



*Promoting
appropriate
aquaculture
technology
for more fish
in Southeast
Asia*



**AQUACULTURE DEPARTMENT
SOUTHEAST ASIAN FISHERIES
DEVELOPMENT CENTER**

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aquaculture technology for more fish
in Southeast Asia**

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**PROMOTING APPROPRIATE
AQUACULTURE TECHNOLOGY
FOR MORE FISH IN SOUTHEAST ASIA**



Aquaculture Department
Southeast Asian Fisheries Development Center
Tigbauan, Iloilo, Philippines
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FOREWORD

In mid-1996, the Philippine-based Aquaculture Department (AQD) of the Southeast Asian Fisheries Development Center (SEAFDEC) focused its efforts in promoting the commercialization of aquaculture technologies. It subjected research technologies to various validation trials through a technology verification and extension program.

Through this program, AQD facilitates the use and adoption of commercially viable aquaculture technologies by different beneficiaries in the region's aquaculture industry – big and small private entrepreneurs, farmer and fisherfolk cooperatives, local government units, and other academic, and research and development institutions.

Mature aquaculture technologies earlier developed at AQD's research laboratories and elsewhere are verified in brackishwater ponds, small farm freshwater impoundments, and coastal marine waters like bays and coves. These are conducted in cooperation with private fish farmers, universities, local government units, and national government agencies.

At present, AQD has verified certain aquaculture technologies that can be implemented commercially for such commodities as tiger shrimp, milkfish, grouper, mudcrab, tilapia, catfish, and oysters. The results of these verification studies have been published by AQD in the form of easy-to-follow extension manuals.

In addition to its training and mass media information activities, AQD has forged ties with private fishpond owners, universities, and other agencies in maintaining demonstration centers for aquaculture technologies. These are intended to showcase to interested aquaculture farmers the benefits that they can get from adopting AQD's technologies.

It is hoped that all these AQD efforts in promoting aquaculture technology may help provide more food for the table of the many people of Southeast Asia.



A handwritten signature in black ink, appearing to read 'R. Platon'.

Dr. Rolando R. Platon
Chief, Aquaculture Department
SEAFDEC



FROM RESEARCH LABORATORY TO THE FARM

The Aquaculture Department (AQD) of the Southeast Asian Fisheries Development Center (SEAFDEC) is mandated to conduct aquaculture research, training and extension activities. These activities are designed to assist in alleviating the food crisis in Southeast Asia.

Results of AQD research are disseminated to its various clientele through three major technology transfer strategies: technology verification, packaging and commercialization; training and extension delivery systems; and media strategies.

AQD addresses the following technology beneficiaries: fisherfolk, private industry, research and academic institutions, resource managers, non-government organizations, policy makers, regional and international organizations, member countries, and local and national governments.

In 1996, AQD intensified its efforts in promoting the commercialization of aquaculture technologies generated from its previous research activities.

It embarked on an aggressive technology verification and extension program to demonstrate the technical and economic feasibility of these technologies in commercial farms in the Philippines.

This program aims:

- To intensify technology verification activities by field testing specific culture systems in selected farm sites and determining their economic and commercial viability

- To package technologies that are found to enhance productivity and/or profitability
- To prepare extension materials for dissemination to SEAFDEC member countries in general and the Philippine Government through the Department of

Agriculture's Bureau of Fisheries and Aquatic Resources (DA-BFAR) in particular, and

- To network with other related local and international research and educational institutions and fishfarmer associations.



