek AQD technologies

Aquaculture may just be the option for rebel returnees in Jamindan and Dumarao, Capiz, west central Philippines. Inspired by their comrades in nearby Tapaz, they will venture into tilapia and catfish culture, the most appropriate for land-locked towns. Tilapia and catfish culture require relatively less capital investment.

The rebel returnees is being assisted by the Provincial Government of Capiz in capability building (e.g. training courses on tilapia culture with AQD resource speakers). They are learning from the demonstration site of tilapia culture in San Julian dam which was put into place with AQD's help. This Tapaz site is now run by a people's cooperative. "We have been selectively harvesting tilapia after several months of culture," said Mr. J. Farinas (Ka Ebong), the cooperative chair.

Meanwhile, Tubungan, another land-locked municipality, initiated tilapia culture in some of their SFRs (they have around 100). The Department of Agriculture has earlier provided the town with African catfish fingerlings; and AQD recently provided tilapia fingerlings which the town mayor, Gorgonio Talledo, distributed to various SFR owners. The recipients said they were hopeful that tilapia culture will provide them with additional income, if not, at least their own consumption of fish.

Mayor Talledo has earlier sent his technical staff to Tapaz. The trainees were able to observe the stocking, feeding, and harvesting protocols for tilapia.

Dr. Platon speaks to MSU graduates

AQD Chief Dr. Rolando Platon was the choice of the Mindanao State University in Marawi City to address the graduates of its Colleges of Agriculture, Fisheries, Forestry, Natural Sciences and Humanities, Science Training Center, and the Graduate School last March 31. Dr. Platon is himself an alumnus of MSU.

He exhorted the Class of 2000 to keep pace with the rapid change of technology in the areas of biotechnology, information, fiber optics, human genome, among others. He urged the graduates to master information management rather than just knowledge acquisition because it will serve them in good stead over time.

Researchers attend workshop in Indonesia

Upon the invitation of the Government of Indonesia, AQD researchers Renato Agbayani and Joebert Toledo attended the regional workshop on sustainable seafarming and grouper aquaculture in Medan on April 17-20. Agbayani discussed seafarming and AQD's community development experience in the Philippines, and Toledo presented the status of breeding and rearing of groupers.

The workshop was co-sponsored by the Bay of Bengal Programme, Asia-Pacific Economic Cooperation, and the Network of Aquaculture Centres in Asia and the Pacific.

New library software

Forget the old stuffy image of a library. The AQD Library has become a dynamic place where information can be accessed faster and more comprehensively through the use of computer databases and the internet. Recently, the Lib acquired Follet's OPAC (online public access) software with the help of the equipment fund from the Government of Japan. Follet is a library automation software.

With OPAC, users can do online search of all library contents -- be it journals, journal articles, books, pamphlets, proceeding, etc. "Our catalogues are all integrated with OPAC," says Library head Amy Arisola. "In the past, you go to different indexes to search, but not anymore."

This is just a start. Later this year, the Library will get another Follet software, for circulation (barcoding as in a grocery) and for web access (searching can be done through the AQD website).

[With reports from E. Aldon, V. Sulit, A. Surtida, and R.I.Y. Adan]



AQD Research Publications

Reprints of papers listed here may be requested directly from AQD authors or from the AQD Library

Compiled by the **AQD LIBRARY** <library@aqd.seafdec.org.ph>

Quinitio ET and Estepa-Parado FD. 2000. Transport of *Scylla serrata* megalopae at various densities and durations. *Aquaculture* 185: 63-71

Abstract. The optimal conditions for transport of *Scylla serrata* megalopae were determined. Loading densities of 50, 100 and 150 ind l⁻¹ of hatchery-reared megalopae were studied over 1 6-h simulated transport, including shaking. Survival immediately after transport was significantly higher at 50 ind l⁻¹ (99.3 ± 1.6%) (mean±x%) than at 100 (93.0 ± 5.0) and 150 ind l⁻¹ (94.0±3.8%). The same trend was noted 15 h after transport. Another experiment compared survival of megalopae packed at 50 and 100 ind l⁻¹ with simulated transport of various durations (3, 6, and 9 h) at mobile and stationary conditions. Regardless of the duration and condition of transport, survival was again significantly conditions. Regardless of the duration and condition of transport, survival was again significantly higher at 50 ind l⁻¹ (86.7 ± 2.4%) compared to 100 ind l⁻¹ (79.7 ± 2.1%). Megalopae that were shaken or remained unshaken for 3 or 6 h had similar survival through transport as those shaken for 9 h. Megalopae that remained unshaken for 9 h gave the lowest survival among treatment groups (38.7 ± 0.2%).

Due to cannibalistic behavior, stationary transport conditions may have provided the megalopae with a chance to grasp each other. In a third experiment, a batch of megalopae was packed at water temperature levels of 20, 24 and 28°C (ambient) at 50 and 100 ind l⁻¹ for 6 h simulated transport, including shaking. Density and temperature separately influenced survival. Survival was lower at 28°C than 24°C. Although megalopae were less active at 20°C, survival was similar to that at 24°C and 28°C. These results provide useful information for megalopae transport from hatchery to ponds.

Santiago CB and Gonzal AC. 2000. Effect of prepared diet and vitamins A, E and C supplementation on the reproductive performance of cage-reared bighead carp *Aristichthys nobilis* (Richardson). *J. appl. Ichthyol.* 16 (1): 8-13

Abstract. Twenty-month old bighead carp, *Aristichthys nobilis* (Richardson), were fed prepared dry diets for 20 months in cages in Laguna de Bay, Philippines, to determine the effect on reproductive performance. The experimental diets were similar in composition except for the combinations of vitamins be-

ing tested. Diet 1 was supplemented with vitamins A, E and C, diets 2, 3 and 4 each lacked one of the supplementary vitamins; and diet 5 did not include any vitamin supplementation. Big-head carp that relied solely on natural food without a prepared diet served as a control. The total of six treatments each had two replicates. Results showed that the onset of gonad maturation was 2-3 months earlier in the fish that were fed the prepared diets regardless of vitamin supplementation, when compared with the fish that were fed natural food (control). Moreover, the prepared diets enhanced egg hatchability which was significantly higher in fish that were fed diet 1 (± vitamins A, E and C, 80.5 ± 18.1%) and diet 3 (-vitamin E, 78.5 ± 1.1%) than in those fish that were fed natural food (control) (36.5 ± 31.3%). Mean number of 3-day-old larvae was highest in fish fed on diet 1 (34525 ± 1732), followed closely by fish that were fed on diet 3 (32420 ± 3909). A low number of 3-day-old larvae was obtained from fish fed the natural diet (14490 ± 4331) as well as in fish that were fed diet 2(-vitamin A, 14347 ± 4863), diet 4 (-vitamin C, 21407 ± 5840) and diet 5 (-vitamin A, E and C, 12191 ± 1439). Other criteria for reproduction such as relative fecundity, fertilization rate, and hatching rate did not differ significantly (P>0.05) among treatments. The addition of vitamins also had no significant effects on weights gain of adult fish.

Tan-Fermin JD, Marte CL, Ueda H, Adachi S, and Yamauchi K. 1999. Effect of season on oocyte development and serum steroid hormones in LHRHa and pimoziide-injected catfish *Clarias macrocephalus*. *Fisheries Science* 65(6): 865-870

Abstract. Oocyte and blood samples were taken from gravid female catfish *Clarias macrocephalus* at 4-h intervals to monitor the stage of oocyte development and serum steroid hormone profiles after injection of luteinizing hormone-releasing hormone analogue (LHRHa) and pimoziide (PIM) during the off-season (February) and the peak of the natural breeding period (August). Results showed that the onset of final oocyte maturation (12 h) and ovulation (16 h), and levels of serum estradiol-17 beta (E-2) did not vary with season in LHRHa injected fish. In February, ovulated eggs were stripped from three and two hormone-treated fish at 16 h and 20 h post-injection, respectively. In August, ovulation was observed in all hormone-treated females (n=5) at 16 h post-injection but stripping of the eggs

☞ next page

AQD research publications ... from previous page

was possible only 4h thereafter. Serum E-2 levels were significantly different only with varying time post-injection; a marked increase occurred at 12 h, but the elevation was higher in fish induced to ovulate during the peak (16.8 ng/ml) than off-season (7.7 ng/ml). Hormone-treated fish showed higher serum testosterone (T) levels during the peak season (17-23 ng/ml) than those injected during the off-season (10-20 ng/ml) at 4-12 h post-injection. Serum 17 alpha,20 beta-dihydroxy-4-pregnene-3-one (DHP) levels of hormone-treated fish during the off-season were only about half the level (0.29 and 0.52 ng/ml) of those treated with the same hormones during the peak season (0.54 and 0.9 ng/ml) at 8 and 12 h post injection, respectively. Development of oocytes and serum steroid hormone profiles after LHRHa induced ovulation provide basic understanding of the processes that mediate final oocyte maturation and ovulation in captive *C. macrocephalus*.

Nocillado JN, Penafiorida VD, Borlongan IG. 2000. Measures of egg quality in induced spawns of the Asian sea bass, *Lates calcarifer*. *Fish Physiology & Biochemistry* 22(1): 1-9

Abstract. The egg morphometry and lipid and protein components were determined in induced spawns (n=14) of the sea bass, *Lates calcarifer*, to identify measures of egg quality. Based on fertilization and hatching rates, the spawns were classified either in Group I, (zero fertilization) or Group II (where fertilization and hatching occurred). The egg morphometry did not differ between the two groups ($p > 0.05$). The total lipid was

higher in Group II than in Group I, although the difference was not significant ($p > 0.05$). The EPA and linoleic acid were significantly higher in Group II ($p < 0.05$). There were positive correlations between the total saturated fatty acids and fertilization rate ($p < 0.05$; $r=0.58$), the total saturated fatty acids and percentage of normal zygotes ($p < 0.02$; $r=0.62$), and DHA and the percentage of normal zygotes ($p < 0.04$; $r=0.56$). The total protein and FAAs were higher in Group I than in Group II, but the differences were not significant ($p > 0.05$). Proline, glycine, p-ethanolamine, and aspartic acid were significantly higher in Group II ($p < 0.05$), while tyrosine and glutamic acid were significantly higher in Group I ($p < 0.05$). Phosphoserine and fertilization rate were positively correlated ($p < 0.03$; $r=0.60$), as well as aspartic acid and hatching rate ($p < 0.05$; $r=0.54$). Arginine was negatively correlated with fertilization rate ($p < 0.03$; $r=-0.61$) and the percentage of normal zygotes ($p < 0.03$; $r=-0.63$). Serine was inversely correlated with yolk volume of the newly-hatched larvae ($p < 0.03$; $r=-0.77$). The moisture content of the eggs, which was significantly higher in Group II than in Group I ($p < 0.03$), was directly correlated with the FAAs:protein ratio ($p < 0.03$; $r=0.76$). The present results reveal egg components that may be used as quality measures in induced spawns of sea bass, a euryhaline teleost that spawn pelagic eggs containing an oil globule.

[**Note:** Abstracts from journals covered by Current Contents are downloaded from the CD-Rom version (Agriculture, Biology & Environmental Sciences; 26 April 1999 - 17 April 2000). 2000. Institute for Scientific Information, Pennsylvania, USA]

Online aquaculture ... from page 8

tion is about 1,200 tons of eel per year), and the collaboration desired is joint venture or financing. Project cost is about US\$1.25 million. There is also a fish pen venture in Tawi-tawi (US\$2.9 million) for groupers, milkfish, shrimps, tuna and seaweeds. Crocodile farming for meat and hide production in a 5-ha site in Cotabato City is open to investors for joint venture or financing (US\$1.28 million). These projects would go a long way in easing the economic burden of the people in the area.

In the press releases posted online, agriculture secretary Edgardo Angara has this to say: "By starting service delivery

online, we are slowly building the infrastructure of the future. We are creating the highway of the virtual world where farmers can access vital information that enhances their farm productivity and global competitiveness."

As to access to agriculture data, the director of the government's Information Technology Center for Agriculture and Fisheries, Roberto Villa, said that information kiosks will be set-up in provincial offices to cater mainly to small farmers. "The updated prices to be posted on basic commodities will help empower producers who are usually at the mercy of the traders ..."

By MT Castaños

www.fao.org

This is the website of the Food and Agriculture Organization (FAO) of the United Nations. For beginning entrepreneurs, this is a good site to assess the aquaculture industry's trends. Data on the state of world aquaculture is based "mainly on national statistics provided to FAO by its members through 1995." Of particular interest is the paper of R. Subasinghe, MJ Phillips, and AGJ Tacon on Southeast Asian aquaculture. They discussed production and production trends, main issues, and industry outlook: "Overall, the future for aquaculture development in Southeast Asia (SEA) is good and the sub-region will continue to produce all types of aquatic products, including plants. SEA will overcome its constraints for such development, especially the environmental concerns, by addressing common resource utilization concepts and probably acting as a group within the larger existing economic groupings."

http://aquanic.org

This is the website of the Agriculture Network Information Center (AgNIC), described as a voluntary alliance of the National Agricultural Library, the various land- or sea-grant universities and agricultural organizations in the US in cooperation with citizen groups and government agencies. Aquaculture is searchable by species and systems. Tilapia (pond, cage, and tank culture) and shrimp (market study of SPF or specific pathogen-free shrimp) are of most interest to tropical aquaculturists. For the latter, the market study includes Ecuador, the Philippines, Thailand, and Indonesia. SPF project leader CL Brown wrote: "In the Philippines, postlarvae sell for US\$7 to 10 per 1,000. Postlarvae that are free of MBV (monodon baculovirus) occlusion bodies are at a premium. Therefore, SPF postlarvae are likely to be well received initially there. If SPF postlarvae perform up to expectations, the premium price is likely to continue. However, SPF (*Penaeus monodon*) have yet to be tested in production trials, and speculation is premature on their long-term acceptance. No spawning stations operate in the Philippines, and hatcheries do not typically sell nauplii to each other . . . Maturation systems are not normally used, and broodstock is usually

In this issue, we are starting a new feature on aquaculture websites to help our readers sift through the tremendous amount of information available online on the internet.

We also hope to encourage the use of information technology (=computers) especially by students of aquaculture.



Feel free to write us for information and topic search: <devcom@aqd.seafdec.org.ph> -- Ed.



From www.fao.org/fi/publ/circular/c886.1/c886-1.asp

spawned once and discarded. Attempts have been made to spawn broodstock more than once, but hatchery operators reported that nauplii quality diminished with each successive spawn. If nauplii were to be sold, they probably would sell for approximately US\$0.20 per 1,000 and total value would be \$900,000 annually. The best quality spawners sell for approximately \$50 each in the Philippines. However, if SPF broodstock were able to produce postlarvae that performed as well or better than the best quality postlarvae, the SPF broodstock would likely sell for \$50 per pair. The Philippines has no ready market for SPF broodstock because captive maturation is not practiced. In order for SPF broodstock to gain wide acceptance, the technology for captive maturation must be demonstrated to be superior to the current methods of producing nauplii."

www.gaalliance.org

The Global Aquaculture Alliance (GAA) is an international non-government organization founded in 1997 whose mission statement include (1) the representation of the aquaculture industries in the international arena and (2) the education of the public on the benefits of aquaculture to the consumers, the food service sectors, and the economies of countries around the globe. Their website is a good source of press releases though this is a bit thinnish. One of the releases is about an eco-labeling program conducted by GAA with the Responsible Fisheries Society (RFS) of the United States. It seems a "new ecolabel will be offered to industry members who endorse the Principles for Responsible Fisheries of RFS or GAA's Principles for Responsible Aquaculture, and incorporate these Principles into their businesses. (This) is open to all segments of the industry (e.g., producer, importer, distributor, retailer or restaurant operator) and requires the preparation of reports or plans that document implementation of the RFS/GAA principles."

The document on Principles was previously available on the site, so, you may inquire through email instead: <homeoffice@gaalliance.org>. Another book is posted -- *Codes of Practice*

☞ next page

for *Responsible Shrimp Farming* -- which can be ordered online (costs US\$20). The book was prepared by Dr. Claude Boyd, and includes codes on mangroves, site evaluation, design and construction, feeds and feed use, shrimp health management, therapeutic agents and other chemicals, general pond operations, effluents and solid wastes, and community and employee relations.

