1990

Aqua Farm News Volume 08(04) July - August 1990

Aquaculture Department, Southeast Asian Fisheries Development Center

AQUA FARM NEWS

ISSN 0116-6573

Produced by Audiovisual-Print Section
Training & Information Division
SEAFDEC Aquaculture Department

Vol. VIII No. 4
July-August 1990

IN THIS ISSUE:

SEAFDEC "Better life through aquaculture"

Aqua Farm News is published bimonthly by
Audiovisual-Print Section, Training and Information Division
Aquaculture Department
Southeast Asian Fisheries Development Center
P.O. Box 256, Iloilo City, Philippines

ISSN 0116-6573

In citing information from **AFN**, please cite the institutional source which, in some articles, is not necessarily SEAFDEC Aquaculture Department. Mention of trade names in this publication is not necessarily an endorsement.

Subscription rates:

Local - P40.00 per year
Foreign - US$26.00 per year (including air mail postage)

Please make remittances in Postal Money Order/Bank Draft/Demand Draft payable to **SEAFDEC Aquaculture Department**.

Editor: **J. Lagoc**
Associate Editor: **M. Castanos**
Production: **R. Tenedero**
A. Surtida
L. Plondaya
R. Buendia
D. Badilles
J. Requintina
E. Ledesma
Circulation: **E. Aldon**
L. Tabigo-on, Jr.
Consultant: **I.J. Dogma, Jr.**

MANAGING AN AQUACULTURE ENTERPRISE

In recognition of the increasingly important role of management in an aquaculture enterprise, the SEAFDEC Aquaculture Department has offered a Training Course on Aquaculture Management. The main points in the lectures are excerpted in this issue, the bottom line in all these being that - managerial skills of the fish farmer could spell the difference between his success or failure.

Role of Management

Management can be simply defined as "getting things done through people". The first function of management is *planning* - the work of determining and specifying objectives, policies, programs, organizational relationships, procedures, and budgets. The manager must first set the objectives and then specify the factors, forces, and effects necessary for their accomplishment.

The second function of management is *organizing* - relating functions, physical factors, and personnel into proper relationships with one another in advance of the execution of a plan or a major part of it. It establishes proper relationships between (1) work to be done (2) people to do the work, and (3) place of work. In an aquaculture farm for example, the manager specifies the job duties of the technicians, e.g., pond liming, fertilization, and stocking of juveniles. He instructs the head technician to oversee the said duties and the workers in undertaking the work as instructed. The place of work is the pond.

The third function of management is *controlling* - constraining, coordinating, and regulating actions in accordance with plans for the attainment of specific objectives. Constraining of activities is within the limits of predetermined plans. There are standards of performance used as a basis of control. An example is production of milkfish per hectare per crop. A certain standard, 500 kg for example, is based on industry output. The standard unit cost of production is set at P12.00/kg. The production personnel in the farm are expected to produce the set target at a standard cost which has been predetermined. In controlling, the manager must be able to schedule, prepare, dispatch, direct, supervise, and undertake corrective measures relative to the specified work.

Business System

In an aquaculture enterprise, the business system includes the internal variables as well as the business environment that affects directly or indirectly the operations of an aquaculture enterprise.

The internal variables to be considered are raw materials, machineries, manpower, and money. These are the 4 Ms in business management. Raw materials are the seeds or fry, fertilizers and feeds needed for the growth and survival of the fish. The manager must be able to ascertain the availability of these materials in the right quantity, quality, at the right price and the right time for proper scheduling of work in the farm.

The machineries needed in an aquaculture farm are pumps, blowers, power generating sets and other laboratory equipment. The machineries must follow certain specifications that will suit the requirements in rearing the fish from fry to marketable size.