TECHNOLOGY VERIFICATION TRIALS

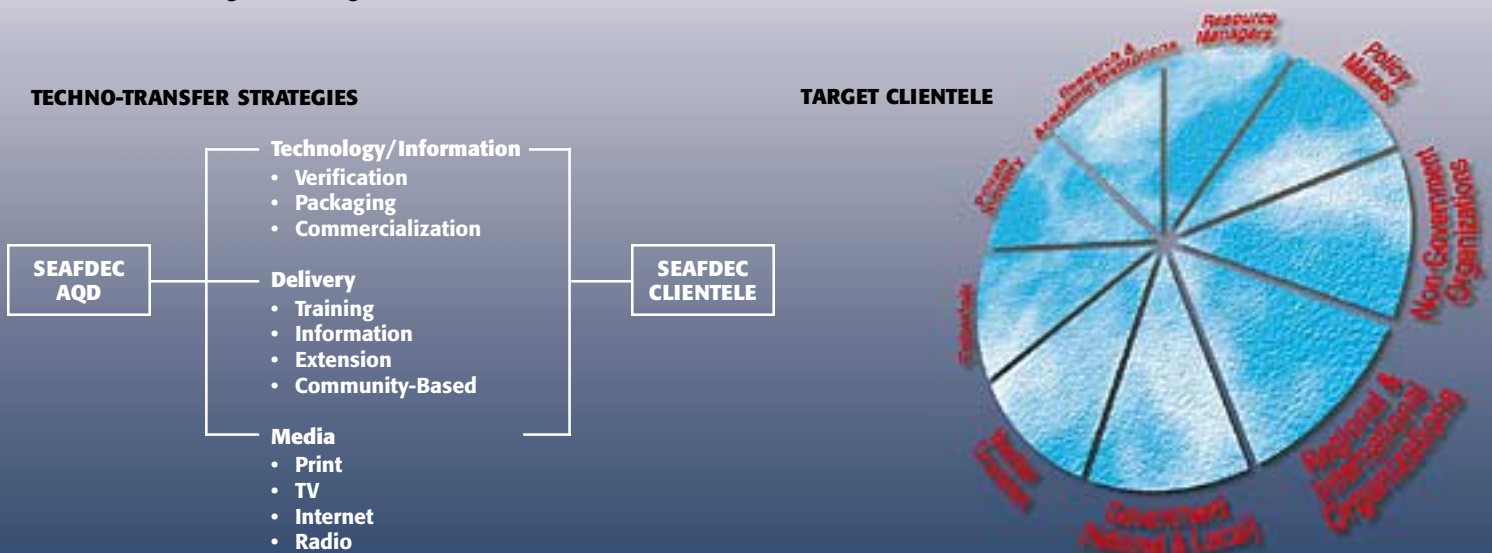


In commercializing and promoting its research-generated technologies, AQD adopts the Food and Agriculture Organization of the United Nations (FAO) definition of sustainable development. Under this framework, AQD ensures that its technology verification trials consider the following:

- Production and marketing linkage – forward and backward linkages are considered in ensuring continuity of viable technology operations. In the case of grow-out technology, backward linkages such as availability of seed supply from the wild and broodstock and hatchery development are assessed. Forward linkages are also evaluated, such as stability of local and export markets.
- Social equitability – technologies are evaluated in terms of their impact on a wider segment of aquaculture practitioners, including low-income fishers. The technologies verified for commercialization are not only limited to commodities with export potential or those suitable for big fishpond operators and entrepreneurs. They also include those that marginal fisherfolks, including the fry gatherers, can afford to invest in.
- Economic and financial viability – technologies are verified in actual field settings to determine their profitability and viability.
- Environment-friendliness – as a response to the worldwide concern for resource protection and ecological balance of the environment, aquaculture technologies are tested as to their positive impact on the environment.

At present, AQD has conducted several verification studies on these commodities: milkfish, grouper, tiger prawn, mudcrab, tilapia, and catfish.

Techno-Transfer Strategies and Target Clientele of SEAFDEC/AQD.



MILKFISH

In the late 1970s, AQD researchers achieved a breakthrough in inducing milkfish broodstock from the wild to spawn. Subsequently, AQD reared fry to breeders in cages and tanks. Then, eggs from captive breeders supported the development of a milkfish hatchery fry production technology. This was in response to the need for an alternative source of milkfish fry to augment the requirements of fishpond operators, especially when a large number is needed at one time. Traditionally, all of the fry needed by the industry came from the wild and more often, they were not enough. Fry also came seasonally. In addition, climate and pollution of the sea affected this supply.

In a 1992 study, AQD scientists proved that commercial hatchery operations for milkfish were viable. Collaborating with tiger shrimp hatchery owners whose operations were severely affected by the decline of the industry due to diseases brought about by highly intensive shrimp culture, AQD encouraged them to use their facilities for milkfish fry production.

The study found that with AQD technology, a return on investment of 54-61% and a payback period of 1.5 years were comparable between small (145-173 tons larval rearing and natural food tank capacity) and big hatcheries (282-325 tons). While the study showed profitability of the hatchery technology, a problem on deformed fry surfaced. Some doubts were also raised on the technology as to its comparative performance with fry from the wild. This made prospective fry buyers reluctant in using hatchery-reared fry.



AQD has since then proven that hatchery-reared fry are comparable in performance with wild fry. It collaborated with three commercial fishfarms (Gatuslao, Jalandoni and Naranjo) in Negros Occidental, Philippines. Results showed that in the nursery phase, a mere 0.23% deformity in fry was observed. This decreased further to almost nil – 0.05% in the grow-out phase using single ponds and 0.003% using a modular pond growing system. In addition, yields were found to be comparable with, if not better than those milkfish raised from wild fry.

The BFAR National Brackishwater Aquaculture Technology Research Center in Pagbilao, Quezon also collaborated with AQD on stock assessment of AQD's hatchery-reared milkfish fry. From the fry that survived (83.75% of 50,000 fry), about 97% were normal fingerlings. Only 3% had abnormalities, which were reported to be mostly uncovered gills.

Other similar trials were conducted in the Naranjo Farm in Iloilo, the Arches Farm in Capiz, and in the Capiz Institute of Technology and the Iloilo State College of Fisheries.



"Our experience with grow-out culture of hatchery-reared fry showed very little fish deformity at harvest time. We also observed that the milkfish growth and yield were the same as those grown from wild fry. We appreciate efforts of SEAFDEC/AQD in getting out of their laboratories and sharing with us this milkfish hatchery technology."

Roberto Gatuslao, fishpond operator; president of the Negros Prawn Producers and Marketing Cooperative, Bacolod City; AQD cooperator.



"In our limited trial, we did not achieve maximum benefits from the hatchery technology. Probably, we were not able to provide enough feed for the fish. However, this experience has taught me that there are new technologies that are more beneficial than traditional practices."

Damaso Arches, fishpond owner, Roxas City; AQD cooperator.

Accelerated Transfer of Milkfish Hatchery Technology

Emboldened by the previous encouraging results, AQD started in 1998 its *Accelerated Transfer of Milkfish Hatchery Technology Program*. This aims to increase the supply of milkfish fry through commercial hatchery operations using AQD technology.

The program encourages backyard shrimp hatchery operators to diversify into milkfish fry production. AQD provides the cooperators with milkfish eggs, natural food starter, a feeding regime, and technical assistance. The cooperator finances the operation and sells his fry as he wishes. AQD researchers collect pertinent data.

The cooperators of the project are Luis Rojas of the TRC hatchery in Batan, Aklan and Salvador Gestosani of the Sto. Niño hatchery in Guimbal, Iloilo. Experiences of the cooperators indicate that the prospects for milkfish hatchery operation as a viable commercial enterprise are very encouraging.