The site also advertises a new 90-page color magazine, *Global Aquaculture Advocate*, which has articles by international experts.

www.was.org

The World Aquaculture Society (WAS) is an international non-profit society with over 4,000 members in 94 countries. Their aim is improving communication and information exchange within the diverse global aquaculture community. True to their goal, the strength of the WAS website is the links they provide to aquaculture associations and suppliers. The site list is searchable and in alphabetical order. [We tried to search for SEAFDEC, which was not on the alphabetical list, and this is what we come up with: "*South East Asian Fisheries Development Center (SEAFDEC) -- Aquaculture Department AQD or the Aquaculture Department is one of the four departments under SEAFDEC or the Southeast Asian Fisheries Development Center, a regional treaty organization established in 1967 to promote fisheries development in Southeast Asia. rddata@i-iloilo.com.ph*" Allow us to update the contact number. It is <aqdchief@aqd.seafdec.org.ph>, and our website address is www.seafdec.org.ph (see the website entry that follows below).]

The WAS website also offers several information materials, one of which is a CD-ROM on "Diagnosis of Shrimp Diseases - With Emphasis on the Black Tiger Shrimp *Penaeus monodon*" prepared by VA de Graindorge and TW Flegel.

www.seafdec.org.ph

The SEAFDEC Aquaculture Department is mandated to pursue research on appropriate aquaculture technologies, trains aquaculture manpower, and disseminates/exchanges information especially to member-countries (see also the inside front cover of this issue). Our website covers the research programs, a list of our experts and their areas of specialization, actual field verification runs, a list of training courses scheduled for the year, and a listing of available information materials.

We are also linked to the other SEAFDEC departments in Thailand (seafdec.org), Singapore (asean.fishnet.gov.sg/mfrd1), and Malaysia (agrolink.moa.my/dof/seafdec).



www.aquaculture.co.il

This is a private consulting company, the Aquaculture Production Technology (APT) Ltd, established in 1978 by a group of scientists from Hebrew University in Jerusalem, Israel. Their list of clients is a bit impressive -- some 30 countries in 5 continents -- with activities ranging from site review to project management and staff training. They say their "technological packages" include the integration of aquaculture and (agricultural) irrigation. Israel is known for their drip irrigation which literally makes the desert bloom. Both irrigated agriculture and aquaculture are said to be "highly developed in spite of climatic constraints and chronic lack of water." This is achieved by placing the aquaculture production system between

the water source and the agricultural field.

A few documents can be downloaded, including "Aquaculture in Israel," which lists production systems like plastic-lined and concrete super-intensive ponds. Culture species include carp, tilapia, mullet, catfish, and sea bass. Another document is "World trade and future consumption" which pegs the additional annual requirements for seafood of the European market at 650,000 tons and of the US market at 250,000 tons. By 2005, the seafood shortage will be about 20 million tons per year. Aquaculture will have to satisfy this demand.

www.da.gov.ph

This is the Philippine government's agriculture website. It has a lot of materials, from history of Philippine agriculture to the programs of its bureaus, attached agencies, field offices. [You may access the SEAFDEC aquaculture website through the navigation bar on attached agencies.]

To cut through the bureaucratic layers, go directly to OPPORTUNITIES and SERVICES. There, one can find investment opportunities; commodity situationer (prices and export data for milkfish, prawn, seaweeds); agribusiness events; credit information, and producer-buyer directory.

Recently posted under investment on post-harvest facilities is the installation of a seaweed buying station in Sulu to be run by the Seaweed Growers Multi-purpose Cooperative. The collaboration desired from potential investor may be a joint venture, procurement of machinery and equipment, and/or market access. Project cost is about US\$0.50 million.

For commercial production, there is investment opportunity for eel fattening in Cotabato City (estimated target produc-

to page 6, please

A beginner's guide to aquaculture

Like the introductory collegiate courses, this issue would be our **Aquaculture 101**. It has just enough information for beginning aquaculturists to take note of the intricacies of a fish farming business.

Fish farming usually starts with finding a good site and then deciding what fish to culture. This issue presents the most common industry choices. It also includes two (Philippine) government programs, one on financial assistance from the LandBank and the other on volunteer experts fielded by the Department of Science and Technology.

The contents are essentially Philippine examples because of our limitation in getting first-hand information. Readers from other SEAFDEC member-countries need not fear. The process of getting started and running the farm are universal principles, and can apply to your farms too. We are also pretty sure there are similar institutions in your own countries that offer similar services to ours.

We interviewed two successful fish farmers who started with practically no knowledge in aquaculture. Their success can be emulated.

The letters that started this issue ...

From: <Regomon@aramco.com.sa>
5 March 2000

I obtained a copy of your August 1999 newsletter while on vacation in the Philippines, December-January, and was impressed with the way the newsletter is produced. I was specially intrigued by your special report entitled, "Searanching in a Quezon island, Philippines: toward sustainable livelihood for small fisherfolks" (pages 12-13; 38), because, Perez town, where that searanch is located, happens to be my hometown. Out of curiosity, I visited the place (it's been a while since I was there last) and managed to talk to the town mayor who turned out to be a not-too-distant relative of mine!

During the course of conversation, she emphasized that their primary concern is the lack of underwater video equipment to monitor the progress of coral growth within the enclosure, or whether or not breeder-groupers are multiplying. They also need to make sure that damage to the net enclosure (whether man-made or natural) is promptly fixed, to avoid escape of breeder fish. Well, after hearing all the "sob stories" I ended up committing myself to providing them with an underwater video system (costing around P50,000).

Anyway, the bottom line of this story is that, as a result of this encounter, I suddenly got myself interested in aquaculture — exactly the reason why I accessed your Web site on the Net. And you know what? I'd like to know more about aquaculture by undergoing whatever training SEAFDEC can offer, so that when I finally come home (perhaps within the next 2-3 years), I would be engaged in aqua/fish farming ...

Do you have training programs geared specifically for prospective (but ageing) entrepreneurs, more specifically for OCWs who are coming home for good (who are more or less inclined to set up their own business)? If so, I would be very grateful to receive your training schedule and figure out how I could adjust my next vacation to

coincide with it. For your information, I have inherited a 10-hectare piece of land that has since been acting like a natural fishpond. I said “natural” because, though undeveloped, milkfish, prawn and mudcrabs habitually grow on it with no human intervention at all. Of course, my neighbors are just too eager to harvest the bonanza during summertime when the soil dries up and those hapless creatures get caught in a few remaining pools of water where they congregate.

Well, this message is getting a bit too long, so, I have to park here . . . Thank you for your time.

Momoy Regodon
LAN Administrator
Saudi Arabian Oil Company

I just acquired a 5 hectare fishpond with tiger prawn in it. I would like to know the latest technology, especially the cheapest feeds. I also want to know the latest technology in raising lapu-lapu (grouper). And, we would like to subscribe to your publication regarding aquaculture.

Bonifacio Sia Jr.
Naga City

22 March 2000



continued from previous page ...

We also have a special write-up on making aquaculture more environment-friendly and a fun article on what aquaculture can be in the future.

We would like to mention that our choice of topic this issue has been inspired by two letters we recently received. These letters asked very basic questions on aquaculture which we are now glad to answer.



A -- mudcrab culture in pens in mangrove areas; B -- tilapia; C -- the seaweed Kappaphycus; D -- hanging culture method for oysters and mussels



I'd like to invest in aquaculture, what choices do I have?

By **MB Surtida**

According to Yap (1999), the Philippines ranks 12th among the largest fish producers in the world and 5th in terms of aquaculture production. The Philippines has one of the highest per capita fish consumptions in the world at 36 kg per year. This makes aquaculture a very promising industry when viewed in relation to the decreasing catch from natural sources due mainly to rapid population growth.

A new investor in aquaculture has many decisions to make, foremost of which is the site for his fishfarm. If he has a property that can be developed for aquaculture, the fish species suitable to

this area should be chosen. Similarly, if he has in mind a particular fish to raise but doesn't have a property, he should choose a site that would be suitable to the fish.

Today, several aquaculture commodities are being raised profitably in the Philippines. These are: seaweeds, milkfish, tiger shrimp, grouper, catfish, carp, tilapia, green mussel, and oyster. Other species such as gouramy, rabbitfish, snappers, spadefish, lobsters, and abalone are also cultured in limited quantity.

The following table will help an investor through his initial decisions.

Species	Hatchery	How cultured	Where cultured	Extent commercialized/ economics and costing
Seaweed, <i>Kappaphycus</i>	Seedling bank in nursery stage	Fixed off-bottom monoline; bottom line	<i>Location:</i> below zero tide line in tropical intertidal and subtidal waters; in Clear, clean, pollution- free water; full sunlight <i>Substrate:</i> sandy-rocky to corally <i>Temperature:</i> 29-34°C <i>Salinity:</i> >32 ppt; <i>pH:</i> 7-9 <i>Nutrients:</i> nitrogen and phosphorus <i>Water current:</i> 20-40 m per min	Highly developed industry; for a 500 m ² area with multiple raft/longlines, investment is about P43,000, **ROI is 115- 1,470%, and payback period is 0.7 years
Seaweed, <i>Gracilariopsis</i> <i>bailinae</i>	Seedling bank in nursery stage	Fixed bottom, longline	Brackishwater milkfish or shrimp pond	For a 0.1 ha farm, invest- ment is P3,100, ROI is 576%, and payback is 0.16 year
Milkfish, <i>Chanos</i> <i>chanos</i>	Developed	Brackishwater ponds*; freshwater pens/cages; marine pens/cages	<i>Location:</i> free from industrial, agricultural, domestic pollution; protected from typhoons, floods, erosion; accessible to transport; free from poachers <i>Temperature:</i> 15-43°C <i>Salinity:</i> 1-158 g per l; <i>pH:</i> 4.5-9 <i>Dissolved oxygen:</i> 3-15 mg per l	Grow-out highly developed; commercial feeds readily available; For a 1-ha modular pond, investment is P40,000, ROI is 131%, and payback is 0.76 year
Tiger shrimp, <i>Penaeus</i> <i>monodon</i>	Developed	Brackishwater ponds	<i>Location:</i> pollution-free seawater, preferably with freshwater source <i>Temperature:</i> 15-30°C <i>Salinity:</i> 8-25 ppt; <i>pH:</i> 7-8.5 <i>Dissolved oxygen:</i> 4 mg per l <i>Water depth:</i> 1.2-1.5 m	Highly developed; For a 1-ha semi-intensive farm, investment is P1.4 million, ROI is 60%, payback is 0.76 year
Grouper, <i>Epinephelus</i>	R&D stage	Brackishwater ponds; marine cages	<i>Location:</i> calm waters, sheltered lagoons, coves, inlets, bays;	Grow-out limited by fingerling supply; For a

* brackishwater ponds are situated in estuarine environments with water arising from mixture of saltwater and freshwater and having a salinity of 0.50 and 17 ppt

**ROI -- return-on-investment

A cage for grouper near a mangrove area



Freshwater tilapia culture in a dam reservoir



A milkfish sea cage in an inlet



continued ... from previous page

Species	Hatchery	How cultured	Where cultured	Extent commercialized
			accessible to cheap trash fish and shellfish supply <i>Salinity:</i> 20-34 ppt <i>Water depth:</i> >3 m for cages, 1.2-2.0 m for ponds	0.9-ha pond, investment is P195,000, ROI is 82%, and payback is 1.22 years. For 6 units of 5x5x3 m cages, investment is P192,000, ROI is 59%, and payback is 1.68 years
Tilapia	Developed; now into genetic manipulation	Freshwater /brackishwater ponds; freshwater pens/ cages	<i>Location:</i> protected from strong winds and waves (preferably beside or between hills); dams; reservoirs <i>Bottom soil:</i> soft to enable easy embedding of stakes <i>Water depth:</i> 2-6 m for the duration of culture	Developed; commercial feed available; For 14 units of 5x5x3 m cages, investment is P145,000, ROI is 80%, and payback is 1-2 years
Oysters& mussels	R&D	Lines suspended from fixed or floating rafts	<i>Location:</i> presence of natural population of parent oysters; free from typhoons, strong waves or currents <i>Water depth:</i> > 5 m during low spring tides; fast moving 0.25-0.35 m per sec	Widespread small-scale, red tide constraints; For a 6x8 m bamboo raft, investment is P18,000, ROI is 74%, and payback is 0.9 year
Mudcrab, <i>Scylla</i> sp.	R&D	Brackishwater ponds, same as shrimp and milkfish; pens in mangroves	<i>Location:</i> freshwater source necessary <i>Salinity:</i> 10-34 ppt; <i>temp:</i> 23-40oC <i>DO:</i> 3 ppm; <i>pH:</i> 8.0	For a 0.5-ha pond, investment is P165,000, ROI is 49%, payback is 2 years
Catfish, <i>Clarias macrocephalus</i>	Developed	Freshwater ponds, small-farm reservoirs	<i>Location:</i> close to freshwater source <i>Soil:</i> heavy clay or not too sandy	Limited, mostly small-scale; for a 450-m ² pond, investment is P38,000 and net margin is P8,000
Carp, <i>Aristichthys</i>	Developed	Freshwater ponds, cages, pens	<i>Location:</i> close to freshwater source, sandy-clay soil	Limited; For a 1-ha pen, gross profit is P300,000

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New environment-friendly technology. *Mudcrab culture in pens in mangrove areas has proven to be quite profitable. At the same time, this system keeps the mangrove areas intact. The mangrove area is an important support system for aquaculture because most economically important fishes, shrimps, mollusks, and crustaceans nurse their young or feed in the area. Once grown, most move on to the sea to spawn, hence, providing seed for aquaculture*

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Requirements for fishpond lease: things you need to know and do*

By **RIY Adan**

Planning to venture into aquaculture? Here are the things you need to know and do to start the operation.

Lands are classified into: the titled or private land and the government-owned land. If the area you are eyeing to use is a titled land, then there is no problem. You can now start with your fishpond operation, just make sure you obtain a business permit. This also holds true with other similar aquaculture structures such as floating cages and small farm reservoirs. Technical assistance can be sought from the Bureau of Fisheries and Aquatic Resources (BFAR) and other fisheries agencies.

On the other hand, government-owned land is another story. It is governed by the Fishpond Lease Agreement (FLA), a 25-year contract. If after five years you were not able to develop the area, your lease will be cancelled. The area will then be made available to others who are interested or willing to develop it. Actually since 1992, BFAR has not been accepting FLA applications for new areas and especially those areas covered with mangroves. **Only existing areas with FLA permits either cancelled or forfeited are open for lease.** This is to curb the increase in

environmental exploitation. The government wants to retain and restore what is left of the country's once rich resources. Besides, the number of fishponds operating in the country is already enough to provide for the needs of the people, if and only if this is well developed.