Manpower includes both the operations and managerial staff that will operate and manage the entire business operation. In a medium-scale prawn hatchery operation, production staff includes the head technician, hatchery aides, and a phycologist. The production staff is accountable to the Production Manager who schedules the production runs, controls the materials, monitors the flow of operation, and makes sure that the facilities are in good working condition. The Production Manager, in turn, is accountable to the General Manager who oversees the entire business operation to include the administrative and marketing functions. The General Manager is accountable to the owners of the enterprise through a Board of Directors in a corporate set-up.

Without money, no business or any organization for that matter will exist. The investment of the owners, known as owner's equity, and external sources such as loans and trade credits are the sources of financing a business enterprise. For small scale aquaculture enterprises, outside financing through loans from banks and other formal financing companies is difficult to acquire because of strict collateral requirements.

The above-mentioned internal variables in the business system are affected by broader forces, e.g., government intervention, market supply and demand, technology, etc.

Item One: Business Policy

A business organization should have a policy which defines its business ethics, management philosophy, objectives, plans, or procedures in the conduct of business. A business policy is composed of a principle and rule of action.

An example of a business policy of a hatchery operator is "the company shall endeavor to satisfy the needs of prawn growers by supplying quality fry at reasonable prices." The principle is "satisfy the needs of prawn growers" and the rule of action is "supply quality fry."

A business policy must be formulated to permit decentralized decision-making in the various operational departments of the organization. It allows an individual to exercise his own initiative to a great degree.

The characteristics of a sound business policy are the following:

1. It must be based on objectives.
2. It must relate objectives to functions, physical factors, and personnel.
3. It must conform to ethical standards.
4. It should be stated in simple and understandable terms.
5. It should have stability and flexibility.
6. It should be sufficiently comprehensive.
7. It should be complementary and supplementary.

In making business policies, the following elements are undertaken:

1. Formulation - the selection of principles and rules of action that govern a particular type of activity.

2. Promulgation - getting the policy down to the level of the organization where it is to be applied. Personnel cannot be expected to conform with policies not known to them.

3. Education - making sure that everyone understands what the policy means. There should be a wide participation in the formulation of policies. Training and conferences as well as policy manuals are helpful in the dissemination of policies among the personnel.

4. Application - the day-to-day use of policy for making managerial and operative decisions. There are situations wherein policies need interpretation as it is applied.

5. Control - policy control must be performed to insure that operations are currently in consonance with policy.

Item Two: Business Environment in the Aquaculture Industry

An investor or a manager of an aquaculture enterprise should not only be knowledgeable of the internal operations of his business, but equally important is for him to be aware of the conditions prevailing in the overall business environment.