"We produced fry from SEAFDEC/AQD's milkfish eggs which were given to us for testing in our hatchery. We sold some fry to brokers and gave some to our friends who also had fishponds. We still get deformed fry but at 2%, this is negligible. One problem though, is the non-uniform size of the fry at 18-20 days of culture. So this technology needs to be refined. SEAFDEC/AQD can be relied on to assist us solve this problem."

Luis Rojas, hatchery operator, Batan, Aklan; AQD cooperator.



The Rojas TRC hatchery in Aklan used to produce shrimp fry. Since the slump in the shrimp industry, this hatchery has been revived as a facility for verifying AQD milkfish hatchery technology.



“Our hatchery operations may be considered a medium-scale one. In 1997, we tested production of milkfish fry in our hatchery that we previously used for our shrimp fry business.

“SEAFDEC/AQD provided us with milkfish eggs and feed. They also trained our people in the technology. We sold some 130,000 fry to fishpond owners in the nearby towns and provinces. We did get some income from the enterprise, about US\$925.¹”

Salvador Gestosani, hatchery owner, Iloilo; AQD cooperator.



“We were able to show that producing milkfish fry could be profitable. A significant factor that would allow this is producing fry at the time that fry from the wild is low in supply. It is more like an off-season market that a fry producer would target. Compared with shrimp fry production, producing milkfish fry is easy and does not cost as much.”

Gorgonio Talledo, Municipal Mayor, Tubungan, Iloilo; business partner of Gestosani.



The Sto. Niño hatchery (above) also engaged in milkfish fry production in collaboration with AQD.

¹ Exchange rate used was the 1997 figure: US\$1 equals 35 Philippine pesos. All dollar figures mentioned in succeeding pages follow the 1997 exchange rate unless stated otherwise.

Pond Cooperators Project

Mr. Tomas Hautea Jr., fishpond operator (left of photo), receives AQD hatchery-produced milkfish fry from Philippine Department of Agriculture Secretary William Dar at the inauguration of the AQD fish broodstock-hatchery complex last year. AQD's Pond Cooperators Project aims to promote the use of hatchery-reared fry as an alternative to wild fry.

Mr. Hautea reports that he has been using the AQD milkfish fry for grow-out in his fishponds in Dumangas, Iloilo. He claims that the hatchery-reared fry that AQD treated with Vitamin C and a Japanese manufactured feed supplement showed more resistance to stress and grew faster.



AQD has instituted a Pond Cooperators Project that would continue to evaluate the performance of hatchery-reared milkfish fry in commercial grow-out scale. Under this scheme, AQD will give hatchery-reared fry to cooperators for free. The cooperators will grow this fry in their ponds using their own management and culture techniques.

Verification trials are currently ongoing in five fishfarms. The cooperators are Dr. Juan Gustilo, Mr. Tomas Hautea Jr., and Mr. Francis Griño, all in Iloilo; Mr. Rene Obregon, Guimaras; and Mr. Romeo Aaron, Bohol.

Polyculture of Milkfish and Seaweed in Brackishwater Ponds

Seaweed (*Gracilariopsis bailinae*) grown with milkfish in brackishwater ponds was verified as a potentially profitable enterprise for fishfarmers. AQD, in collaboration with the Iloilo State College of Fisheries in Iloilo, conducted a trial in nine 100-meter ponds.

Initial computations showed that seaweed stocked at 2,500 kilos per hectare and milkfish at 3,000 fingerlings per hectare can produce in a 3-month cropping period a milkfish yield of 722 kilos per hectare. While this yield does not differ significantly from milkfish grown alone, an additional income from the seaweed harvest can be achieved. The results demonstrated that a fishfarmer can harvest 8.7 tons per hectare of fresh seaweed, which can then be sold fresh or dried. Thus, a milkfish

grower stands to earn an added gross income of approximately US\$ 1,900 for fresh seaweed or US\$ 500 for dried seaweed.

The seaweed-milkfish system was also observed to provide a much-improved pond water quality. The seaweed reduced ammonia levels in the water that can contribute to better growth of milkfish. Fishfarmers can adopt this system during the dry season when high water salinity (25-40 ppt) favors seaweed growth. During the rainy season, rains lower the pond water salinity (less than 15 ppt) and seaweed will not thrive.

Fishfarmers can earn more income with seaweed cultured with milkfish in brackishwater ponds.



GROUPEL CULTURE IN BRACKISHWATER PONDS

Groupers are a popular food fish in Asia. At present it is a highly valued commodity in the live fish export market.

Mr. Roberto Sanson, a fishpond operator who has a 19-hectare fishpond in Bacolod City in the Philippines, is the first collaborator of AQD in testing the viability of raising groupers in ponds. Groupers are usually cultured in netcages. Like other fishfarmers in Western Visayas, his tiger shrimp operations were greatly affected by the slump in the industry in the mid-80s. AQD then offered him an alternative: growing groupers instead of shrimp.

Based on initial calculations from a harvest of about 1,500 kilos, he obtained a net income of US\$4,535 from a 0.9-ha pond that served as the first trial. This was for a period of 5-7 months culture. AQD reports that Mr. Sanson obtained a return on investment of 82%. His payback period was calculated at 1.22 years.

Mr. Sanson claims that he was able to scout for a good export market through a group of traders in Manila who buy his groupers at US\$11-12 per kilo. Today, he produces an average of 700 kilos a week. He intends to increase this to 1,000 kilos a week to meet the demand.