The following are the things you need to comply with before you will be granted FLA:

Requirements in filing (new applicants)

- 1 Duly accomplished fishpond application form
- 2 Fishpond application fee of P1,000
- 3 Bank certification that the applicant has deposited an amount of P10, 000.00 per hectare for fishpond development
- 4 Affidavit of the applicant that the amount deposited in the bank will be used in the development of the area
- 5 Sixteen sets of initial environmental examination report
- 6 Survey plan of the area by a licensed geodetic engineer
- 7 Certification from the DENR that the area applied for is within the alienable and disposable area for fishpond development

*Interview with Dr. Sonia Seville, BFAR 6 Regional Director

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A typical fishpond in the Philippines; this one raises milkfish

- 8 Certification or resolution from the *Sangguniang Bayan* which states that municipality does not interpose in the development of the area applied for into fishpond

Requirements for FLA conversion, transfer and renewal

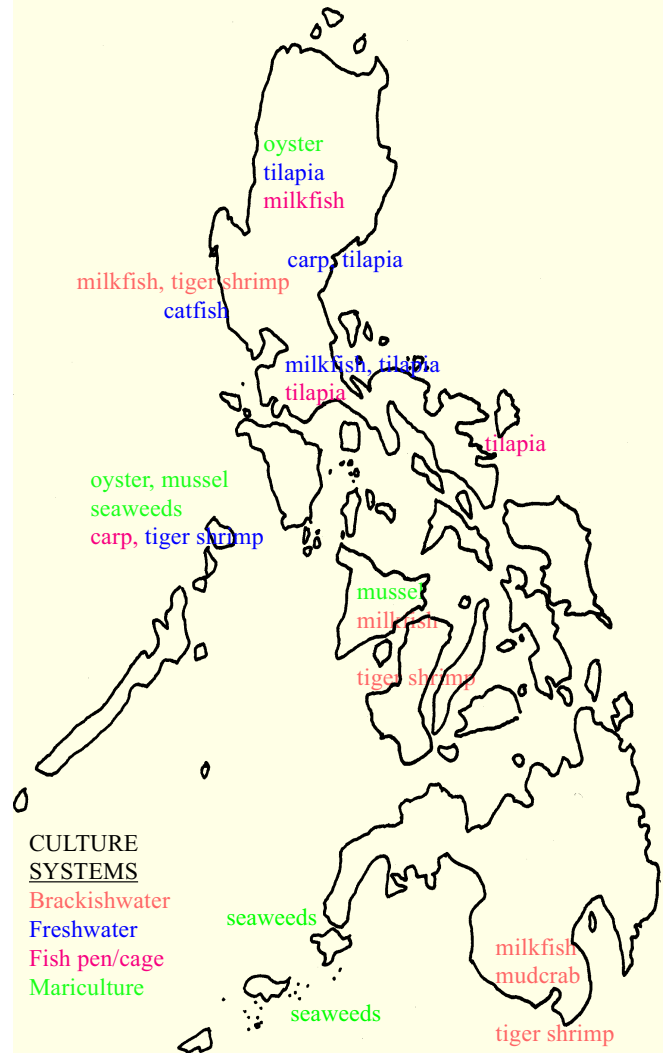
- 1 Twelve copies of approved survey plan
- 2 Twelve copies of FLA contract forms duly accomplished and notarized
- 3 Updated rentals
- 4 Cash bond deposit of P100 per hectare or fraction thereof
- 5 Certification from the Clerk of Court that the area is not subject to any judicial proceedings
- 6 Certification of the application that the area will not be subleased in the future
- 7 Certification from the BFAR Regional Director that the area is not subleased and not involved in any administrative case
- 8 Minutes of investigation
- 9 Recent improvement report
- 10 Updated semi-annual report
- 11 Certification fee of P4 (if transfer), a Transfer fee of not less than P10 but not more than P50

Fishpond rentals are now P500 ha per year – this rate will be increased to P1000 within five years.

To hasten application, it is advised that you apply personally. Make sure that the land you are applying is clear from any occupants or any court cases to avoid conflicts. You can apply at the nearest BFAR Provincial or Regional office. Call or write BFAR if you want to clarify things first.

Application is actually a breeze. It will be approved in a month or two so long as you have complied with all the requirements. ###

Choice spots



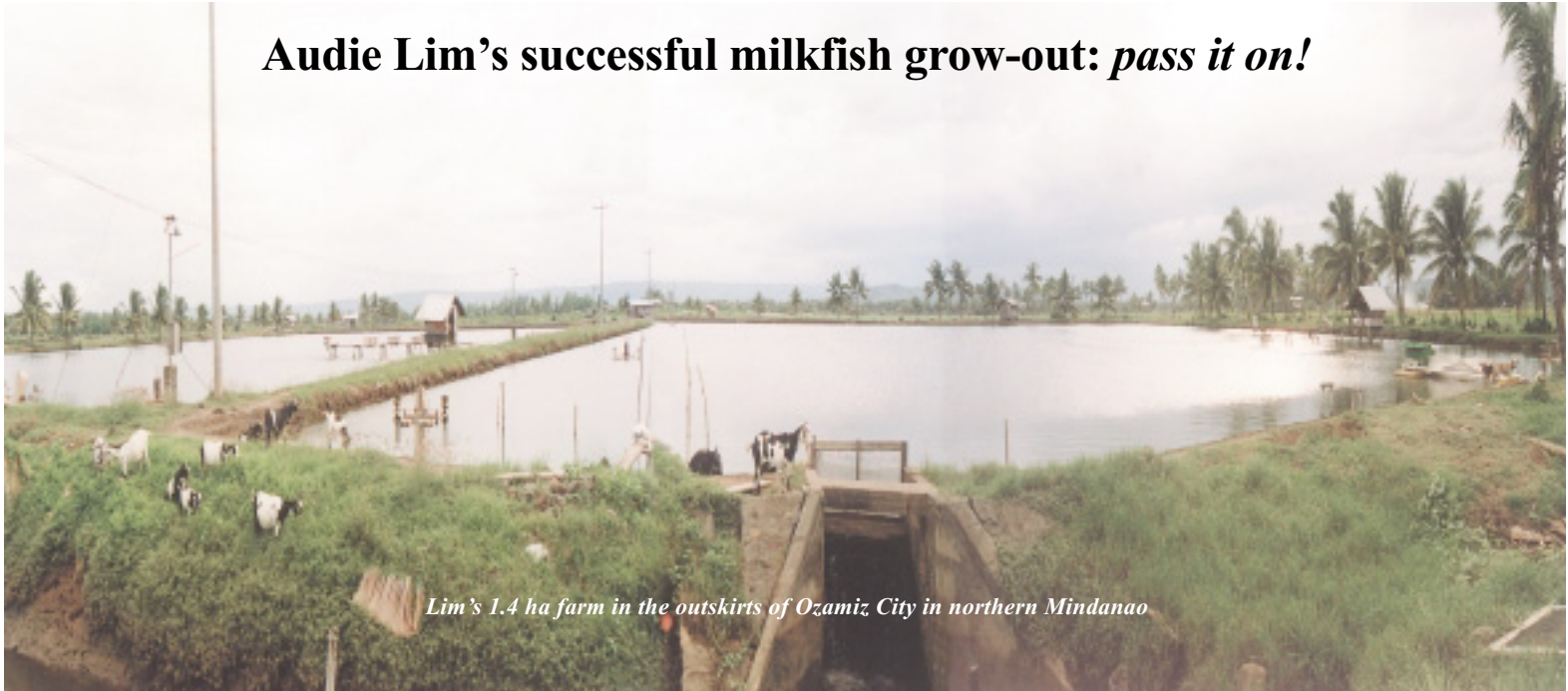
Aquaculture is the leading fish producing sector in the Philippines, contributing 34% to total fish production in 1998. Southern Tagalog region and the Autonomous Region for Muslim Mindanao surpassed other regions with its extensive production of milkfish and tilapia, and seaweeds, respectively.

Major species cultured in the country includes: seaweeds (68%), milkfish (16%), tilapia (8%), shrimps or prawn (4%) and others (4%). Only the top two commodities in each culture system and in each region are reflected in the above map.

DATA FROM 1998 PHILIPPINE FISHERIES PROFILE, DA-BFAR

PROFILE OF SUCCESS

Audie Lim's successful milkfish grow-out: *pass it on!*



Lim's 1.4 ha farm in the outskirts of Ozamiz City in northern Mindanao

By **NJ Dagoon**

Audie Lim has never had a formal knowledge of aquaculture. But his name is fast becoming a byword among serious intensive milkfish aquaculturists in southern Philippines. If things should continue to go well, his name may become famous in the milkfish-producing countries in Southeast Asia -- Taiwan, Indonesia, and the Philippines.

Lim is known as Chun Chay in the Chinese community. He pursued a degree in medical technology in a Cebu college in the 70s and at the young age of 19 got married. He then took over the family business in Ozamiz City, a hardware construction and supply store.

It is by "accident" that he is now fully engaged in aquaculture, Lim recounts. In 1986, stories about sudden overnight financial windfalls from tiger shrimp culture were spreading around the area. Everyone seemed to agree that shrimp was the sunshine industry of that time; so it was not difficult to see how he and his associates (some family members) got "lured" into the business, even with little knowledge about it.

They started building their farm (at the cost of about P500,000 per ha) and did get a good harvest in 1988-89. But the early 1990s was the dreadful time they experienced a financial reversal, as all the other shrimp farmers did because of widespread disease problems. While the rest of the community seemed to express violent reactions to it, Audie Lim calmly began his

odyssey into the serious world of aquaculture by reading Taiwanese books on the subject. Finally in 1992, he and his associates decided to halt operations. But as he relates, Chinese entrepreneurs are not known to give up easily. His brother suggested that they go into milkfish farming to make use of their idle but developed ponds. While other farmers scoffed at the idea -- was there real money in *bangus*? -- they proceeded to stock in the latter part of 1992.

Commercial feed for milkfish was not available then and literature was scant. So Audie Lim innovated steps along the way. He attempted extensive farming first by growing *lablab*. After two to three months, he began feeding the fish with rice bran. In about 6-7 months of culture, he was able to harvest 600 g fish. He concluded that there was money in milkfish after all. Then true to his nature, Lim decided to increase his stocking rates.

During the course of these initial ventures, Lim and his associates were introduced to Tateh Feeds, a commercial feed company. By using the formulated feeds, they were able to shorten the culture period to 4 to 5 months. "With good survival, good quality fish with bigger bellies and a good smell," Lim narrates, "we decided to go as high as 35,000 per 0.6-0.7 ha (or 50,000-60,000 per ha)." They reduced this level to about 40,000 per ha, however, as they had not forgotten their disastrous experience

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NOTE: THE MENTION OF TRADE NAMES IN THIS PUBLICATION IS NOT AN ENDORSEMENT BY SEAFDEC/AQD



Mr. Audie Lim and his harvest of bangus at the Ozamiz farm (middle photo)



The Tateh Feeds demonstration farm in Silay City, west Negros. In the foreground is one of the farm's paddle-wheels (designed by PS Cruz)

with prawn. [Note: at this time of writing, SEAFDEC researchers have not yet established the limits for stocking density that would not harm the environment.]

Seeing their thriving business, people have begun to take interest in it. He says that *bangus* culture involves less risk than prawn. Profit is quite small (about P10 per kilo, ROI of around 24-28% in five months) but with intensive culture a hundred ton production would be equivalent to a million pesos. "That's just enough to keep your interest going."

As one of the pioneer users of Tateh Feeds in Ozamiz, Audie Lim has become a dealer of the product in the area. "I have a few friends who are close to me; I have offered to help them with their farms. In exchange, they get feeds from us," he said. "A lot of farms now run *bangus* in the area."

Two years into the business, Lim began to practice *bangus*-prawn polyculture which he has found even more successful. On a 0.6-0.7 ha area he stocks 30,000 *bangus* fingerlings and 15,000 wild prawn fry (bought at P0.70 apiece). At five months of culture, he is able to get 350 kilos of prawns (jumbo, 60-70 g). Selling at P550 a kilo, the prawns reap more than P150,000 in net profit.

Currently, Lim manages a total of 25-30 ha of farms in the area (including 4-5 ha all his own). His *bangus* fry, though, travelling a long and winding route (SACI hatchery in General Santos City-Manila-Bacolod-Dumaguete-Ozamiz) are strong and sturdy with survival rates as high as 80-100%. Because fry is available throughout the year, this makes possible his plan of doing 5 croppings every two years (currently, it is two a year). He harvests 15-20 tons of milkfish per week bringing the annual total to about 500-600 tons. He computes cost of production at around P36-40 a kilo and sells his produce at P50-60 a kilo.

"When we started, we had a hard time selling our fish," Lim recounts. "So while we were increasing our production we

were also trying to sort out our market." Aside from the Ozamiz market, they also sell to other cities as well. Now they regularly bring a major portion of their fish to the Navotas fishing port.

What makes Audie Lim's farm technology different from the rest?

First, he digs his ponds a little bit deeper than conventional farms, from 1 to 1.5 m to accommodate intensive operations. He also believes in feeding fish continuously from morning till late afternoon. "As long as the fish eats, we feed them," he says. He has developed a feeding rate that is adjusted according to the average body weight of the fish. "How much they can eat, is how much they can grow, that's our concept. So if your fish eats a kilo a day, your fish will grow half a kilo a day if your FCR (feed conversion ratio) is 1:2."

Another useful innovation is a speedy harvesting and packing system. He recalls how difficult the first time they harvested using a gill net in 1995. "To harvest 800 kilos we had to start at 8 a.m. and finish at 6 in the evening." Now they use a very large net. With their current capacity, they can process 2 tons of fish from harvest, chilling, sorting, weighing to packing in styrofoam boxes in only 1-2 hours.

Most farmers sell their fish when these reach 300 g (3 pieces to a kilo). Lim, however, grows them for 10 days more, as demand and the price are higher for bigger ones.

Lim keeps careful records of farm production data, past and present, and analyzes these to make projections about the future. This is perhaps the secret to his successful handling of crisis situations: the crashes experienced by the prawn industry in the early 1990s and by the milkfish industry in 1997.

In the crash of 1997, milkfish prices plummeted to as low as P35-38 a kilo. With resolute will, however, Audie Lim and his associates rode out the storm. They had predicted the crash a

PROFILE OF SUCCESS

The Jamandre *bangus* hatchery

By **NJ Dagoon**

The business started in the early 1970s when the Iloilo City family patriarch Engr. Tirso Jamandre Jr, an industrial engineer by practice, became an aquaculture engineering consultant for the UNDP-FAO South China Sea project. With the experience gained, he decided to set up a prawn hatchery in Lapuz, along the Iloilo River. Being successful in growing different species on a pilot scale, he closed down the hatchery in the area and set up a bigger one in Oton in 1981.

After his unexpected death in 1982, the Jamandre family in 1985 went into a joint venture with a consulting company Aquatic Farms Ltd. Together, they formed Jamandre Hatcheries, Inc. with Stella Aileen Jamandre, one of the daughters, becoming president of the company. While her mother, sister and brother have remained in the company's Board of Directors, Aileen who has a degree in marine biology is the one in direct control of the business. Their foreign partners have also left the daily operations of the business in Aileen's hands, though they continue to serve on the Board.

An all-Filipino staff totaling 40 now man the company with each hatchery operation having a manager. A few have a formal knowledge of fisheries, while most have some learning gained from on-the-job experience, training, and interest.

Being one of the pioneers in the prawn aquaculture business, Jamandre Hatcheries is reputed to have one of the highest average survival rates (about 90%) in the locality. "I think we have a technical advantage. We invest more. Hopefully, it pays off, but it costs to do it," Aileen remarked.

About six years ago, the company started the shift to milkfish breeding, after having served as a cooperator of a successful SEAFDEC/AQD-conducted *bangus* hatchery trial run in



The Jamandre milkfish hatchery in San Joaquin, Iloilo. CEO Stella Aileen Jamandre (left) says that the milkfish hatchery business will pick up soon.

1992. Their 200 broodstock are a combination of eggs sourced from AQD and grown to maturity, along with other milkfish from brother Tirso III's ponds. The broodstock are fed with a diet based on the AQD formulation.

Today, one of the company's four operations is on *bangus*. Larvae are reared in 10-ton tanks in their milkfish hatchery (converted from prawn) located at Crossing Dapuyan in the town of San Joaquin, Iloilo. The milkfish larvae are fed mostly live food, algae and *Brachionus*, and are stocked at a density of about 100 per liter.

The hatchery facilities are part of the Department of Science and Technology / United Nations Development Programme / Gainex project formally known as Milkfish Broodstock Development and Fry Production in Ponds and Tanks. The project is coordinated by the Philippine Council for Aquatic and Marine Research and Development, and has UP-Visayas as its consultant.

The project started in August 1997 and will end July 2000.

The five-year-old *bangus* breeders only started to spawn in late November-December of last year. Since March to September is spawning season for the species, they are expecting full-scale production this year. They usually sell 20-day-old fry lower than the prevailing hatchery market price and those caught from the wild. Their price ranges from as low as 20 centavos to as high as one peso apiece.

Aileen said, "We are able to dispose all of them (fry). Abnormalities are less than one percent in our case. We believe in natural selection and that only the ones without deformities survive." She roughly places survival rate at about 50%. The hatchery gives an allowance of extra fry to cover for incidence of de-

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formity or mortality.