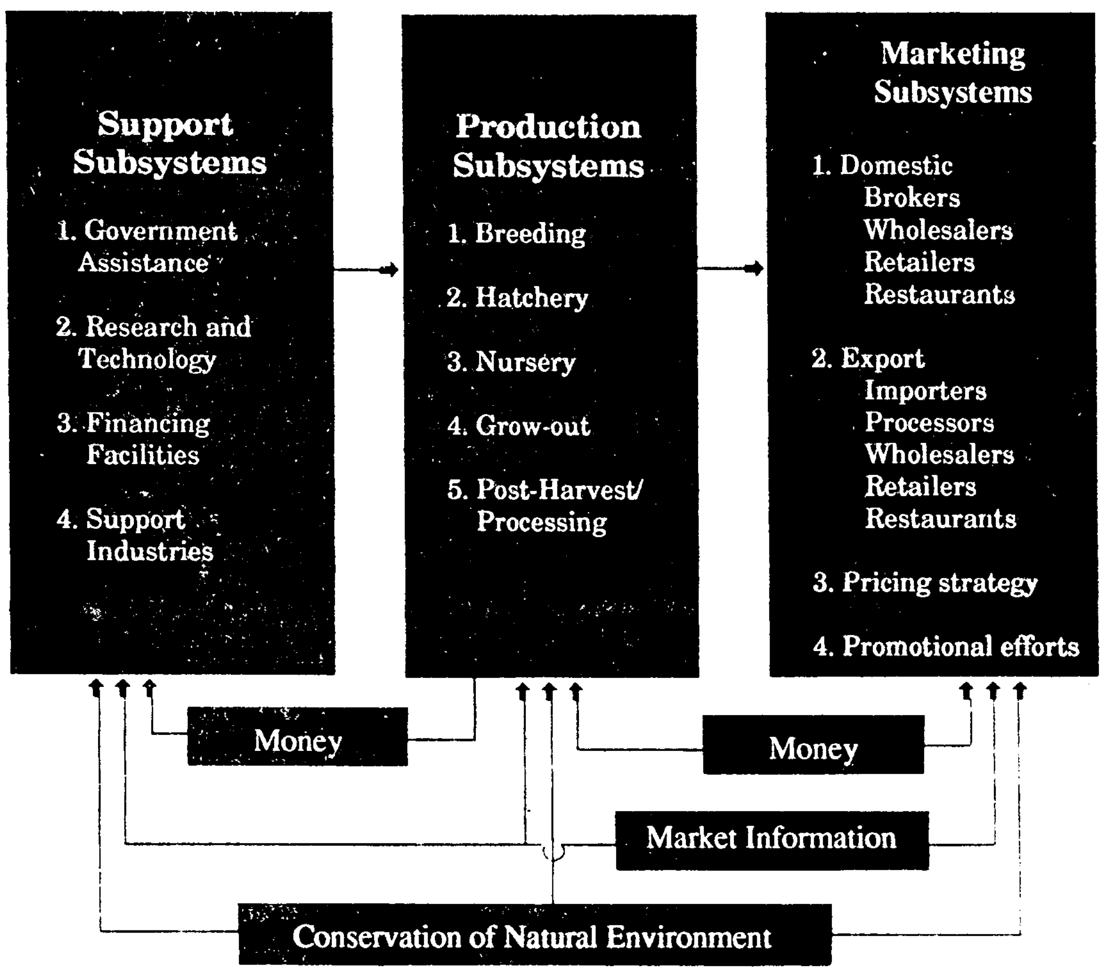
It is a typical Filipino trait to go into business because his neighbor has done so. Using the initial success of his neighbor as a parameter of good business, he decides to go into the same business. This is true in the aquaculture business especially in Panay and Negros Occ. In the southern part of Iloilo, more than 100 small- and medium-scale prawn hatcheries have proliferated. Majority of these investors were influenced by their neighbors or friends who were successful in their initial production runs.

After less than 6 months of operations, the new businessman starts encountering problems of low survival, diseases, cutthroat price competition, lack of buyers, lack of cash, etc. The next thing you hear is that he stopped operations, lost all his money, and is saddled with unpaid loans. He starts blaming his technician or consultant for failure to solve technical problems. He blames the middlemen for the low prices that he gets for his fry. He blames almost everybody except himself.

This typical Filipino entrepreneur failed in his business because he lacked the management skill to detect problems and come out with workable solutions. He failed to consider the business environment where he is operating.

Aquaculture Industry System. The aquaculture industry operates in a system composed of groups of interacting and interrelated bodies, each group performing vital functions. The core of the system is the production subsystem where all activities evolve (see figure below).

During the last 15 years, the aquaculture production subsystem has developed into a full-cycle technology for some species, i.e., prawn and milkfish, primarily due to research and development activities undertaken at the SEAFDEC Aquaculture Department. A full-cycle



Aquaculture Industry Systems

technology starts from the breeding in captivity of culturable species. In the case of milkfish, the duration of broodstock development is about 5 years. With the right ratio of male to female and proper nutrition, the fish mature and spawn. In the case of prawn (*P. monodon*), maturation period is 9 to 12 months.

The fertilized eggs from the broodstock are then transferred to the hatchery where they are reared to fry size for about 30 days. The fry are reared further to fingerling or juvenile size in the nursery, e.g., in tanks, ponds or cages whichever is more economically viable.