“My experience proves that growing groupers in brackishwater ponds is profitable. However, one has to have a secure market. The live fish export market provides a much higher price.

“One good area for SEAFDEC/AQD to study is the agribusiness side of aquaculture. This would surely encourage more entrepreneurs to try new technologies.”

Roberto Sanson, fishpond operator, Bacolod City; AQD cooperater.



Mr. Sanson oversees harvesting of groupers he cultured in a brackishwater pond. His groupers are shipped live to Manila traders who give him US\$11-12 per kilo of grouper.

TIGER SHRIMP: USE OF ENVIRONMENT- FRIENDLY SCHEMES

A promising AQD technology for the tiger shrimp industry is the use of reservoirs, sludge collectors, fish as biological manipulators, bacterial inoculants (probiotics) and/or low salinity levels in shrimp ponds. These environment-friendly schemes are designed to prevent the occurrence of diseases.

Under the Philippine Government "*Oplan Sagip Sugpo*" (Save the Shrimp) program, AQD worked with three intensive tiger shrimp farms (Sanson Farm, Sta. Clara Farm and Golden Prawn Farm) in Negros Occidental. In each farm, two ponds were used for the trial.

The trials showed that the above schemes in shrimp culture were indeed useful in preventing shrimp disease. One pond in the Sanson Farm produced shrimp with an average weight of 18 g after 109 days of culture. In the second pond, shrimps were 17 g after 120 days. At the Sta. Clara Farm, tiger shrimp weighed 32 g after 125 days. In another pond, stocks were harvested with an average weight of 20 g. Survival rate was 65%.

The scheme achieved best results in the Golden Prawn Farm. The first pond of 0.4 ha produced a harvest of 2,800 kg after 164 days of culture. Survival rate was 94% and shrimp weighed 38 g. The second pond (0.5 ha) yielded 3,400 kg of tiger shrimp after 168 days and the shrimp weighed 36 g on average. Survival rate was 92%.

Actual sales proceeds from the two ponds amounted to US\$45,171 while direct operating cost was US\$25,165. Gross profit was calculated as US\$20,005.



Cooperators' ponds used in verification trials on environment-friendly schemes for shrimp culture included those in the Sanson Farm (top) and the Sta. Clara Farm (left). These commercial aquaculture farms are located in Negros Occidental, Philippines.

MUDCRAB

Mudcrab Culture in Brackishwater Ponds

Brackishwater pond production of mudcrab (*Scylla* spp.) is usually done in combination with milkfish. In ponds where milkfish natural food does not thrive, an alternative is to grow mudcrab alone.

AQD has shown the technical and economic feasibility of raising mudcrabs in commercial brackishwater ponds.

Its researchers collaborated with three fishfarms in Negros Occidental, Philippines: Jalandoni, Montelibano and Gargarita farms. In each of these farms, the trials used 0.5 ha ponds that were stocked with 5,000 pieces of crablets. The technology verification trials showed the following results:

ITEM	JALANDONI FARM	MONTELIBANO FARM	GARGARITA FARM
Yield (kg)	792	669	713
Culture period (days)	145	130	122
Survival rate (%)	63	66	72
Gross profit (US\$)	3,543	2,992	3,189
Variable cost (US\$)	2,583	1,987*	2,530
Net profit (US\$)	960	1,005	660

*This farm used its existing concrete vertical dikes in its ponds where the mudcrab was grown. The other farms incurred costs for materials and construction of the mudcrab pens in the pond.



"I read somewhere about SEAFDEC/AQD mudcrab technology in one of its publications. I wrote SEAFDEC and asked for technical assistance. Their researchers assisted me in the construction of a net enclosure for the mudcrab in my half-hectare pond that we previously used for milkfish. They also provided the technology for its culture. We do not have a large farm so this mudcrab project helped supplement our family income."

Arlene Gargarita, fishpond owner, Negros Occidental; AQD cooperater.



"At first, raising mudcrab in our ponds was a very new experience. We are used to growing milkfish and shrimp.

"We found out that harvesting of mudcrab was a very tedious process. Mudcrab would have to be dug from their hiding places, claws have to be tied, and so on."

Claudette Jalandoni, Jalandoni Farms, Negros Occidental; AQD cooperater.

Mudcrab Culture in Net Enclosures in Mangroves

Growing mudcrabs in net enclosures in mangrove areas offers a viable livelihood alternative for coastal communities. In addition, it ensures protection of mangroves since the net enclosures where mudcrab is raised leave the trees alone as they are. This system has been practiced in Malaysia, Vietnam and China.

AQD verified this technology in two sites in the Philippines: Puerto Princesa City, Palawan, and Kalibo, Aklan.

In the Palawan site, AQD specialists teamed up with a local farmer cooperative and the City Agriculture Office of Puerto Princesa. The verification trial harvested 485 kilos after 5 months of culture in a 0.4-hectare mangrove area. The survival rate was 86%. Calculations showed that the return on investment on the production of mudcrab in mangrove areas was 59%, and the payback period was 1.6 years.



A staff member of the City Agriculturist Office of Puerto Princesa City and a farmer member of a local cooperative help in the harvesting of mudcrab. This AQD verification trial of growing mudcrab in a net enclosure in a mangrove area offers an alternative livelihood for coastal fishers and farmers.