Since the Jamandre's *bangus* hatchery is still a fledgling enterprise, accurate production data such as rates of hatching and survival are not yet available. The company has not yet even recovered their initial investment on the hatchery for more than five years already. But the family business CEO foresees that the venture will be picking up soon. "(Hatchery-bred milkfish fry) are becoming more acceptable because a lot of (them) came from the one before (referring to the AQD trial run), and they (now, broodstock) have performed very well," noted Aileen. "Even the milkfish grow-out technology is something that AQD has proven as early as 10 years back. But the reason it has not taken off," she laments, "is the government's lack of support. (Even now,) the situation has not changed much, but that has not stopped us."

Can she share some secrets of doing well in the aquaculture



This marker at the hatchery entrance notes the assistance extended by the Philippine government to private investors like Jamandre

business? "Like in any business I guess, perseverance, belief in what you're doing, integrity, honesty with the people you work with and with your clients, and attention to detail (in the hatchery) are important," she stressed.

Will they go beyond the hatchery business in the near or distant future? "We're pretty much a hatchery business," Aileen said. "With regards to other species, perhaps—I'm very interested in tilapia."

Concerning the future of their *bangus* hatchery business, the company president said that they plan to become a more efficient and stable enterprise. "I would also like to see a higher percentage of utilization of our hatcheries for *bangus* operations," she remarked.

Her advise for interested prospective hatchery operators? "The hatchery is very much dependent on the way you want to run it. You reap what you sow; you invest more, you gain more...but I don't think it is simply that we spend much, and that anybody who spends this much, can. Actually, there are a lot of facilities still not being operated; so if you want to start a backyard operation, you may rent one of those."

"Prospects are very good," she stressed. "I think that people who are really decided should do it. Like any other business, there are obstacles that could be overcome."

"But in anything that we do, I think that the most important thing to do is God's will. No matter how strong your financial judgment is, but if (the business) is not his will for you, (you won't succeed). It is better to do the right things at the right time, because that's where he wants you to be," she concludes.

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TECHNOLOGY UPDATE

High-density milkfish sea cage farming prospers

Thirty-three tons of milkfish per ha may be cultured in 115 days inside marine pens and cages. The promising technology is a result of tests conducted by the Department of Agriculture in the coastal provinces of Pangasinan and La Union. Already, fishpens have rapidly proliferated in central Luzon.

"Production from a 6-m deep 1,000 m² cage was 5.7 tons of milkfish after 138 days at 94% survival and feed conversion ratio of 1.77. Return-on-investment was about 45%," said aquaculturist Arlene de la Vega of a Batangas project which was based on the above technique, though modified to suit local conditions.

The basic design of these confining structures is described by de Vega as follows. "Fishpens are square or rectangular netwalled structures using bamboo or wooden poles and polyethylene nets. Sizes range from 500 m² (25 m x 20 m) to 1 ha (100 m x 100 m).

"Floating cages are square or rectangular cages made of

polythelene netting attached to wooden bamboo or GI pipe frames and are kept afloat by bamboo, styrofoam or plastic drum. Concrete weights attach or anchor the corners of the floating cages to the bottom. Sizes range from 27 m³ (3 x 3 x 3m) to 1,800 m³ (15 x 20 x 6m).

More sophisticated designs (stationary cages, offshore cages) have been briefly described by de Vega in the previous issue of this newsletter (October 1998).

Fish pens may be stocked at 5-20 pcs per m². Floating and stationary cages, and offshore cages are stocked at 10-30 per m³ and 35-100 per m³, respectively. Monthly production in Pangasinan during peak operations is 3,000 tons.

It is best to develop an efficient management strategy for feeding, and perhaps, to employ automatic feeders, to improve the feed conversion ratio (FCR) from 3.0-4.0 to 1.8-2.0.

Farming milkfish in the sea has a considerably higher productivity at a lower capital cost (at least thrice more fish biomass for about the same investment in facilities) than land-based aquaculture. -- NJD

Financing from LandBank

By LandBank, Iloilo City

The Land Bank of the Philippines provides financial support to farmers and fishermen cooperatives, small and medium enterprise (SMEs), local government units (LGUs) and commercial borrowers.

Lending to cooperatives

Eligible fisheries-based projects include the following:

- aquaculture (fishery operations involving all forms of raising and culturing fish and other fishery species, in brackish and marine waters)
- development of postharvest facilities, fishpond development, acquisition of fishing vessel and accessories, processing, and marketing activities

These are covered by the following types of loan:

- fixed asset loans are medium- and long-term loans used to finance acquisition or establishment of production, processing, or postharvest facilities and equipment
- production loans are short term loans that may be used to finance the production inputs for one crop cycle such as purchase of materials for farming
- operating or working capital loans are loans used for the maintenance of storage, processing, and marketing facilities as well as trading and marketing capital

The corresponding interest rates are: 12% for production and operating capital; 14% for fixed assets; plus 2% supervision fee.

Production, working and operating capital loans are payable from six months up to one year. Fixed asset loans are payable in two years up to a maximum of ten years depending on economic useful life asset and cash flow of the project.

Other support interventions of the bank to the cooperatives are organizational and institutional development, institutional capability strengthening, enterprise development, marketing, and technical assistance.

Collateral requirements cover:

- production loans -- Deed of Assignment of Individual Member PNs/TRs; Deed of Assignment of Insurance or Guarantee Coverage
- fixed asset loans -- Object of financing/Chattel/REM for fixed asset loans; Real Estate collaterals acceptable to LandBank
- operating capital loans -- Continuing CM or Stocks/REM/ Chattels



Basic requirement for newly accessing co-ops under the accreditation criteria include:

- CDA requirements like articles of cooperation and by-laws; duly organized set of BOD and committees, and certificate of good standing
- membership of at least 60
- minimum paid-up share capital of P30,000
- all members have undergone PMES
- Core Management Team that includes qualified or duly designated part- or full-time Manager bonded part- or full-time Cashier or Treasurer and full time Bookeeper

Small and Medium Enterprise (SME) lending program

LandBank also provides financing to small and medium entrepreneurs. Here, eligible borrowers are sole proprietorships (100% Filipino-owned), partnerships (100% Filipino-owned), or corporation (at least 60% Filipino-owned). The asset size is up to P15 million (small enterprise) and up to P60 million (medium) excluding land or project site; and should not be a branch, subsidiary, or division of any large corporation or company.

Eligible projects should fall under the following industries: agri-business, manufacturing, processing, services, trading, and general merchandising. Apart from the standard requirements, the projects should be able to generate employment and should show high potentials.

Loan amount is based on the actual project needs but should not exceed 80% of the total project cost. The 20% is the borrower's equity. Loan maturity is based on project cash flow. For interest, the project will be charged prevailing market rates that can be negotiable depending on the collateral business (deposits, LCs, etc.) that the project can generate.

☞ page 22

Getting the fishfarm ready

AND THEN OPERATING IT

By **M Castaños**

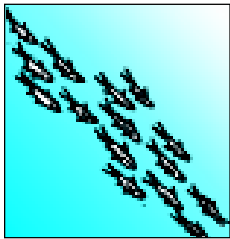
Having bought or leased the farm area and sourced the operation money, the next step is getting the fish farm ready. Below is an overview of farm operations.

Whether you're running a fishpond or a netcage/pen, thoroughly **inspect the farm site first**. Repair those structures that



need to be repaired or replace them; pay special attention to pond leaks, broken gates, net tears, and/or pen gaps. The bottomline is, the stock should not be able to escape nor should pests and predators easily come in and compete for food and space with your stock. Check equipment, power supply, and other necessary stuff.

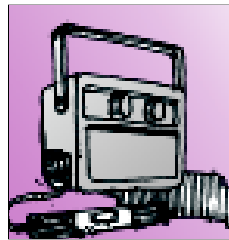
Ponds would need **special preparation**, like the growing of natural food (*lablab* or *lumot*), especially when the culture system is extensive or semi-intensive. This may take at least a month. You may need to apply lime, organic (environment-friendly) pesticides like teaseed powder to kill pests/predators inside the pond, and (organic) fertilizers like chicken manure to support the growth of natural food. Eradicate snails in milkfish ponds by drying or using metaldehyde-based products. Some cultured species have special requirements, like extra shelter and mounds (i.e., grouper and mudcrab). Prepare these as well.



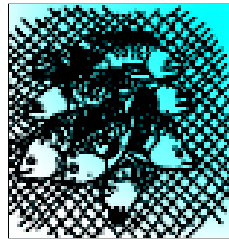
After these preparations, it is now time to **stock the fry**. The usual source for bulk purchase is the hatchery (especially for tiger shrimp) or the fry bodega (these are middlemen who buy directly from fry gatherers of wild grouper, milkfish, and other fry). It is best if you get from reputable sources. Note that you can have the fry delivered right to your farm or you can pick these up yourself. Stock the fry in early morning when it is cooler to avoid stressing the fish.

Like a human baby, your growing stock would need **care and close attention**. See if the stock is eating well and the water is relatively of good quality. Natural food in ponds is usually "consumed" in about a month in semi-intensive culture, but this can be visually checked. [For extensive culture, inorganic fertilizer may be used as "dressing" every two weeks after water change to maintain growth of natural food.] Then its time to give artificial feed. But first, sample the stock so you'll know how much to feed. This means you fish out a few of the stock, weigh and measure them. Keep a record, and use the feeding rate ap-

propriate for a certain fish size and estimated survival and growth. Feed companies usually recommend feeding rates with their products. There are also cases where fresh feed or live feed is called for. Live tilapia or trash fish are fed to grouper, seabass and/or mudcrab.



As for water quality, these should be monitored at least weekly. Check the dissolved oxygen (especially morning DO), temperature, salinity and water depth. For DO-temp, a YSI oxygen meter is relatively easy to operate; for salinity, a refractometer is very accurate (not your tongue!); and for water depth, a simple calibrated wood stuck in the middle of the pond will suffice. Another routine is the changing of water. This usually follows the lunar or tidal cycle. Drain water when its low tide and replenish during high tide (by pump if not natural tidal flow). It is a must that you keep a calendar carrying the dates and heights of low/high tides in your farm office.



If all goes well, you can **harvest in 4- or 5 months**. Remember that timing is also important. The law of supply-and-demand holds especially true for milkfish. Shrimp, on the other hand, has basically remained a seller's market after the industry slump caused by disease problems. You can have a buyer get your produce at the farm or you can go to the fish port to sell it (see our related story on fish marketing, page 23).

In harvesting, take note of the natural characteristics of your stock. Milkfish, for instance, swim against the current. So, farmers harvest by the *pasulang* method. That is, they let out water during low tide, then let it in again in high tide; when milkfish congregate near the pond gate in response to the water current, a matting made of bamboo is made to encircle the stock. Harvest becomes easy.

Other crops would have to be harvested the hard way -- seining then totally draining pond water (like shrimp) or manually and painfully (like mudcrab).

The fresher, the better. The recommended way in bringing harvest to the market is by chilling in ice water and adding crushed ice in between shrimp/milkfish layers. Of course, other crops are more acceptable when marketed live, like grouper, seabass, and mudcrab.

We hope you have a profitable experience. ###

Technical support groups

By **RIY Adan**

So, you want some help? You can count on a lot of people to assist you. The first choice would probably be BFAR -- the Bureau of Fisheries and Aquatic Resources (BFAR) -- which is the lead government agency mandated to manage the country's fishing industry. You can always drop by any Regional or Provincial BFAR office nearest you. But there is a new government program where you can get technical advice tailored to your needs.

DOST-TAPI-CTDP

The Department of Science and Technology (DOST) - Technology Application and Promotion Institute (TAPI) brings scientists and experts from different fields to clients all over the country through the Science and Technology Expert Volunteers Pool Program (STEVPP). Experts are made available free for very short term technical assistance to cooperatives, LGUs, state colleges/universities, NGOs and other interested parties.

This program is a primary component of the Comprehensive Technology Delivery Program (CTDP) which aims to fast track technology transfer and commercialization. This is also made possible with the cooperation of over 65 agencies from DOST, other government agencies, private corporations and the academe.

Interested parties should detail the following in their request: type of technical assistance needed, proposed date of the activity, proposed venue, potential beneficiaries, and expertise required. TAPI provides the matching and networking of experts across the country vis-à-vis the technical requirement of the requesting party. Present volunteers include aquaculture/fisheries experts coming from BFAR, SEAFDEC/AQD, PCAMRD, PCARRD, UPV, CLSU, UPLB, Agri-Aqua Network International and some private practitioners. The Institute shoulders the volunteer experts' plane and other transportation expenses, portage, and terminal fees, including insurance coverage for the duration of their assignment. Requesting parties, on the other hand, should provide for the experts' food, accommodation and in-land travel expenses while on site.

Interested parties may submit request for volunteer consultants to:

National STEVPP and Luzon:

Dr. Maripaz L. Perez

Director and In-charge, STEVPP

Technology Application and Promotion Institute

Gen. Santos Avenue, Bicutan
Taguig, Metro Manila
Tel. Nos. (02) 837-6188, 837-2936, 838-1140
Contact Person: Lot Palileo

STEVPP-Visayas:

Engr. Reneburt N. Llanto
In-charge, STEVPP-Visayas and Regional Director
DOST Region VII
Gov. Manuel Cuenco Avenue
Banilad, Cebu City
Tel. Nos. (032) 231-1916, 231-7015, 232-8632
Contact Person: Sam Parcon

STEVPP-Mindanao:

Dr. Constancio C. Cañete
In-Charge, STEVPP-Mindanao and Regional Director
DOST Region X
JR Borja Memorial Hospital Compound
Carmen, Cagayan de Oro City
Tel. No. (088) 858-3932
Contact Person: Bernie Mendoza

Other sources

Or you can visit us in Tigbauan, Iloilo and have first hand information from experts in the different fields of aquaculture. SEAFDEC/AQD develops technologies on the farming of fishes, crustaceans, mollusks, and seaweeds for food, livelihood, equity, and sustainable development. It offers the following regular training courses: responsible aquaculture development, fish health management, freshwater aquaculture, management of sustainable aquafarming systems, marine fish hatchery among others (see page 37 for schedule).

And if you want more information on specific topics, you can always drop by the SEAFDEC/AQD Library – known for having the biggest collection of aquaculture materials in South-east Asia.

AQD Library contains a comprehensive collection of materials on fisheries/aquaculture and on allied disciplines such as biochemistry, ecology, feeds and nutrition, fishpond engineering, freshwater, brackishwater and marine biology, oceanography, phycology and others. You can also search these topics using the CD-Roms that the library maintains. Copies of Aquatic Science and Fisheries Abstracts (ASFA, www.silverplatter.com),

☞ next page

Support groups ... from previous page

Fish and Fisheries Worldwide (FFW) and Aquatic Biology and Fisheries Resources (ABFAR, www.nisc.com), Current Contents (www.isenet.com) - Agriculture, Biology and Environmental Science and Life Sciences, Reef Base, FishBase and FishStat (FAO, www.fao.org) are available for your use.

The newest feature of AQD Library is the use of Follet – a library automation software which speeds up the location of library materials through easy on-line searching methods. In-house databases can be accessed through this software.

AQD's library databases include aquaculture/fisheries books, pamphlets, journals, magazines, newsletters, bulletins, special collection of information materials on selected brackishwater aquaculture species, materials and citations on Philippine fisheries and aquaculture including SEAFDEC/AQD's papers published in journals and proceedings.

These are just some of the institutions you can seek assistance for your aquaculture venture. It's just a matter of approaching the right people. Good luck! ###

bank financing ... from page 19

Acceptable collaterals include:

- real estate properties and improvements
- machinery or equipment
- deposit hold-out
- Joint and Several Signatures (JSS) of principal stockholders or officers
- guarantee coverage (SBGFC or GFSME), if collateral-short;
- for transactional facilities, confirmed LCs/Pos, with the endorsement of appropriate industry association

Lending program to local government units

The Local Government Code of 1991 provides that any LGU may avail of credit facilities to finance local infrastructure and other socio-economic development projects in accordance with the approved local development plan and public investment program of the LGU.