The juveniles are then stocked in ponds, cages or pens whichever is the appropriate culture technique. The culture period is about 3 to 4 months (for milkfish and prawn). The fish are then harvested and brought to market or to processing plants.

The production subsystem cannot survive by itself. Support is needed from external forces: government assistance, technology, support industries, financing, market factors, and physical environment. These forces comprise the business environment that affects the success and failure of an aquaculture enterprise.

Government assistance. The Department of Agriculture has been entrusted to pursue the following overall fishery development objectives as enunciated in the Medium Term Development Plan (1987-1992):

1. Enhance the income and improve the quality of life of rural fishing families;
2. Attain and maintain self-sufficiency in fish;
3. Optimize utilization of fish and other aquatic resources;
4. Increase exportation of traditional and non-traditional fish and fishery export products;
5. Achieve and maintain the optimum productive condition of the country's fishery and aquatic resources.

The Department of Agriculture, through its regional offices, is mandated to undertake fishery development projects with the private sector as its implementing partner.

The government has supported research and academic institutions such as SEAFDEC/AQD and the University of the Philippines in the Visayas (UPV) to undertake basic and applied research in fisheries and aquaculture. The Department of Science and Technology has also supported fishery research undertakings through the Philippine Council for Aquatic and Marine Research and Development (PCAMRD). The International Center for Living Aquatic Resources Management (ICLARM), an international fishery research institution located in Manila is also pursuing fishery research in the country.

At present, there are about 73 school of fisheries all over the country; most if not all are government-supported. Short training programs are offered by SEAFDEC/AQD, UPV, the Technology and Livelihood Resource Center (TLRC), and the Department of Agriculture through the Bureau of Fisheries and Aquatic Resources. Some of the technicians employed in the fishery and aquaculture industry undertook training in these institutions.

Suppport Industries. A potential investor must consider the availability in the local market of inputs such as feeds, chemicals, fertilizers, and other supplies and materials needed in the operation of an aquaculture enterprise. The growth of the aquaculture industry spawned the growth of support or allied industries such as the manufacture of fish feeds, fertilizers, and chemicals. There are more than a hundred suppliers of aquaculture supplies and materials in cities and provinces where aquaculture is a booming industry. There are also plenty of suppliers and manufacturers of equipment such as pumps, blowers, generators and laboratory kits listed in the latest Aquaculture Buyer's Guide and the Yellow Pages of the telephone directory. The more suppliers there are, the more advantageous to the aquaculture enterprise in terms of quality products and lower prices.

There is, however, a lack of service laboratories for analysis of physico-chemical parameters, soil quality, fish disease detection and prevention and feeds analysis. Service laboratories are needed to assist fish farmers and hatchery operators in producing quality fish.

Technology. The SEAFDEC Aquaculture Department has engaged in aquaculture research and information dissemination for the last 17 years. Appropriate and viable technologies on prawn hatchery and culture techniques have been extended to the private sector through training programs, seminars, outreach programs and manuals which are available for sale. SEAFDEC has also developed technology on milkfish broodstock and hatchery operations which the industry can adopt.

There have been advances in sea bass broodstock and hatchery techniques developed at SEAFDEC. Also, tilapia broodstock and hatchery techniques are now being adopted by private operators in Laguna de Bay.

At present, other culturable species are being studied for broodstock development and hatchery operation. These species are siganids, mullet, grouper, and snapper.

Research on molluscs and seaweeds are also given priorities. There are big export potentials for these species. Western Europe is a potential market for mollusc (shellfishes) and Japan for seaweeds, both for food and industrial use.

Aside from SEAFDEC, other institutions such as UPV, Marine Science Institute of UP, ICLARM, and BFAR undertake continuous research and development activities to develop economically viable technologies and help solve the problems encountered by the industry.