Meanwhile, an enterprising farmer in Puerto Princesa has tried mudcrab production in one of his fishponds. Using the AQD technology practiced in the farmers' cooperative site in Barangay Manalo, Mr. Fred Magbanua, a farmer, tried mudcrab culture in a 200 sq m pond. He usually raises milkfish in his fishponds. He also produces mangoes, bananas, and other vegetables in his farm. Mr. Magbanua reports that from a total operations cost of US\$514, he was still able to obtain an additional net income of US\$257 from his 200 sq m mudcrab initial trial.



"It was my son who works in the City Agriculturist Office who convinced me to try mudcrab in one of our fishponds. He said that the technology tried by SEAFDEC/AQD, the farmer cooperative and their office could be an additional source of income for our farm.

"We constructed a 200-sq.m. net enclosure inside one pond and stocked it with mudcrab. I harvested the mudcrab and sold 5-10 kilos at a time, within the 3-month culture period.

"Some office workers in Manila bought my mudcrab through another relative that worked in the same office. I'll continue with this mudcrab project, even though small as it may be. This is really another profitable venture for me as a farmer."

Fred Magbanua, farmer, Puerto Princesa City.



Two hundred sq.m.-net enclosures housed the mudcrab at the trial site in Aklan, Philippines. Mudcrab culture in tidal flats like the above site proves to be an aquaculture system that is environment-friendly. No mangrove trees are cut to give way to the construction of net enclosures.

AQD conducted another trial to demonstrate that growing mudcrab in tidal flats with existing mangroves is a viable aqua-silviculture venture. This was done in collaboration with KASAMA, a local farmer and fisher cooperative in Kalibo, Aklan.

In the tidal flats with reforested mangroves, uniformly sized net enclosures measuring 200 sq m, were used to raise the mudcrab.

Mudcrabs were stocked at 0.5 and at 1.5 per sq m and were fed with either salted fish bycatch or a mixed diet of salted brown mussel flesh and salted fish bycatch. From a 200-sq m enclosure, a net revenue of US\$98.50 was obtained from the 0.5 crab stocked per sq m and US\$130.80 for mudcrab stocked at 1.5 per sq m. Return on investment was calculated at 65% for the 0.5 per sq m stocking rate and 87% for the 1.5 per sq m stocking rate.



“Our coop members saw the profitability of growing mudcrab in mangrove areas as shown to us by SEAFDEC/AQD researchers. We are small fisherfolks and the 200-sq.m. mudcrab pen is an ideal size that would attract more families in our area to engage in mudcrab culture.

“We are currently negotiating with the Department of Environment and Natural Resources for a 10-hectare area adjacent to our farms that we can use for mudcrab culture and other aquaculture projects.”

Francisco Sutoniel, Chairperson, KASAMA cooperative, Aklan; AQD cooperater.

NETCAGE CULTURE OF HYBRID TILAPIA

The AQD's first tilapia verification trial was conducted using netcages (below). The trial showed that tilapia culture could improve the livelihood of farm families, especially those who reside in places where small water reservoirs or impoundments can be used for tilapia production.

Tilapia culture in freshwater ponds, pens and net cages is now widely practiced in the Philippines. Demand for tilapia fry has been increasing that breeding techniques have come up with tilapia hybrids. A tilapia culture system using netcages in a natural or man-made water impoundment offers a profitable livelihood to farmers and fisherfolks.

AQD tested this system in cooperation with a people's organization and the local government unit in Bingawan, Iloilo. Eleven net cages were installed in a small farm freshwater reservoir to raise a genetically improved all-male tilapia hybrid. Preliminary data from initial harvests showed a return on investment of 49% with a payback period of 2 years.

A second verification run was conducted in another site in Bingawan in cooperation with the current municipal mayor Ted Peter Plagata. Initial reports show that some 1,500 kilos of tilapia with an average body weight of 125 gm could be produced in eight 5x5x3-meter netcages.

Due to the successful experience of Mr. Plagata, many farmers in the municipality have been attracted and are willing to try growing tilapia. He reports that his office has acquired funds from the Department of Agriculture to support farmers who are interested in tilapia production. He adds that while engaging in tilapia culture is profitable, farmers in the municipality cannot easily afford the venture, as the cost of fry and feed accounts for a large portion of operating costs.





“This verification trial that SEAFDEC/AQD conducted in my small farm reservoir proved that tilapia production is profitable.

“This can greatly help supplement the income of our farmers, who are mostly rice farmers. We learned much from the tilapia technology introduced to us, especially on the economical and efficient ways of utilizing feeds.”

Ted Peter Plagata, Bingawan Municipal Mayor and AQD cooperater.



Many small farm water reservoirs are found in the rolling agricultural landscape of Bingawan town (above). These ponds can be effectively used for growing tilapia as an added source of income for rice farmers.

Meanwhile, news about the Bingawan tilapia verification trials and their income-generating potential has reached local government officials of an adjacent municipality, Tapaz, in Capiz province. They immediately sought the assistance of AQD in putting up a similar project in a 16-hectare irrigation dam in the municipality. At present, AQD staff, in cooperation with the Tapaz local government, is constructing 14

netcages (5x5 m each) which will be used to demonstrate the culture of tilapia. Some 600 pieces of an AQD-developed tilapia hybrid are to be used as stock in a few netcages. The rest of the fingerling stocks will be supplied by DA-BFAR, another collaborating institution.

Due to the increased interest in raising tilapia among community residents, AQD is closely collaborating with the local government in initiating zoning regulations. This is to prevent undue proliferation of netcage tilapia culture that may result in environmental problems.



The Tapaz irrigation dam (below) draws water from many small springs from the surrounding mountains. The dam shall serve as a demonstration center for AQD's technologies on netcage culture of tilapia and other freshwater fish.