Eligible projects include construction, installation, improvement, expansion, operation or maintenance of the following: public utilities; infrastructure projects; housing projects; implementation of capital investment projects; waste disposal system; electrification; waterworks; establishment, development or expansion of agricultural, industrial, commercial and livelihood projects; and acquisition of property, plant, machinery, and equipment and other similar accessories.

Loan amount is based on project requirement but should not be more than the net borrowing capacity as defined in Article 419 of RA 7160. The LGU shall contribute at least 25% of total project cost. Loan maturity is based on LGU's cash flow but preferably not to exceed five years. Interest rate shall be based on prevailing market rate. Lending rates are, however, negotiable.

Collaterals include the following: hold-out on deposits; real estate properties; machinery and equipment owned by the LGU; and Deed of Assignment on any or all of the following -- (i) 20% of the LGU's Internal Revenue Allotment (IRA), (ii) LGU's regular income as sourced from its annual budget, equivalent to an amount sufficient to service the loan with LBP but in no case exceeding 20% to its regular income, and (iii) net profits or income for the project or economic enterprise to be financed. This shall be the net of all costs and expenses related to the project.

Commercial credit

Commercial and industrial loans include, among others the following:

- Omnibus Credit Line - a flexible revolving credit line with maturity of one year and more than one type of loan line can be availed of. An OCL usually included any two or all of the following lines short term loan, export packing credit, export bills purchase, LC/TR, and foreign bills purchase
- short term loan line - a one-year revolving credit line to finance seasonal or cyclical needs of an ongoing business
- Export Packing Credit Line (EPCL) - a one-year pre-shipment credit facility extended to an exporter who is a beneficiary of a valid (LC/PO). The line will finance procurement of materials and labor to manufacturer goods for export
- term Loan - a credit facility with maturity of more than one year to finance fixed assets acquisition and other long term needs as well as expansion of an ongoing business

For more inquiries, visit any LandBank branch:

Ms. Janice Hilay
Bank Executive Officer
Agrarian Lending, In-charge
LandBank of the Philippines
Iloilo City

Ms. Jane Seloso
Administrative Services Officer
Iloilo Business Center, In-charge
LandBank of the Philippines
Iloilo City

*Acknowledgment: Mr. Ibram M. Alonto, Regional Head,
LandBank of the Philippines, Iloilo City*

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Fish marketing practices

By **NJ Dagoon**

Trading activities at the Iloilo Fishing Port begins at about midnight and lasts to 7 in the morning. Fish from commercial fishing vessels and from fish ponds from other parts of Panay island are unloaded into the 1,200 m² market area as the mass of fish brokers and wholesale fish buyers eagerly await the business of the day.

Harbor and Market Operations Chief Rizaldy Toledo, notes that about 60 tons of fish are unloaded every day based on the past year's records. On a typical shift, Port market checkers on duty roam the crowded market premises to list the number of *bañeras* (each roughly equivalent to about 35 kg of fish) that constitute the volume of fish unloaded for the day. Milkfish and other aquaculture products accounts for more than 23% (or 1/5) of the market's total volume. Last year's top five local fishes in terms of volume (expressed in kg) were *bangus* (5, 571,125), *tuloy* (1,937,110), *aloy* (1,839,425), *baticuling* (1,272,075), and *bilang-bilang* (1,068, 865). Peak season for commercial marine fishing, according to the Port market chief, is around December to June. During the southwest monsoon, aquaculture products usually take the bulk of the products, with other fish coming even as far away as General Santos, Davao and Zamboanga in Mindanao.

Mr. Toledo mentions that commercial catch is now declining. "Then fishers only had to go some hours from here to their fishing grounds now they have to go as far as Cebu or Mindanao and spend more for their fuel."

Considering that milkfish is now among the top five fishes the Iloilo market accommodates, how will aquaculture products fare in the next 5-10 years? What will their effect on the market be? "Our population is increasing," he notes, "but fishponds can



Mr. Laure's trayloads of bangus bound for the Navotas fish market

no longer be expanded to preserve our remaining mangrove areas. The price of *bangus* is stable now, being maintained at P50 a kilo. We even get big sizes of Lake Sebu tilapia from General Santos City. Who would have heard of that ten years ago? Freshwater species are becoming more acceptable. If majority of fishes to be traded here will be aquaculture products in the future, I don't think there would be much of an effect. People are now becoming more health conscious, people will learn to accept the change. Even now, *hito* (catfish), already has a market. We have to be competitive because Taiwan is now gaining entry into the local market."

On one particular early morning visit to the port complex, the newsletter staff spotted Manuel Laure, Jr., busy packing a little more than two tons of four-month-old milkfish which were harvested prematurely from a flooded extensive fishpond in Ajuy, Iloilo. Laure has been a wholesale *comprador* for a Navotas-based fish trader for two years now. On the day of our interview, he has successfully negotiated a deal to buy the milkfish at P42 a kilo (11 small pieces) *sa komisyonan* (through a stand-in guarantor) PSJ Fish Brokers, one of around 25 trading facilities in the area. He believed that his boss in Navotas, a close business associate of the brokerage facility, might sell the fish on retail for about P58 a kilo.

Laure's aide and secretary, Sonia Ocampo, said that shipping the fish to Luzon necessitates the use of two large boxes with a capacity of about 1,400 kilos each. Trays, each containing around 35 kilos of fish and crushed ice packed in layers, are mounted inside. Ice is purchased at about P112 per block; each box uses about 14 ice blocks. A box containing about 42 trays

➤ next page



Elmer Figuracion, the Fishing Port's Ice Plant and Refrigeration Division Chief (left) and Rizaldy Toledo, the Port's Harbor and Market Division Chief



Lloyd Hilado, Port market supervisor



Inside the processing facilities



A factory worker displays the branded and packed aso-os fillets

costs about P1,800 in shipping fees.

Edwin Jordan, on the other hand, is part of the husband-and-wife team who manages PSJ Fish Brokers. Today, he was able to purchase and sell about seven tons of varied fish, mostly coming from marine deepwater sources and caught by hand. He mentioned some fishes by their local names: *malasugi*, *gingaw*, *kansilayan*, and *kilawan*. The prices each kilo of fish took ranged from P10-20 (*pagi*, *bagis*) to about P100 (*lapulapu*, etc.). He expected a drop in sales these summer months because school was off.

The Philippine Fisheries Development Authority (PFDA) that operates Iloilo Fishing Port Complex is a government corporation. Commercial, municipal and aquaculture fish producers and wholesale fish buyers pay fees for port entry, and market access. Fish brokers pay for market space on a contractual, renewable basis, other market fees and sundries (unloading, etc.).

Port authorities' main concern is to see that trading activities focused on the fish brokerage business go on smoothly. The fish broker's office serves as the middleman between the fish

producer and the wholesale fish buyer. The fish broker buys the fish in cash from the supplier (a commercial, municipal or aquaculture producer) and sells the fish wholesale by *bañeras*. Negotiations between the brokers' salesman (or in local terms, the *mayor panting*) come in the form of the informal "bulungan" system and the auction/bidding system. When fish are scarce, Mr. Toledo pointed out, the "bulungan" or closed system prevails. The broker charges a 6% commission for every kilo of fish he sells. Mr. Lloyd Hilado, market supervisor said that about 98% of the wholesale fish trade is in the form of credit. Since this "gentleman's agreement" is not binding, it often is the source of consternation among traders and port authorities.

Some other facilities that are available for fish activities at the Port are freezing and cold storage, and fish processing areas, which are available for rent at certain charges. The port, said Mr. Toledo, is an interagency effort, a one-stop shop for fishery-related activities. It even includes a customs area, and functions as a call port for fishing vessels that load provisions such as ice,

The hidden traps in aquaculture

By **MB Surtida**

New investors in aquaculture probably know that they can make mistakes as they continue to operate their farms. Whether the mistakes happen immediately or not are risks they take as long as the mistakes are manageable and can easily be corrected. But many aquaculturists who have long been in the business say that there are costly mistakes that can wipe out one's investment. This paper is based on interviews with experienced aquaculturists and some popular articles from other aquaculture newsletters (Lindberg and Pryor on ways to lose money in aquaculture, Proceedings, sustainable aquaculture 95) and shares some insights regarding mistakes that may be hidden to new investors but obvious to experienced aquaculturists.

1. It is a blunder not to think of aquaculture as a business enterprise. Aquaculture is business. Some investors who have technical know-how, such as retirees who have had a chance to observe aquaculture operations while still working, think that farming problems can be solved with high technology set-up, top biologists, and known consultants. But the real problems that cost money, say Lindberg and Pryor are bad weather that damages pens or cause flooding in ponds with mud, careless and drunken or absent employees, poaching (very serious if stocks are wiped out), stopped up pipes, broken trucks, delayed shipments, poor prices in the market, high cost of feed, parasites, and diseases. Lindberg and Pryor further add that academicians and scientists are inexperienced managers and that hardy, hard-headed, experienced overseers of laborers with mechanical skills and no fear of hard labor must be the kind of people to run a farm. The technical skills to run a farm may be immediately acquired but managerial skills especially in dealing with emergencies take years for research-oriented people to acquire. According to an experienced aquaculturist, long distance management is not workable in aquaculture and that "what you hear is different from what you see." The most effective type of management is for the owner who lives in the vicinity of his ponds. Most corporate-type management for prawn aquaculture, for example, have dismally failed.

Once aquaculture is considered business, budgeting and cost projections would be reflected. Important to consider are equipment breakdown, storms, theft and diseases, power brownouts, cold storage, travel to similar farms to observe farming practices, and other maintenance costs.

2. Buying unnecessary equipment. Complex equipment and unproven gadgets may cost heavy expenditure. Be sure to

invest only in equipment that is needed. It takes at least twice as long for the first cash crop to pay. By that time, salaries have to be paid, feeds bought, power and water utilized. The tendency to spend too much in the first operation phase is a mistake most new businesses experience.

3. Investing in relatively new farming species. It is dangerous to farm a species that has not yet been successfully bred and reared in captivity. Trying to learn a new technique, like growing fry at acceptable quantity can take up so much time.

4. Putting all investments in a single crop. If 10 hectares of ponds are available, initially stock 3 hectares with a crop whose technology has been proven to make profit. Stock other ponds with a commodity one is less confident in and slowly expand farming when profits are made until a degree of competence in a single crop is attained. Then perhaps, compare the economics and confidence level of farming of the various species being farmed.

5. Failure to consider international standards. Several years ago, shrimp farmers from Asia were taken by surprise when their imports to developed countries were slapped an embargo for not using turtle extruder devices. Other aquaculture products have various requirements. For value-added products, ISO and HACCP are required while smoked aquaculture products also have strict requirements (the smoked products are tested for presence of harmful chemicals that may have been formed in the smoking process). Other requirements are specific for size, bacterial load, etc.

6. Producing an aquaculture product with an uncertain profit margin. Sometimes, fishfarmers focus on producing large volumes of low-priced fish instead of high-priced ones that have been proven to make better profit. Lindberg and Pryor again attest to the success of raising high quality table items such as shrimp (extensive culture system), grouper, and mudcrab even in less developed countries. The state of aquaculture production is such that producing a large volume of low-priced fish cannot compete with wild fisheries in producing, for example, cheap fish meal for human or animal feed. Aquaculture activities for poverty alleviation or food security belong to government and research institutions and not to the commercial entrepreneur who hopes to

☞ page 34

Realizing green aquaculture

By AP Surtida

The world population exceeds six billion and is still growing. Obviously, food security becomes a question. How do you feed the growing population when ocean catches seem to have reached their limit? The catch is declining for about a third of major commercial fisheries. Collapsing fisheries will directly hurt about a billion people, particularly in Southeast Asia.

Aquaculture, apparently, is the answer. Aquaculture now contributes 19% to total world fish production. It is growing at an extraordinary rate of 8.8% per year since 1986 compared to only 0.7% for capture fisheries production (Williams & Bimbao 1998).

For the Philippines, aquaculture has the highest annual growth rate with 5.42% followed by commercial fisheries (4.47%) and municipal fisheries (1.54%). As a result of aquaculture's contribution, total fishery production has jumped from 26.4% in 1988 to a high of 34.6% in 1997 (Yap 1999).

Aquaculture is on a roll. As management guru Peter Drucker predicted in a New York Times interview, the new century's most exciting industries will no longer be the Internet, but fish farming.

But with the growing global awareness and militance on environmental issues, aquaculture has been fingered as one of the culprits in environmental degradation, particularly the destruction of mangrove forests for shrimp farming. Aquaculture has been getting a bad name. But recently the industry struck back. A letter of the Global Aquaculture Alliance (GAA) to Fish Farming International (February 2000 issue) said they want to set the record straight with facts.

Excerpts:

"The UN World Commission on Environment and Development defines sustainable development as: meeting current needs without compromising the ability of future generations to meet theirs.

Not all environmentalists agree. Randal O'Toole of the environmental 'think-tank', the Thoreau Institute, divides the environmental movement in two: preservationists and conservationists.

Preservationists say 'nature knows best and should be preserved at any cost. Sustainability means 'no impact', so neither aquaculture nor any other system of food production has much growing room.

Conservationists are more realistic. Their goal is to main-

tain ecosystems through collaborative management by public and private stakeholders at a local level.

Clearly, aquaculturists are also conservationists. In most areas, water rights are publicly held, and access to space requires farmers to engage in a permitting process.

Regardless of their leanings, environmental groups make an important contribution by alerting the public to risks. However, as they proliferate and compete for public attention and funding, they tend to reduce facts to 'soundbites'."

On the assertions that shrimp farms pollute and destroy habitats, GAA answers: "To the consumer, pollution conjures up visions of smoke stacks, toxic waste, etc. But shrimp farm waste is natural algae and organic matter: neither toxic nor illegal."

On the assertion that it destroys habitat, GAA says: "This refers to mangroves. Early shrimp farmers were actually encouraged by governments to tap mangrove areas, but they soon learned that the poor drainage and acidic soils were not well-suited for pond construction.

"It is far better to build farms on higher ground and leave man-



A typical semi-intensive pond is sited above the mangrove area; R&D institutions are improving wastewater management so it won't negatively impact the downstream mangrove areas

grove areas intact to help recycle discharge and protect farms from erosion and storms. Shrimp farmers recognize their value and are leading mangrove conservationists.

“In Honduras for example, high altitude imaging shows that the area of mangroves in the vicinity of shrimps farms actually increased in the last 10 years.”

On the allegations that the Indian government ordered 100 shrimp farms to close - GAA answers: “This is misleading. In 1995, shortly after shrimp farming began in India, a kind of shrimp disease began passing through many farms. In 1996, the Indian Supreme Court ruled to close all shrimp farms within 500 meters of the high-tide line.

However, the decision was later stayed before it could take effect. The government proposes to introduce an aquaculture bill with environmental safeguards for sustainable development. Meanwhile, the farms are learning to manage the disease, and production has increased to 70,000 tons a year.”

The GAA advises aquaculturists to recognize the need of seafood buyers and consumers to be better informed. From an environmental perspective, aquaculture dovetails with conservations goals more than any standard agricultural practices.

The GAA’s beef against environmental groups is that they tend to exaggerate the facts and appeal to emotion and that their soundbite judgements are not supported by facts.

While nature’s integrity continues to be compromised in many areas throughout the world due to urbanization and rapid increases in population and industrialization, more governments are reconsidering and restoring various ecosystems, including tropical rain forests, mangrove forests and wetlands.

In Southeast Asia for example, wherein top aquaculture-producing countries are situated, governments are coming-up with mangrove-friendly shrimp culture technology.

For one, the SEAFDEC member countries are initiating shrimp culture practices which can be considered friendly not only to mangroves but also to the environment in general.

In the face of existing realities, SEAFDEC redefined mangrove and mangrove-friendly: Mangrove should refer not only to the trees but also to the biota generally associated with a mangrove ecosystem which includes the various organisms which make the mangrove as their habitat for part or all of their life stages.

Mangrove-friendly should refer to practices which have no adverse impact on the mangrove ecosystem from the development up to the operation stage.