Financing. During the mid-1980's the Asian Development Bank (ADB) provided credit facilities to prawn and milkfish growers in Panay. The rural banks and subsequently commercial banks were used as conduits of the loans. The interest rate was 17% per year. It was reported, however, that the lending program of the ADB was not fully availed of primarily due to stringent collateral requirements The banks required prime real estate as collaterals and only those with prime real estate properties could avail of the loan. Agricultural lands were not acceptable in fear of the Comprehensive Land Reform Program of the government.

Commercial banks were also active in lending to aquaculture enterprise. Lately, however, banks became hesitant in lending to aquaculture projects especially for prawn culture in view of the drastic decrease in export prices. There have been reports that many borrowers have defaulted in the amortization of their loans in view of low export prices.

Most commercial banks treat aquaculture loans as ordinary commercial loans where interest rates are high. The going rates as of the first quarter of 1990 ranges from 24% to 28% depending on the credit-worthiness of the borrower. The high cost of financing has contributed to the higher cost of production of prawns which affects its competitiveness in the world market. In Malaysia, it is reported that interest rate is only 7.5%.

Government loans were also made available through the Guarantee Fund for Small and Medium Enterprises and the Comprehensive Agricultural Loan Fund. The Technology and Livelihood Resource Center also provided loans to selected operators.

The small aquaculture operators are adversely affected by the lack of cheap credit facilities. Most of the small operators rely on informal sources (friends, relatives, usurers) of financing and, at times, trade credits from suppliers of input needed in the operation.

There have been reports of closures or sell-outs of aquaculture enterprises due to poor financial conditions. This has been true for both small and big operators. Other companies have merged with the more stable ones in order to save the business.

Ecological Factors. The destruction of the environment has become an international menace caused by irresponsible and uncontrolled exploitation of natural resources. Forests have been denuded without workable programs of reforestation, causing floods and siltation of low lands and marine ecosystems.

Mangrove swamps which provide nutrients and breeding places for marine fishes have been destroyed through uncontrolled conversion to aquaculture ponds. BFAR reports that there are about 207.000 hectares of brackishwater ponds in the country, majority of which were converted mangrove areas. Reports showed that every hectare of mangrove area converted into pond reduces the harvest of fishes and crustaceans by about 0.8 to 1.4 tons per year. Although the conversion of ponds have created employment to pond workers, produced fish (milkfish and prawns), and improved the income of pond owners, it has displaced mangrove dwellers and destroyed marine flora and fauna with the discharge of toxic wastes from the ponds.

Item Three: Corporate Objectives

In defining corporate objectives, an aquaculture enterprise sets performance targets in terms of sales, profit, and return on investment. A prawn hatchery operator, for example, prepares sales projections based on the production capacity of the hatchery facilities and market demand. In setting sales projections, most hatchery operators in Iloilo based their estimates on the production capacity of their hatchery facilities, disregarding the market demand for prawn fry. In the early 1980's, the market situation for prawn fry was described as "seller's market." This means that the seller, the hatchery operator, has better bargaining power in price determination than the buyer or the prawn pond grower. The lack of market information and analysis on the part of the hatchery operators resulted in oversupply of fry in the province and the surrounding areas during the last years of the 1980's. This caused the price to go down, thus affecting the sales of the hatchery operators.

The declining sales affected the profit and the return on investments of the hatchery operators.

There are four approaches in preparing corporate objectives. They are (1) cost-oriented, (2) growth-oriented, (3) employee-oriented, and (4) community-oriented. The cost-oriented approach tends to concentrate on cost-control measures to maximize profits in a short period of time. This is true especially for small- and medium-scale operators wherein they would like to recover their investments in about a year. Feasibility studies on small- and medium-scale hatchery operations prepared in early to mid-1980 showed that payback periods were less than a year. A lot of these studies, however, failed to consider risk in terms of market saturation and ecological destruction.