"We are a member of the Central Panay Economic Unification, Inc., a 5-municipality consortium whose main aim is to provide a unified and systematic development program for our constituents.

"Our collaboration with SEAFDEC/AQD and DA-BFAR in the tilapia project aims to draw attention to this technology as a possible alternative enterprise for our farmers. We shall promote this livelihood project especially among our rebel-returnees who need to be integrated in the mainstream of government assistance programs."

Mayor Romualdo Exmundo, Tapaz, Capiz.



CATFISH HATCHERY TECHNOLOGY

AQD has recently developed an induced breeding and hatchery technology for mass production of fry of the Philippine catfish (*Clarias macrocephalus*). This technology answers the need for fry for grow-out production as this catfish is fast disappearing from its natural habitat in the Philippines.

AQD research found that fry reared in net cages in ponds produced heavier and longer fingerlings than those reared in tanks. Also, the catfish grew faster in ponds. When the fingerlings were stocked in pens in a 440-sq m pond for the grow-out period and fed with an AQD-formulated diet in combination with commercial pellets containing 27% protein, the catfish exhibited higher growth rate than those fed with other diets.



AQD reared catfish fry in netcages in ponds and found them to grow into heavier and longer fingerlings.



“Yes, SEAFDEC/AQD showed that hatchery-produced catfish fry can be used for grow-out culture. In our first trial in my 450 sq. m. pond, we were able to harvest 456 kilos after 6 months of culture. The fish body weight averaged 100 g. From a stocking density of 5,000 pieces, we got a survival rate of 88%. We obtained US\$ 1,200 gross sales and incurred an operating expense of US\$ 997. Our net margin was US\$ 203².”

Tomas Hautea Jr., fishpond operator and AQD collaborator.

² Exchange rate: US\$ 1 = 38 Philippine pesos, May 1999.

OYSTER AND MUSSEL CULTURE IN RAFTS

Oyster and mussel farming is a household activity in fishing communities. Young and adult members of the household perform various tasks during the culture cycle.

An AQD technology on the production of oyster and mussel using bamboo raft has been developed by researchers in the early 1980s. This technology uses spat collectors that are hung in a bamboo raft and submerged in seawater instead of the usual practice of horizontal stakes. The production system promises higher yield potential, higher profits and less pollution of the water where the oyster and mussel are grown. Previously, the raft method (also known as rack hanging method) of



“Many fishers here raise oysters using the traditional bamboo stakes. Some ten of them who saw our verification trial began adopting our bamboo raft technology. They may be a few but we are happy that this technology is proving useful to them.

“This technology has much potential in this area, since the bamboo raft method is highly suitable and works better in deeper waters.”

Ruben Rabe, aquaculture officer, Local Government of Ivisan; AQD collaborator.

oyster culture was shown to be twice as profitable as the stake method used in medium-sized farms of 826-962 sq m in Western Visayas, Philippines.

Aiming to promote this technology, AQD conducted a verification trial in Ivisan and President Roxas in Capiz. This was implemented in cooperation with the local government unit. The trial used 6 x 8 m

bamboo rafts containing 800 hangings/raft with 15 spat collectors/hanging.

Initial calculations showed that an average of 10 kilos of oyster per collector could be harvested after 6 months. This could amount to 4 tons/raft, a potential additional gross income of US\$274-411. For mussels, harvest could be 2,000 kilos that could command a price of US\$114-160.



“This SEAFDEC/AQD technology of using bamboo raft for oyster and mussel culture can provide added income since we’re getting more in our harvests.

“Our village is adjacent to a 50-hectare cove that leads to Sapiian Bay. Our village has about 1,000 families, mostly composed of small fishermen. There are some of us who grow grouper, milkfish and snapper in net cages. We also grow oyster and mussel. We hope more would adopt this bamboo raft technology for oyster and mussel production.”

Jonathan Malan, fisher, Ivisan, Capiz; AQD cooperator.

BROODSTOCK MANAGEMENT AND SEED PRODUCTION OF ECONOMICALLY IMPORTANT AND CULTURED FISHES

AQD collaborates with the Philippine Department of Agriculture's Inland Searanching Station in Palawan province and the Puerto Princesa City Agriculturist Office in verifying broodstock management and hatchery techniques for groupers and other important fishes.

Recently, a groundbreaking ceremony for the AQD-designed hatchery of the Station was held with officials of AQD, BFAR and the Puerto Princesa City Government in attendance. The local government has provided a new 5-hectare site for the hatchery in its City Environment Estate.

This estate is an important component of the Puerto Princesa environment program. The City Government is popularly known for its espousal of environment-friendly activities in the use of its natural resources.

The Inland Searanching Station is expected to be a demonstration center for aquaculture technologies. At present, the Station raises broodstock of groupers, panther



groupers, milkfish and some marine ornamental fish. AQD hopes to provide the station with more technical assistance in broodstock management and hatchery operations.



Floating netcages house broodstock of several fishes in the Department of Agriculture's Inland Searanching Station in Palawan (above). The Station shall serve as a demonstration center for aquaculture technologies developed by SEAFDEC/AQD and other agencies.



The SEAFDEC/AQD-designed broodstock and hatchery complex (above right) is now in its initial stage of construction at the DA-BFAR Inland Searanching Station. This facility will showcase hatchery technology for economically important fishes like grouper, snapper, siganids and others.



"We will strive to extend as much technical assistance as possible for this station to be able to conduct its expanded broodstock and hatchery management program. Our hatchery complex aims to produce fry to show that hatchery-produced fry can augment the need for fry, especially during times that fry supply is low."