In the case of existing shrimp farms which are already built on mangrove areas, being mangrove-friendly should mean that its continued operation should not further affect any existing mangrove negatively and that such farms take positive steps towards mangrove restoration particularly along the shoreline or river banks.

A project which SEAFDEC has started in April 1998 and to

run until December 2002 (titled “Development of mangrove-friendly shrimp culture technology”) has the primary objective of developing sustainable shrimp culture technology packages. SEAFDEC will conduct research and verification runs on this project.

The research areas will include the following: nutrient cycles of both semi-intensive and intensive shrimp farming; the use of “green water” (microbial/phytoflora); capacity of mangroves to absorb nutrients; and use of probiotics or bioaugmentation.

The technology generated will be disseminated through regional training programs. Position papers will be provided to member governments on policies and regulations to make shrimp culture environment-friendly.

In the Philippines, the government professes a new sensitivity to ecological issues and this hasn’t gone unnoticed. In the October 4, 1997 issue of *New Scientist*, Clive Wilkinson, coordinator of the Global Coral Reef Monitoring Network writes: “Poor villages in southern Philippines have set aside some 25 percent of their reefs as protected reserves. The US, on the other hand, designated only 5 percent of the whole Florida mangrove/reef tract. For them, the idea of reserves flies in the face of the ‘right to carry a spear gun and go fishing anywhere.’”

And if it’s any indication, witness these Mangrove Forest Management Laws Rules and Regulations - Provisions of P.D. 705 as amended otherwise known as the Revised Forestry Code of the Philippines.

- Conversion of mangrove areas into fishponds. Conversion of thickly vegetated mangrove areas into fishponds *shall no longer be allowed*. All mangrove swamps released to the Bureau of Fisheries and Aquatic Resources (BFAR) which are not utilized, or which have been abandoned for five (5) years from the date of such release shall revert to the category of forest land in accordance with existing laws and regulations.

- Prohibition in the issuance of license and permit. The granting and renewal of mangrove timber license or permit of any kind that authorizes the cutting or debarking of trees for commercial purposes in areas outside the coverage of the Fishpond Lease Agreement (FLA) and mangrove plantation shall no longer be allowed.

And more laws -- Sec. 47 of Article III, Philippine Fisheries Code of 1998 (RA 8550):

- A code of practice for aquaculture shall be established. This will outline the general principles and guidelines for environmentally-sound design and operation to promote the sustainable development of the industry. Such code shall be developed by the Department of Agriculture (DA) through a consultative process with the DENR, the fishworkers, FLA hold-

Shape of things to come

By AP Surtida

What does the future hold for aquaculture? any major innovations coming? or dire consequences of technology gone haywire? effects of climate change and environment perhaps?

Is aquaculture strictly for food production? or are there myriad uses for it as well?

We try to plumb the depths of its potential uses as well as future scenarios for the industry from various sources including the Internet. Here is what we found out.



Tilapia as cure for childhood diabetes? its guts as source of organ transplant for humans?

Incredible as it might seem, Canadian scientists at the Izaak Walton Killam-Grace Health Centre in Halifax, Nova Scotia are trying to turn genetically-engineered fish into donors for the cells in the pancreas that could cure childhood diabetes.

If the approach is successful, it could put an end to daily injections for millions of children.

When a healthy person eats sugar, cells in the islets of Langerhans secrete the hormone insulin. Insulin allows tissue such as muscles to take up the sugar. But in the most serious form of diabetes which begins in childhood, the islets are destroyed and patients survive on daily injections of insulin.

For years, scientists have been trying various ways to transplant healthy islets and the supply problem could in theory be solved by using animal donors such as the pig.

But pigs would be impractical. You would need a million pigs to treat 10,000 diabetics a year. And the costs would be astronomical. Enter the tilapia, a freshwater fish widely farmed in the tropics. Unlike pigs, fish can be raised cheaply at high density in small places. Tilapia could also solve some of the other major problems with the cross-species transplantation.

Another big bonus with tilapia is that the fish has two pancreases, one for digestive enzymes and the other solely for insulin. Because one pancreas is basically an agglomeration of islets, it is much easier to isolate the cells from other tissues. For human or pig islets, the extraction process costs \$3,000, which is 90% of the cost of human transplants.

Still, there is one big obstacle. Fish insulin works poorly because it differs from the human hormone by 17 amino acids. Pig insulin is only one amino acid different.

The Canadian researchers hopes to breed a stable line of fish that produce only human insulin.



Tilapia farming in outer space

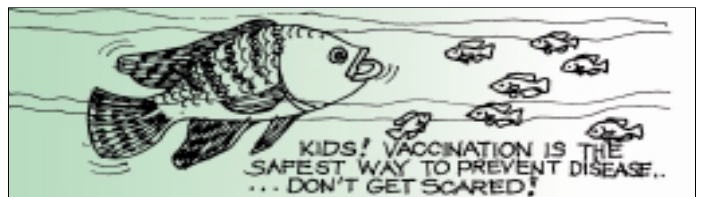
In galaxies far far away, tilapia may be the main source of fish protein for interstellar travelers in the near future.

Researchers from Hillsborough Community College (HCC) in Tampa, Florida, USA are conducting a study titled "Aquaculture Micro-Gravitational Orbit Project (AMIGO)" wherein tilapia eggs were sent into orbit. The eggs were part of the first aquaculture experiments where the effect of a 10% gravitational environment is being tested.

The eggs were sent to space together with astronaut John Glenn of the NASA shuttle program on October 29, 1998. The 77-year old astronaut made history in 1962 as the first American to orbit the earth. It was Glenn's return trip to space and may have been possibly the oldest person ever to blast off into orbit.

Tilapia in particular was selected for this experiment because of their favorable space-culture potential.

Aquaculture is thought to be an attractive food source for space stations and other space exploration.



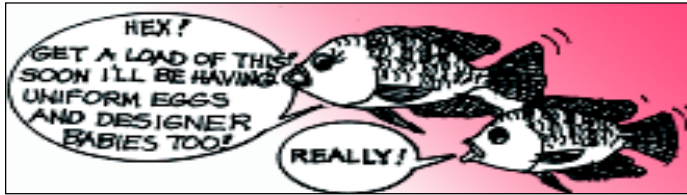
Cutting-edge vaccines for fish is maybe the way to go in disease prevention

A new vaccine provides nearly total protection against infectious haematopoietic necrosis virus (IHNV), a major problem in North American fish farms. Outbreak of IHNV can wipe out most of the fish in farms, costing the industry millions of dollars a year.

The vaccine was developed by government laboratories in the US and Canada, along with Clear Springs Foods, the world's largest producer of trout. What is injected is DNA, containing the gene for one of the viral proteins, priming the immune system to attack the virus itself.

But because the vaccination involves injecting DNA into

fish, there are fears that fish treated this way will provoke food scares in Europe and Japan. They regard the process as genetic modification and the perception might worsen because the DNA comes from a virus. Anything that might be interpreted as genetic modification is likely to get a bad press in Europe.



Synchronized spawning for fish broodstock

Problems in fish broodstock spawning will soon be solved. A team of European researchers has developed a hormone-laced food that makes fish spawn predictably.

Trout are troublesome for fish farmers because harvesting their eggs is laborious and expensive. They commonly spawn over a two-month period during which they must be inspected regularly to decide whether their eggs are ripe and can be manually harvested. But because farms can stock thousands of fish, the inspection process is laborious.

Now, the researchers believe they can get around the problem by feeding trout microspheres laced with gonadotrophin-releasing hormone (GnRH) which encourages the fish to produce eggs. The hormone is combined with a chemical that increases the permeability of the intestine wall, allowing enough of the hormone to be absorbed effectively.

Belgian and Dutch researchers use cellulose to make the microspheres and incorporate the hormone and absorption enhancer into the matrix. They add the microspheres, which are half a millimeter across, to fish food pellets. They prove very effective when tested on trout in the laboratory: the eggs are ready to be harvested within eight days. The feed is only given to broodstock, those fish used exclusively for egg production. The same technique could also be used in salmon farming.



Super-sticky adhesive from mussels

Mussels cling onto wave-lashed rocks for dear life. The molluscs secrete a protein that forms a water resistant adhesive when exposed to the right enzyme. Biologists are stealing the secrets of that grip to produce water resistant glues that could eventually mend broken bones and teeth.

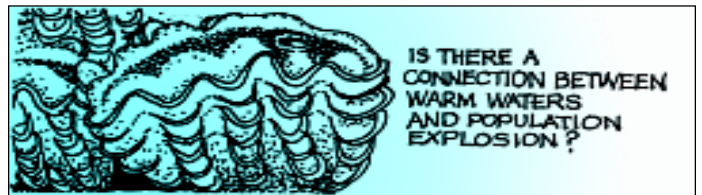
The glue is the envy of adhesive manufacturers, as it has a breaking load twice that of most epoxy resins.

The protein from the mussel *Mytilus galloprovincialis*, is

made of a sequence of ten amino acids that repeats more than 80 times. This structure gives the protein three key properties that make it sticky: the ability to create strong bonds, exclude water molecules and remain flexible. The protein can bind to metals, wood, bone, dental enamel, skin and even super-slippery teflon.

Researchers at the University of York, England are now patenting a method of genetically engineering plants to make the protein. The York researchers have realized that the repeating structure of the mussel protein is similar to that of a class of proteins found in plant cell walls called extensins.

Extensins do a tough job. They make plants less digestible to marauding pests and strengthen their cell walls so they can withstand high winds. Like the mussel protein, the molecules are "crosslinked" by an enzyme to form a strong flexible structure.



Global warming may lead to plagues of exotic pests

Invasions by alien species -- already one of the most serious threats to biodiversity worldwide -- are set to worsen in the next few decades as the world continues to warm. In aquaculture, warming could also cause problems among species that have been intentionally introduced.

In England, British oyster farmers, for example grow Japanese oysters (*Crassostrea gigas*) in coastal waters, but the water gets too cold. Warmer water could turn it into a pest, as it already is in Australia.

A biologist from the Centre for Environmental Fisheries and Aquaculture Science in Conwy, Wales suspects that it would take something like an increase of 2 or 3°C in water temperature to turn them into pests.



Chitin: boon from crustacean shell waste

Chitin is, after wood, the most plentiful organic fiber on earth. It is a starchy plastic-like compound that some scientists believe is one of nature's most generous gifts. It is a very light, white or yellowish colored, powdery product which can be processed into many derivatives. The most readily available is chitosan.

The part of the shrimp most people throw away could turn out to be the most valuable part. That's because the shells of shrimp, crab, squid, cuttlefish, oysters, etc. contain chitin. The processing

➡ next page

of the shell wastes of these species contains about 10-55% of chitin on a dry weight basis, depending on the processing method.

Researchers at the Asian Institute of Technology in Bangkok say these resources could be used to create everything from wonder drugs to biodegradable plastics and crop enhancers for farmers. Chitin can also be used to heal wounds and as an agent in paper and textile.

Japan and the USA are the main producers of chitin and chitosan. The total sales of chitin/chitosan was estimated at US\$50 million in the early 80's, and is expected to surpass US\$2 billion by the turn of the century.



Eels as monitor in water pollution

Eels are raised in Japan as gourmet food. In addition they are also considered as a health food because of high vitamin A content. Now, add another use for eels -- as monitor for water impurities.

Aquatech in Tokyo has developed a monitoring system that measures the eel's heartbeat to detect impurities in water. Heart rates in eels speed up when they are exposed to some pollutants, such as the carcinogen trichloroethylene, and slow down in others, such as cadmium and cyanide.

The system works this way: water is pumped through the usual treatment system. The purified water then passes through an acrylic tube to where the eel is housed. Electrodes are attached to the animal to monitor its heart rate, and any change is detected automatically, at which point an alarm sounds. Engineers can take out a sample from that particular batch of water for more intensive testing. The eels are taken from the superclean Yoshino River on Shikoku island near Osaka.



Stopping algal blooms on their tracks

Blue-green algal blooms -- dense, floating mats of cyanobacteria -- have increased dramatically in recent years. They form when nutrients in rivers and lakes are particularly abundant, something often blamed on discharges from sewage works and the use of fertilizers. More than half of these blooms produce toxins, which can claim the lives of both humans and animals, and therefore,

has direct implications to aquaculture. The good news is that they could be wiped out by spraying rivers and lakes with a fine layer of special clay, say researchers from Australia.

The researchers sprayed a section of the Canning river in Perth, Australia with a slurry of a chemically modified absorbent clay called Phoslock.

The clay is good at binding phosphorus, one of the major nutrients algal blooms need to survive. The researchers sprayed the slurry from the back of the boat onto the water surface. The clay then strips out phosphorus as it sinks down through the water.

When the clay settles on the riverbed, it forms a barrier one millimeter thick, separating algae from phosphorus-rich sediments. Because the clay does not remove all the phosphorus in the water, it will not endanger other organisms in the area dependent on normal levels of phosphorus.

The mineral clay has a high mutual affinity -- it sticks to itself as it settles, so it forms a cap on the riverbed.



Food for fish

Optimize the growth of cultured fish by oxygen analysis? A French Company L'Air 'Liquide claims so by analysing how much oxygen they need at different times of the day. Inventor Bohumil Sevic discovered that fish gets very excited when they see or smell food, and consume more than twice the oxygen they need at the time.

In the L'Air Liquide scheme, the oxygen supply in a fish farm is ramped up two hours before feeding time, and then left running for an hour afterwards. Some of the oxygen is supplied as ozone, which double as a disinfectant, killing viruses and bacteria as it breaks down.

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Audie Lim ... from page 16

year earlier and were prepared for it. Lucky for them, *bangus* prices in their area did not go lower than P42. Expecting a backlash of “sentimentó”—e.g. farmers deciding to quit milkfish grow-out culture -- they double-stocked the next crop. Sure, at the end of five months, *bangus* prices shoot up to P80-90 a kilo. Even then some farmers who continued to raise milkfish were quite dismayed to learn that the government allowed the importation of cheap Taiwanese milkfish at such a time when they thought they could make a recovery.

Taiwan, too, says Lim, sells milkfish very cheaply (about P50) even while its cost of production is about the same as the Philippines, with its *bangus* feeds even more expensive.

What accounts for the difference in milkfish price between these countries and the Philippines? Lim replies, “Their governments’ support of the industry. The incentives they offer. And the cheap labor and better farm-to-market roads available in these countries.”

Shipping fish from Mindanao to Manila, illustrates Lim, costs them an additional P12-15 per kilo. The amount covers inter-island freight service, the purchase of boxes/crates, ice and commission.

“It would be good if the Philippine government would also support the industry, as it does rice,” Lim pointed out. “For example, in electricity costs. If government subsidizes part of the amount, in cognition of the industry’s role in feeding Filipinos, perhaps by then we can even compete with our Asian neighbors in the export trade of milkfish.”

Lim is thankful that Tateh Feeds supports the industry by improving on their products and services. “They see to it that the industry will be sustainable by trying to do technology transfer.”

It is on account of one of these technology transfer missions that the SEAFDEC/AQD newsletter staff has caught up with the busy and always on-the-go entrepreneur in Silay City. He is here to serve as the technical consultant for Tateh’s 4-ha demonstration farm in Brgy Mambulac.

Lily Talaman, a young female graduate of the University of the Philippines-Visayas College of Fisheries, serves as the farm manager. Audie Lim regularly communicates with Lily and visits the farm twice a month. In about 30 days (or by the middle of May, 2000) the Silay farm will be experiencing its first harvest. Audie expects the farm’s performance to be nothing less than what he has experienced. “I am sure it is going to work because we’re getting the same growth, though there just might be a little difference. Ozamiz is surrounded by mountains so there is no flooding; during these times in summer, the growth of the fish is good. Weather here, in contrast, is quite unpredictable, it may be very sunny now, but tomorrow it may rain.”

Silay is the site of the feed company’s Visayas project. Previous to this operation, it did a trial run of Audie Lim’s technology in Lanao province. This proved to be very successful. “Most



A basketload of fish at the Ozamiz farm

of the big growers in the area (northwestern Mindanao) are now tied up with us,” Audie says. After Silay, the company plans to step into the heart of *bangus* country itself -- Pangasinan in Luzon island.

Audie sees that in the very near future, one possible move of the company is to offer to buy back the produce of farmers who use their feeds. This future set-up, he says, could minimize the steps of bringing the fish to the market. “It’s not that we want to cut off the source of living of middlemen, what we want is to bring our product to the people at a more affordable price. While farmgate prices are pegged at P55-60, middlemen sell *bangus* at P80 or higher. It seems like middlemen are the ones getting the better deal.”

His secrets for good farm management? There really are no secrets, he says. “Just be kind to your people. If you can’t give them what they want, give them what they need, the basics, in such a way that they are able to survive in a humane manner. You can’t always be in the farm 24 hours a day, seven days a week. You can’t do it. They are the ones who feed the fish, maintain the water, so it’s very important that you establish a good relationship with them. You should not focus only in one area like production. You should also look at the marketing aspect; try to bring your fish in the best quality and in the best way. If your fish has good quality you can demand a high price. Practice good sanitation.”

His generosity in imparting his technical expertise on farming *bangus* has served Audie Lim very well. “It’s a gift, so why don’t we share? There’s really no monopoly of technology, you can develop it yourself, but it’s going to take years. But instead of going through experimentation, why don’t you just do what we’re doing already? I won’t claim that we are the best, but as far as we know, using our technology at the moment is really efficient, as far as costing is concerned, as far as return of investment is concerned. I’m sure that other farmers are doing better than me, that’s why I’m also getting out of my way to listen to others’ success stories. We are willing to share, we would learn from them also.” ###

WHITHER AQUACULTURE? CONTINUED FROM THE BACK COVER ...

Aquaculture network RDE program (1999-2004)

Improvement of aquaculture systems

- Breeding and seed production
- Health management
- Efficient feeds and feeding strategies
- Bio-physical systems and engineering design

Development of improved strains and new species for aquaculture

- Genetics and biotechnology
- Culture management technologies

Reduction of environmental impacts of aquaculture

- Development of water quality and food safety standards
- Assessment and evaluation of impacts of aquaculture practices on the environment
- Development and evaluation of environment-friendly aquaculture practices

Establishment of database for aquaculture resources

- Inventory of aquaculture resources
- Valuation of aquaculture resources

Formulation of appropriate regulations and policies for aquaculture

- Impact assessment studies of the aquaculture industry
- Policy analysis concerning aquaculture industry

Extension

- Production of information, communication and education (IEC) materials
- Training/upgrading of aquaculture manpower
- Establishment of technology-demonstration farms
- Pilot testing and verification

The projected aquaculture production target of 663,000 mt by 2004 (see Table 1) for finfishes and crustaceans may prove highly optimistic unless the problems affecting the industry are addressed.

Last February 10, the University of the Philippines Visayas (UPV), during its Fisheries Week hosted a round table discussion on fisheries in the coming millennium and invited stakeholders in the industry to participate.

Dr. Crispino Saclauso, director of the UPV Institute of Aquaculture and technical team leader of NIRDEP for aquaculture, presented a situational report, as well as future projections for the industry (the essence of his message is the subject of this article) during the said conference.

At a later date, SAA visited with him to gather additional information on the aquaculture situation of the country.

“We can actually increase production not in terms of area, but in terms of improving aquaculture technologies,” he remarked, noting that the destruction of mangroves in the past to make way for aquaculture ponds has created pitfalls, directly or indirectly,

for the fisheries situation in general.

“While some farmers are producing 3 mt/ha/yr, others are only producing 500-800 kilos, averaging that, that’s only about 1.2 mt/ha/yr (reported statistic for 1995).” He also cited a BFAR report that said that out of 239,000 constructed fishponds in the Philippines, about 96,000 ha (or 40%) is unproductive. Thus, it is most proper to dispense with unprofitable aquaculture methods and instead, find ways to develop already existing ponds using high yielding and yet environment-friendly techniques.

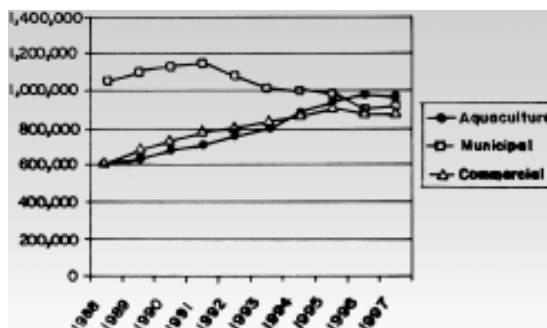
He also noted that there are available areas for limited expansion: marine open water system for fish cages and pens. Citing from the Fisheries Code he said that cage and pen structures, should not take up more than 10 percent of the municipal waters in any given area.

Some questions on issues concerning industry directions were raised by Dr. Saclauso.

The moral issue on how important, how safe are genetically modified organisms. What will their effects be, in terms of modifying the genetic pool of indigenous species of organisms?

How safe are our interventions? “The reason why we have a lot of diseases is because we don’t put into perspective the significant role environment plays in the production system. We have been dumping a lot of things into the environment without really knowing the consequences of inputs that we’ve been throwing into the system-e.g. bioremediation-it’s not a question of whether the person could do it, it’s a question of whether the person knows the consequence of what he did. What we usually do when we encounter problems is come up with remedial measures-but we don’t know the effects of remedies that we offer in terms of overall intervention in the ecosystem. What we see, in probiotics, for instance, is improvement of prawn production at the end of the culture period. We don’t know the other actions of probiotics in the system-we don’t know how safe was our intervention.”

Figure 1. Fish production trend by sector, 1988-1997





Dr. Crispino Saclauso, head of the Institute of Aquaculture, UP - Visayas

His advice for would-be aquaculture investors?

“I think they should first examine what all these things are about. They should not just embark on aquaculture without understanding the intricacies of the business.

“Some think there is money in fisheries, but they don’t understand the intricacies of the business, so they fail. Others put up facilities in areas not suitable for aquaculture, so again, they fail...”

“It’s just a matter of infusing practical plans for something that you thought about and always bearing in mind the importance of protecting the resource base on which aquaculture depends.” -- By NJ Dagoon

Figure 2. The Philippines’ targetted total fish production divided by sectors in 2004 (a consolidation of NEDA and BFAR figures)

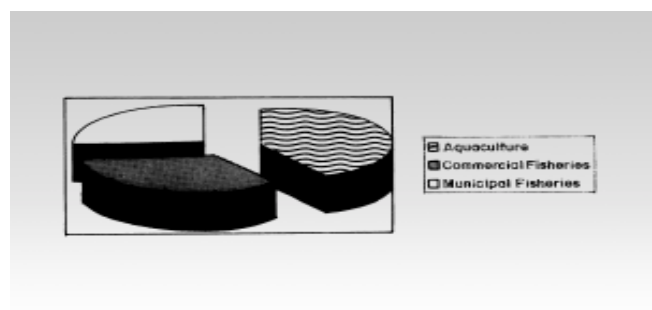


Table 1. Projected aquaculture production, 1999-2004

Culture system / species	Highest production attained (year)	Actual		Projected					Growth rate	
		1997	1999	2000	2001	2002	2003	2004		
Brackishwater fishpond										
Milkfish	214,000 (1991)	147,000	160,524	175,292	191,419	209,330	228,788	250,000	11.20%	
Shrimp	90,000 (1994)	40,000	46,600	54,289	63,247	73,682	85,840	100,000	20.00%	
Tilapia	14,000 (1991)	6,000	7,980	10,613	14,116	18,774	24,969	33,000	33.00%	
Freshwater										
Tilapia	48,000 (1992-93)	39,000	44,538	50,862	58,085	66,333	75,452	86,000	14.20%	
Carp	0.53 (1992)	0.29	0.55	1,039	1,965	3,713	7,018	13,000	89.00%	
Fish cage, pen										
Tilapia		43,000	49,106	56,079	64,042	73,136	33,522	95,000	14.20%	
Milkfish		82,000	20,000	20,000	20,000	20,000	20,000	20,000	0.00%	
Marine cage										
Milkfish			1,500	2,020	5,302	9,967	16,738	85,227	66,000	13.00%
SUBTOTAL	448,000	296,500.29	330,768.55	373,476	422,841	481,706	560,816	663,000	14.33%	
Seaweeds	631,400 (1996)	627,000	644,180	661,830	679,964	698,596	717,737	731,500	2.74%	
Oyster-mussel	43,400 (1993)	30,000	30,000	30,000	30,000	30,000	30,000	30,000	0.00%	
TOTAL	1,122,800.53	953,500.29	1,004,948.55	1,065,306	1,132,805	1,210,302	1,308,553	1,424,500	16.98%	

water and fuel.

Before a product is placed inside cold storage facilities, it has to go through contact plate freezing. According to Engr. Elmer Figuracion, chief of the Ice Plant and Refrigeration Division, the procedure charges P2,800 per freezing cycle of about 3-4 hours. When the inner body temperature of the product drops to a range of about -18°C to -40°C or lower, this may now be transferred to the cold storage area which charges about P1,988 per m² per month. The facility consists of two rooms each capable of storing 250 metric tons at -35°C. Engr. Figuracion noted that with the decline of the prawn industry, the facility is not as fully occupied as it should be. While the first room is exclusively for marine products; the second is rented out to distributors of poultry and meat products.

The processing zones, on the other hand, are divided into two: open (uncovered) space which is rented out at P20 per m² per month and covered space, at P90 per m² per month. The engineer mentioned four processing plants operational at this time.

We had a chance to tour the facility of one such plant: AFI, which also has offices in Cebu and Tagig in Metro Manila. AFI is a fish processing and exporting company that specializes on Japan-bound *aso-os* fillets. It gets its fish mainly from Estancia and Banate fishers. After scaling and cleaning, the fish are packed and block frozen at 550 g each.

This is but a brief prologue to the long account that constitutes the story of the fish trade industry. But one really interested in aquaculture should not be content with just this mere introduction. Aside from knowing how to farm his products well, he should also know how to market them successfully. He should don a pair of rubber sneakers (or slippers) himself and get out one day, to savor the smells, the sights, the sounds of the very wet and squishy fish market. ###

ers, fishpond owners, fisherfolk cooperatives, small-scale operators, research institutions and the academe, and other potential stakeholders. DA may consult with specialized international organizations in the formulation of the code of practice.

At least in the Philippines, the future of aquaculture looks green. But to really make an impact in the greening of our planet, the governments of both developed and underdeveloped nations should strive to stamp out poverty globally.

As the late Indira Gandhi at the first Earth Summit in Stockholm said: "Poverty is the greatest polluter. Poor people in developing countries contribute to ecological destruction through everyday practices such as firewood burning. They are not being malevolent, they are simply living off the cheapest resources available.

"Galloping poverty is a global challenge, not just one for developing nations. Everything is interconnected these days - the rich, the poor, the environment and the economy."

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make a profit. In other words, before production, know your market wherein profit is certain and impressive.

7. Failure to provide for behavioral and environmental needs of the fish. Usually, livestock are kept safe, warm, and comfortable. But aquaculture farms seldom take care of aspects such as presence of too much noise, rough and unnecessary handling, and unsuitable water temperature. Seldom noticed, these

factors are usually causes of poor growth, low conversion ratio, low resistance to disease, and poor survival.

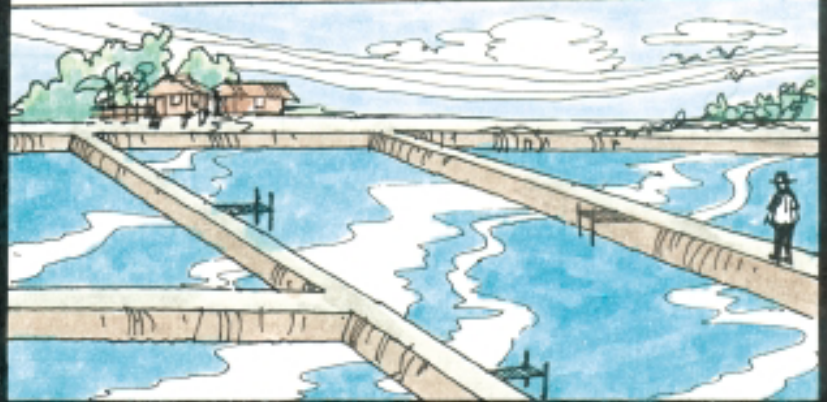
8. Lack of business experience. Again, experts agree that well meaning owners who are hardworking and well-trained as fisheries biologists are seldom competent to meet the normal problems of management of a business. ###

AQUACULTURE ILLUSTRATED

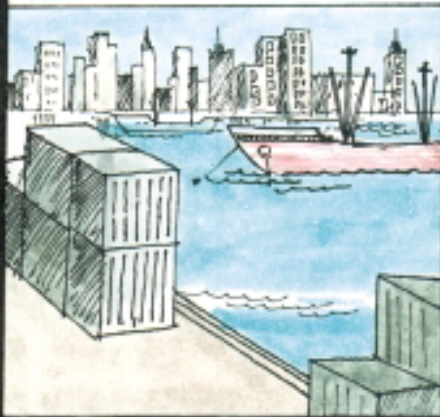
by a.p. surtida &
e.t. ledesma

AQUACULTURE: Making it GREEN

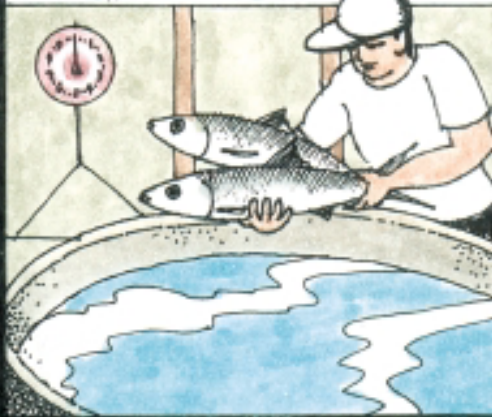
THE COMMON NOTION IS THAT AQUACULTURE WILL PROVIDE A SOURCE OF SEAFOOD WHEN THE OCEAN'S RESOURCES HAVE BEEN DEPLETED. MOST TROPICAL AQUACULTURE HOWEVER, DEPEND ON WILD STOCKS TO PROVIDE JUVENILES OR BREEDING STOCK...



AQUACULTURE HAS A DUAL NATURE: THE INDUSTRIAL-SCALE FISH AND SHRIMP AQUACULTURE OPERATIONS FOR THE GLOBAL MARKET...



... AND THE SMALL-SCALE AQUACULTURE FOR THE DOMESTIC MARKET WHICH UTILIZES VEGETARIAN SPECIES SUCH AS TILAPIA, MILK FISH AND CARPS...



WITH THE GLOBAL PRESSURE FROM ENVIRONMENTAL GROUPS, THE AQUACULTURE INDUSTRY IS FORCED TO SHAPE-UP...



AMONG THE RAPS AGAINST SHRIMP FARMING: OPERATIONS SOMETIMES DAMAGE THE COASTLINES WHERE FACILITIES ARE LOCATED; FARMS FOUL THE WATER, DESTROY MANGROVES...



... SERVES AS BREEDING GROUNDS FOR FISH DISEASES AND DRIVES LOCAL FISHERS OUT OF BUSINESS...



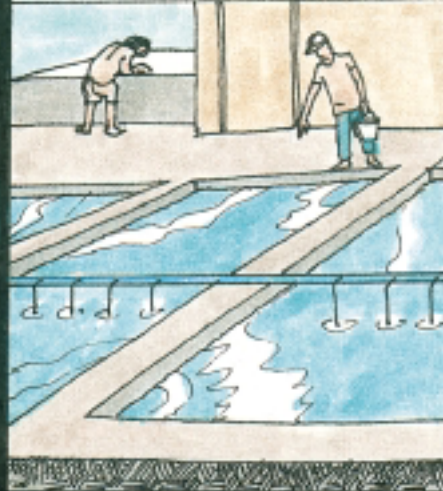
TO AVOID BEING JUST ANOTHER ENVIRONMENTAL HEADACHE, IT IS SUGGESTED THAT AQUACULTURE SET UP STANDARDS...