Dr. Rolando Platon, SEAFDEC/AQD Chief (above, at groundbreaking ceremonies of AQD-designed hatchery complex).



"In the long term, we intend to have this station as a source of SEAFDEC/AQD-developed aquaculture technologies, especially the hatchery-reared fry that we shall produce from our broodstock. Eventually, we would be able to produce fry and show to our entrepreneurs that this could be a profitable venture."

Bert Abrera, Manager, DA-BFAR Inland Searanching Station, Puerto Princesa City.



"Our collaboration with SEAFDEC/AQD and BFAR, through our City Agriculturist Office, will indeed greatly support our environment program and eco-tourism projects in Puerto Princesa City."

"This hatchery will supplement our effort to curb export of live fish caught through non-environment friendly means. In the process, we shall encourage more efforts in aquaculture production."

Mayor Edward Hagedorn, Puerto Princesa City.

AQUACULTURE FOR SUSTAINABLE COASTAL RESOURCES MANAGEMENT



Local government officials of two adjoining coastal municipalities, Ibajay and Tangalan in Aklan province, Philippines are currently collaborating with AQD in testing aquaculture technologies that would ensure a sustainable coastal resources management program.

The collaborative project aims to demonstrate and transfer appropriate aquaculture technologies that are environment friendly and socially equitable. It also seeks to facilitate formulation of coastal resources management policies and aquaculture development programs.



"SEAFDEC/AQD was quite efficient in doing the survey of our coastal resources. I was very much impressed by their thorough study. We feel that this collaboration would really result in a better understanding of our community's capabilities and need for aquaculture technologies."

Pedro Garcia, Municipal Mayor, Ibajay, Aklan.



"Our collaboration with AQD-SEAFDEC aims to provide an alternative livelihood for our community. Their aquaculture technologies promise to uplift our community's standard of living."

"This project will no doubt support our eco-tourism thrust. We have a cloth-weaving industry, our pinya cloth, and our Jawili Falls and beautiful beaches that we are promoting for more people to visit and see."

Jed Tirol, Municipal Mayor, Tangalan, Aklan.



"SEAFDEC/AQD earlier conducted a mudcrab culture project in a net enclosure inside our mangrove area. We were able to get a good harvest and the prospects are bright for us small fisherfolks. We are now trying this technology again in a wider area where our fishers are involved. This is an alternative livelihood for us, especially during the northeast monsoon season. At this time, the winds are strong and we find it difficult to go out to sea to fish."

Norberto Soliba, Village Chief, Ibajay, Aklan.



ponds and pens within a mangrove area, searching with abalone stocked at a nearby fish sanctuary and grouper culture in floating cages.

Another effort that seeks to develop and protect marine resources in four coastal municipalities of Iloilo province (Oton, Tigbauan, Miag-ao and San Joaquin) is the Panay Gulf Development Program (PGDP). This program is under the auspices of Iloilo's first district representative in the Philippine Congress.

At present, AQD is assisting personnel of PGDP in two projects: broodstock development of the window pane shellfish (*Placuna placenta*, locally known as *kapis*, whose shells are used for shellcraft for export) and tilapia culture in small freshwater ponds.

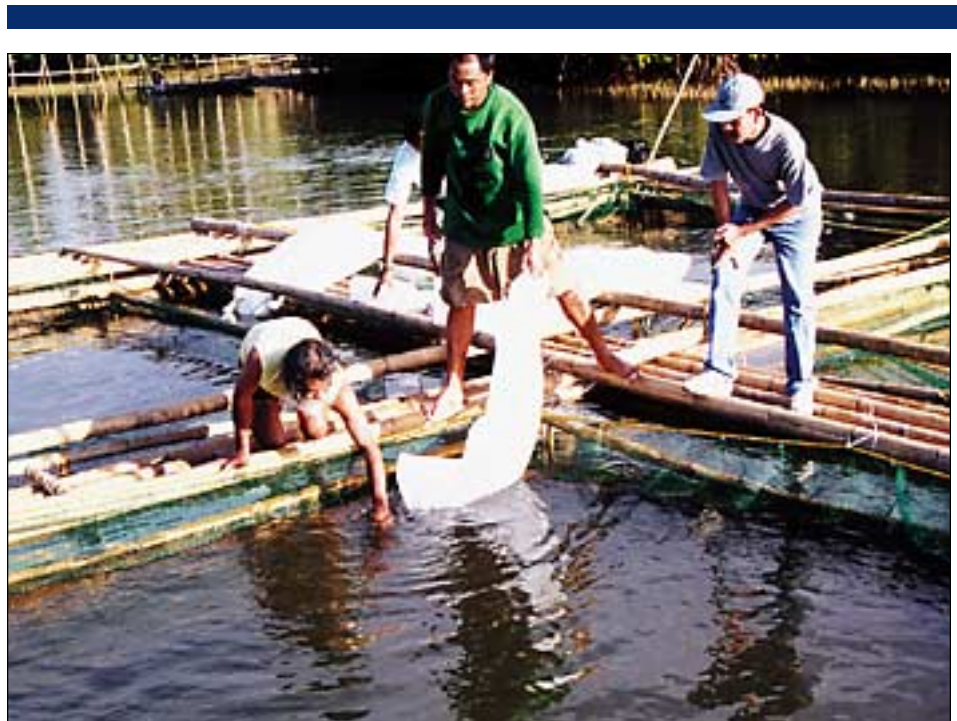
Aside from applying locally suitable aquaculture technologies, the effort is using social technologies and development strategies as the community-based approach, the co-management approach, and cost-sharing among the collaborating institutions. This includes AQD's experience in its previous project in a fishing community in Malalison Island where lessons learned from co-management of fishery resources, people empowerment and community organizing are being applied in the new project.