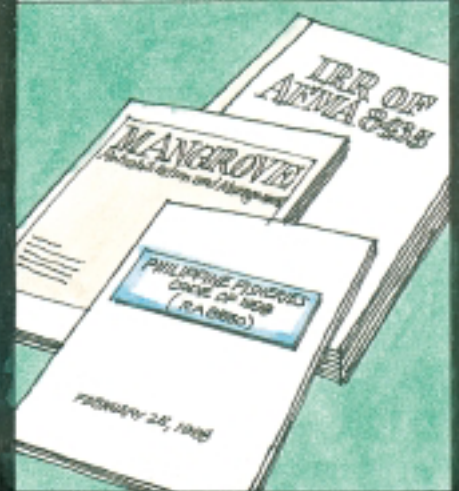
AMONG THE SUGGESTIONS: DON'T RAISE SPECIES ALIEN TO THE HABITAT, SINCE IT CAN DECIMATE AND INFECT NATIVE FISHES WITH DISEASE...



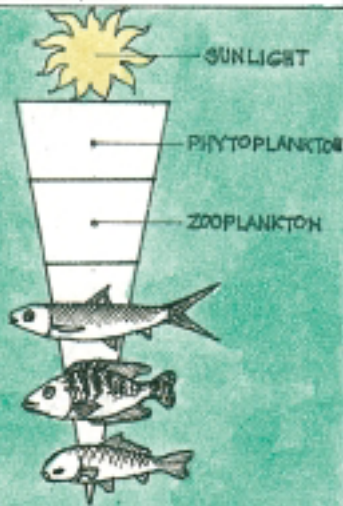
FISH FARMING SHOULD BE DONE INDOOR, ONSHORE FACILITIES AND WASTEWATER CAN BE TREATED BEFORE BEING RELEASED...



STRONG GOVERNMENT REGULATIONS AND PENALTIES ON THE USE OF NATURAL RESOURCES SUCH AS MANGROVES, LAKES, RIVERS, ETC...



USE OF FISH SPECIES FEEDING LOW ON THE FOOD CHAIN SUCH AS TILAPIA, CARP, MILKFISH...



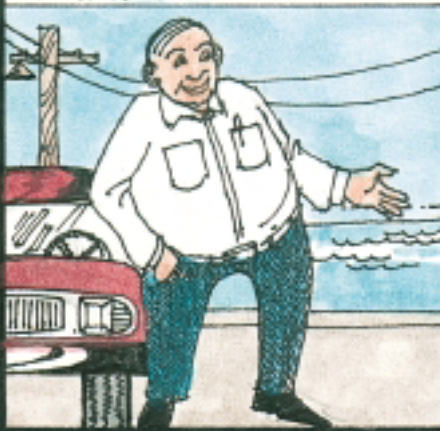
IN THE PHILIPPINES, THE GENETICS BASED TILAPIA TECHNOLOGY HAS THE POTENTIAL TO EXERT A POSITIVE SOCIO-ECONOMIC IMPACT WITHOUT DAMAGE TO THE ENVIRONMENT...



BUT AGAIN, THE SMALL FISH FARMERS SHOULD BE ASSURED OF ACCESS TO THE GENETIC-BASED TECHNOLOGY THRU TRAINING, CREDIT AND ACCESS TO FRY...



OTHERWISE, IT WILL JUST BE THE MIDDLE, LARGE-SCALE AND CORPORATE PRODUCERS WHO WILL BENEFIT AND THUS DEFEAT THE PURPOSE OF POVERTY ALLEVIATION...



AT SEAFDEC/AQD, WE HAVE REFINED TILAPIA AQUACULTURE TECHNOLOGY, PARTICULARLY FOR THE BENEFIT OF SMALL-SCALE FARMERS, NGOs, AND LOCAL GOVERNMENT UNITS.

THE TECHNOLOGIES ARE ENVIRONMENT-FRIENDLY AND UTILIZES VARIOUS FRESHWATER BODIES INCLUDING RIVERS, STREAMS, MAN-MADE LAKES AND WATER RESERVOIRS FOR RICE FARMING...



FOR MORE INFORMATION:
 THE HEAD
 TRAINING AND INFORMATION DIVISION
 SEAFDEC/AQD
 Tigbayan, Iloilo, Philippines
 e-mail: devcom@aqd.seafdec.org.ph

Training, websites, extension materials **NOTICES**

Year 2000 AQD TRAINING COURSES

Third Country Training Program on Responsible Aquaculture Dev't (TCTP, 1st session)	January 18 to March 17
Fish Health Management	April 26 to May 31 (5 weeks)
Freshwater Aquaculture Management of Sustainable Aquafarming Systems (includes module on Aquaculture Management)	April 4 to May 3 (4 weeks) May 30 to July 5 (5 weeks)
Marine Fish Hatchery TCTP, 2nd session	June 6 to July 14 (5 weeks) August 7 to October 6 (8 weeks)

For application forms and further information, please contact:

Training and Information Division
SEAFDEC Aquaculture Department
Tigbauan, Iloilo 5021, Philippines
Tel/fax: 63 (33) 336 2891, 335 1008
E-mail: tid@i-loilo.com.ph; training@aqd.seafdec.org.ph

For local applicants who wish to apply for fellowships, contact:

Hon. Cesar Drilon, *SEAFDEC Council Director for the Philippines*
Office of the Undersecretary for Fisheries and Legislative Affairs
Department of Agriculture, Elliptical Road, Diliman, Quezon City 1104
FAX: (02) 927 8405

For fellowship applicants from other countries, please contact your respective SEAFDEC Council Director.

Videos from SEAFDEC/AQD

Bighead carp hatchery technology, 25 minutes. Shows techniques of hatching bighead carp as practiced by fishfarmers in Laguna de Bay, Philippines, and by SEAFDEC's freshwater fish experts.

Milkfish hatchery operations, 12 minutes. Describes SEAFDEC/AQD's recommended mode of operations for a milkfish hatchery.

A CFRM experience: the Malalison story, a 30-minute video documentary that shows the lessons gained by SEAFDEC's 7-year coastal fishery resource management project (CFRM) in Malalison Island, west central Philippines.

Culture of oyster and mussel using raft method, a 9-minute documentary that depicts the AQD favored method of using the environment-friendly hanging raft for oyster and mussel culture.

Grouper cage culture, 16 minutes. Promotes a profitable way of raising grouper in cages. Describes briefly the processes of site selection, cage construction, and grow-out culture.

Grouper culture in brackishwater ponds, an 8.5-minute video documentary showing the different stages of grouper culture: grow-out, harvest, and post-harvest, as well as site selection and pond preparation. It also describes the economics of one grouper crop, and marketing and transport techniques.

Conserving our mangrove resources, a 12-minute video documentary that describes the plight of mangroves in the wake of the fishpond boom and efforts to sustain the mangroves.

Price for each video title: P500 within the Philippines; US\$45 for other countries. Postage is included in price. Kindly indicate format of VHS tape (eg. NTSC, PAL, etc). See next page for ordering address.

SEAFDEC websites on the internet

- **www.seafdec.org**
maintained by the SEAFDEC Secretariat and SEAFDEC Training Department in Samut Prakan (Thailand) with contributions from the various SEAFDEC departments. Regional programs are highlighted
- **www.seafdec.org.ph**
all about the SEAFDEC Aquaculture Department based in Iloilo, Philippines
- **www.asean.fishnet.gov.sg/mfrd1**
all about the SEAFDEC Marine Fishery Research Department based in Singapore
- **www.agrolink.moa.my/dof/seafdec**
all about the SEAFDEC Marine Fishery Resources Development and Management based in Kuala Terengganu, Malaysia

New publications



Grouper culture in floating net cages, a 10-page manual that details the grow-out culture. Price (including postage): P80 in the Philippines, US\$ 30 other countries.



Pen culture of mudcrab in mangroves, a 10-page manual that details the operation of net enclosures in mangroves for mudcrab culture. Includes site selection, net installation, stock management, and marketing. Price (including postage): P80 in the Philippines, US\$ 30 other countries.

raised fry, and polyculture of milkfish and seaweeds; (2) the use of environment-friendly schemes in tiger shrimp culture; (3) mudcrab culture in ponds and net enclosures in mangroves; (4) cage culture of hybrid tilapia; (5) catfish hatchery technology; and (6) oyster and mussel culture in rafts. *This report is free upon request.*

1998 Highlights, a 31-page report on AQD's research and development activities for 1998. A special insert on AQD's 25th year anniversary celebration is included, describing the organization's contributions to the aquaculture industry in the Philippines and other Southeast Asian countries. What's new for 1998 is AQD's thrust on mangrove-friendly aquaculture; preliminary results are presented. *This report is free upon request.*



Mudcrab *Scylla* spp. production in brackishwater ponds, a 14-page manual that covers the specifics of grow-out operation. Price (including postage): P80 in the Philippines, US\$ 30 other countries.

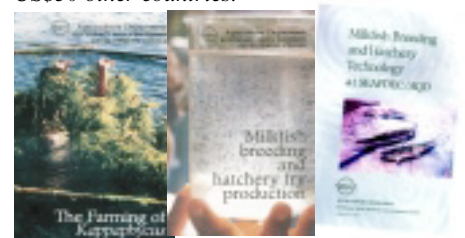
Grouper culture in ponds, a 17-page manual discussing basic information about groupers and detailing brackishwater pond culture: sourcing fry and fingerlings, site selection, pond preparation, nursery operation, grow-out culture, harvest, and post-harvest. It also describes the economics of one grouper crop, marketing and transport techniques and diseases. Price (including postage): P80 in the Philippines, US\$ 30 other countries.

Aquaculture, volume 164, 374 pages. A special issue of the Elsevier journal that contains the papers presented at the *Second international conference on the culture of penaeid prawns and shrimps* held 13-17 May 1996 at Iloilo City, Philippines. This volume is guest-edited by AQD researchers ET Quintino and JH Primavera. Price: P600 in the Philippines or US\$30 other countries.



Ecology and farming of milkfish, a 117-page monograph that discusses the life history and ecology and various aspects of the farming industry in the Philippines. Price (including postage): P300 in the Philippines, US\$50 other countries.

Sea bass hatchery operations, a 42-page manual updating AQD's 1990 publication of the same title. It details the activities in the seabass hatchery, from breeding until the harvest and transport of fry to fishponds. New section on the propagation of natural food *Moina* and *Diaphanosoma* has been added. Price (including postage): P100 in the Philippines, US\$ 30 other countries.



The farming of *Kappaphycus*. Introduces the red seaweed *Kappaphycus* with notes on the types of culture systems, the environmental factors required, initial investment needed, and crop management.

Milkfish breeding and hatchery fry production. Summarizes the integrated milkfish broodstock and hatchery operation technology developed by AQD.

Milkfish breeding and hatchery technology at SEAFDEC/AQD. Describes the techniques already adopted by the private sector: broodstock management, broodstock diet, commercial fry production, live transport, and larval diet. A list of AQD research publications on milkfish is included.



Mudcrab, a 32-page manual that gives a general overview of mudcrab species of commercial value and their grow-out monoculture in ponds; polyculture with milkfish; and fattening in ponds, mangroves, and cages. Price (including postage): P100 in the Philippines, US\$ 35 other countries.

Biology and culture of siganids, a 53-page monograph updating AQD's 1990 publication of the same title. The book includes siganid morphology, distribution and ecology; reproduction; fisheries; diseases and parasites; genetics. It also covers larval culture; fry and fingerling production; nutrition and feeds; and problem areas in aquaculture. Price (including postage): P100 in the Philippines, US\$ 30 other countries.

The farming of *Kappaphycus*. Introduces the red seaweed *Kappaphycus* with notes on the types of culture systems, the environmental factors required, initial investment needed, and crop management.

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The modular method: milkfish pond culture, an 18-page manual that describes a better way of raising milkfish in brackishwater ponds. The modular method is an improvement of the traditional extensive method. Price (including postage): P80 in the Philippines, US\$ 30 other countries.



Promoting appropriate aquaculture technology for more fish in Southeast Asia, a 24-page report that discusses AQD's technology verification trials on (1) milkfish hatchery, pond culture using hatchery-

NEW BOOKS / FLYERS / VIDEOS from SEAFDEC Aquaculture Department



Aquaculture training program. 20-page brochure that introduces SEAFDEC/AQD's short-term regular courses. These flyers and brochures are free upon request.

The commercialization of SEAFDEC/AQD's milkfish fry production technology. Illustrates AQD's newest hatchery facility -- the Integrated Fish Broodstock and Hatchery Demonstration Complex -- and the extension program that go with it -- Accelerated Transfer of Milkfish Fry Production Technology.

Reaching out through technology verification and extension. Presents the efforts of AQD to fast-track commercialization of aquaculture technologies developed

Binangonan Freshwater Station. AQD's R&D on freshwater aquaculture and lake ecology, primarily the Laguna de Bay, is conducted in this station. Species prioritized for research include tilapia, carp and catfish.

Mudcrab culture. Summarizes the available technologies on mudcrab grow-out -- monoculture in ponds, polyculture with milkfish in ponds, monoculture in tidal flats with existing mangroves -- and mudcrab fattening. Details on stocking density, some management tips and investment costs are given.

Seed production of the native catfish Clarias macrocephalus. Describes SEAFDEC/AQD's work on artificially propagating the catfish.

Training Module on Sustainable Aquaculture and Coastal Resource Management. Describes the new SEAFDEC/AQD training course (including course content), qualification of participants, and enrollment process.

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Tigbauan 5021, Iloilo
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Whither aquaculture?

Aquaculture is reputed to be the fastest growing food production sector in the world. The total world fish production from capture fisheries is projected to plateau at 60 million tons by the year 2000. With the estimated world population growth rate of 2.0%, an increasing demand for fishery products is likely to continue. The consequent shortfalls in the global supply of fish is expected to be produced by the aquaculture sector.

The world aquaculture production more than tripled by weight from 10.4 million to 34.1 million tons, and by value from US\$13.1 to 46.5 billion between 1984 and 1996. In the Philippines, aquaculture production in 1997 reached 957,546 tons valued at PHP 27.4 billion. Aquaculture's contribution is approximately 35 percent of the total fisheries production in the country and has been steadily increasing over the last ten years (Figure 1, page 32). The Philippine population has an estimated annual per capita consumption of 29-36 kg.

Taking into account the projected post harvest losses of 30%, and the inclusion of fishery products that are not directly consumed as food (e.g., seaweed), even the projected total fish production of 3.424 million tons by year 2004 may not be sufficient to meet the demands of the growing population.

Aquaculture, with a projected growth of 8.7% per year is expected to contribute 42% to the total fish production target by 2004 (Figure 2).

In the past, aquaculture development in the Philippines and the region, while augmenting the food supply, also became an environmental menace, largely because resource management was not included in the overall production scheme. There is, therefore, a need for a paradigm shift to ensure that production is both profitable and sustainable. At the same time, the industry must continue to improve culture systems and culture strains, and develop techniques for the cultivation of other aquaculture species, to survive intense competition in the global market and to attain the food security agenda of the government.

The National Integrated Research Development and Extension Program (NIRDEP) has put in place a research development and extension (RDE) program in aquaculture for the period 1999-2004. The responsible agency is the Aquaculture RDE Network composed of state colleges and universities of fisheries (the Institute of Aquaculture and the Marine Science Institute, both of the University of the Philippines System; the Freshwater Aquaculture Center of the Central Luzon State University; Mindanao State University at Naawan) and the Bureau of Fisheries and Aquatic Resources.

CONTINUED ON PAGE 32, INSIDE



Better life through aquaculture

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Philippines

E-mail:
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Cover price, P 50.00



SEAFDEC Aquaculture Department supports the Philippine government's Agrikulturang MakaMASA program. This is the banner program of the Estrada Administration for modernizing the agriculture sector.

The goals of the program for the fisheries sub-sector are: (1) food security through sustainable development and management of fisheries resources; (2) socio-economic upliftment of subsistence fisherfolk; and (3) fisherfolk empowerment. The program components are as follows:

- fisheries production
- conservation and management
- fisheries training and extension services
- fisheries information and marketing support
- research and development in fisheries
- fisheries infrastructure
- rural finance for fisheries
- program organization and management for the fisheries sector