In cooperation with the community officials and residents, AQD first conducted a study of the coastal resources, fishing practices and other socio-economic factors in the two municipalities. After this, appropriate aquaculture technologies were identified. These are now being implemented in selected sites. Among these are mudcrab culture in both

In like manner, AQD is also collaborating with the Philippine Business for Social Progress (PBSP), a group of business companies engaged in providing livelihood opportunities for small farmers and fishers.

AQD currently works with PBSP staff in projects designed to rehabilitate the coastal resources in the once rich Maqueda Bay in Samar province. The PBSP's project on cage culture of grouper has been refined with AQD technology. Another project is the culture of mudcrab in mangroves being tested in one village.

Both projects are envisioned to benefit some seven community-based organizations and 844 fishing and farming households in the area.



In cooperation with local government officials and community residents, SEAFDEC/AQD has started testing certain identified technologies that are suitable to the area. One such technology is the culture of grouper in floating netcages. Other trials are being conducted on mudcrab pen culture in the mangrove areas and culture of abalone and seaweed.

AQUACULTURE EXTENSION MANUALS

Supporting AQD's information dissemination is its publication program. Aside from its regularly distributed newsletters and media news releases, AQD also produces aquaculture extension manuals.

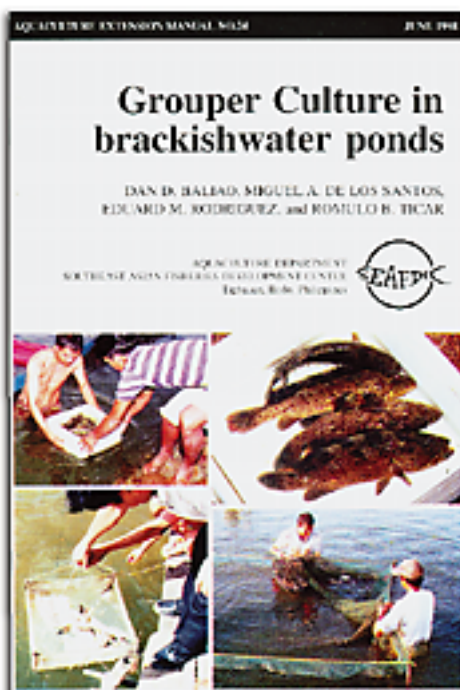
These simple, easy-to-follow manuals are intended as extension education materials that can be used by extension agents, aquaculturists, researchers, academicians and students, policy makers, farmers and other interested parties.

Since its inception, AQD has published several extension manuals on production of various aquaculture commodities.

In addition to these, three extension manuals have been published recently as a result of AQD's technology verification trials in the last two years:

- a. Milkfish pond culture
- b. Pen culture of mudcrab in mangroves
- c. Grouper culture in brackishwater ponds

As other technologies are verified for commercialization, more extension manuals are planned to be published in the near future.



FACILITIES FOR TECHNOLOGY DEMONSTRATION

While AQD tests its technologies in private commercial farms, it also maintains two facilities that the general public can visit to see and observe how these technologies work.

These are the Integrated Fish Broodstock and Hatchery Complex in its main headquarters in Iloilo, and the Brackishwater Pond Station in Dumangas, Iloilo, some 50 kilometers further northeast.

Both facilities are used to verify further improvements in aquaculture technology being developed by AQD researchers. In addition, these serve as appropriate venues for the various training courses that AQD offers every year.



Above left is the Integrated Fish Broodstock and Hatchery Complex that currently houses milkfish and grouper broodstock and fry used for research and technology verification activities. AQD has recently acquired its Dumangas Brackishwater Pond Station (below). This 16-hectare site was donated by the Philippine Department of Agriculture in ceremonies held last year (above right).



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PROMOTING APPROPRIATE AQUACULTURE TECHNOLOGY FOR MORE FISH IN SOUTHEAST ASIA

SEAFDEC AQUACULTURE DEPARTMENT
TIGBAUAN, ILOILO, PHILIPPINES
JUNE 1999



The Southeast Asian Fisheries Development Center (SEAFDEC) is a regional treaty organization established in December 1967 for the purpose of promoting fisheries development in the region. Its Member Countries are Japan, Malaysia, the Philippines, Singapore, Thailand, Brunei Darussalam, and the Socialist Republic of Vietnam.

Representing the Member Countries is the Council of Directors, the policy-making body of SEAFDEC. The chief administrator of SEAFDEC is the Secretary-General whose office, the Secretariat, is based in Bangkok, Thailand.

Created to develop fishery potentials in the region in response to the global food crises, SEAFDEC undertakes research on appropriate fishery technologies, trains fisheries and aquaculture technicians, and disseminates fisheries and aquaculture information. Four departments were established to pursue the objectives of SEAFDEC.

- The Training Department (TD) in Samut Prakan, Thailand, established in 1967 for marine capture fisheries training
- The Marine Fisheries Research Department (MFRD) at Changi Fisheries Complex, Singapore, established in 1967 for fishery post-harvest technology
- The Aquaculture Department (AQD) in Tigbauan, Iloilo, Philippines, established in July 1973 for aquaculture research and development
- The Marine Fishery Resources Development and Management Department (MFRDMD) in Kuala Terengganu, Malaysia, established in 1992 for the development and management of the marine fishery resources in the exclusive economic zones (EEZs) of SEAFDEC Member Countries.