The growth-oriented approach requires a longer time to realize corporate objectives. This approach must be realistic in order that lower management echelons can make their respective plans, targets, and strategies consistent with corporate objectives. Management should allocate a portion of the earnings to be reinvested in expanding facilities over a period of probably five years. The owners of the company are not after immediate recovery of their initial investment but would prefer to have part of their earnings reinvested for expansion purposes.

The employee-oriented corporate objective considers the people in the organization as an important resource in the attainment of company goals. Employees are assured of job security, opportunities for advancement, conducive working conditions, and fair management-labor relationship.

The community-oriented corporate objective considers the relationship of the organization with the immediate community. The company pays taxes to the government, provides employment, creates other business opportunities, helps in preserving the ecology, and supports community activities. In short, the company helps in the economic uplift of the community.

Item Four: Strategic Management

The causes of failure of most aquaculture enterprises can be traced to the lack of strategic management in planning and control. In the prawn industry, the drastic fall of export prices caught most of the prawn growers "with their pants down." They were not ready for such an eventuality causing heavy financial drawbacks. The prices went as low as P80/kg which was lower than the cost of production of about P90-P110/kg. In order to stay afloat in the business, cost control of inputs especially feeds is a must. Lack of production techniques and management expertise resulted in high cost of production.

The prawn hatchery operators were also affected. Most of these operators went into the hatchery business without strong technological back-up, heavily relying on their technicians. The proliferation of hatcheries resulted in price cutthroat competition pushing the price to very low levels which could barely cover the cost of production, thus, forcing entrepreneurs to stop operations.

Strategic management seeks to:

1. Establish the position of the organization in relation to the business system and identify the key components which will affect the performance of the company;
2. Accurately identify the strengths and weaknesses of the company;
3. Specify the long-term goals of the organization;
4. Formulate the business plans necessary to attain the goals;
5. Develop the business policy and plans needed to deliver the targets;
6. Execute the business strategies and plans as agreed;
7. Create a control system which permits an evaluation of actual versus planned performance. This system should be able to identify causes of shortfalls and make the necessary corrective measures.

Item Five: Growth Strategies

Although the bottom line goal of any business organization is to make profit, a portion of the profit must be plowed back in order for the company to grow. Even in the planning stage, the manager should project future expansion of the company operations.

There are four ways of achieving growth of a business organization:

1. Expand sales on current products.
2. Expand into related business with existing products.
3. Introduce new products.
4. Introduce new products in related business.

An example in an aquaculture enterprise is a milkfish grower who traditionally sells all his produce in the fish market. He expands his market by tapping supermarkets by selling deboned milkfish. The deboned milkfish becomes a value-added product since it has undergone some kind of processing which has resulted in an increase in its value. Another way of expanding the operation of the milkfish grower is to polyculture with other species such as crabs or prawns. By increasing his product line, he can tap other markets such as restaurants and hotels.

Another growth strategy is diversification through integration or conglomeration. Integrational diversification can be done vertically or horizontally in the business spectrum. In the aquaculture industry, a prawn grower can integrate horizontally by going backwards to breeding and hatchery operation. This strategy will assure the prawn grower of continuous supply of good quality fry for stocking in his ponds. Excess production can be sold to other prawn growers. He can also move forward by going into marketing and processing of his prawns produced in his farm as well as other farms.

If he decides to expand his operation through vertical integration, he can increase the size of his farm and go to culture of other species such as sea bass, groupers, and snappers.

As his organization grow big, he can expand further through conglomeration. As he has established a strong foothold in the aquaculture industry, he may go into other business such as fish feed milling, production of aquaculture machineries, or probably other types of food businesses.

Source of Items One to Five: Renato F. Agbayani, lecture notes in *Aquaculture Management Training Course*, April 18-May 23, 1990. SEAFDEC/AQD, Tigbauan, Iloilo, Philippines.

Item Six: Record Keeping for Fish Farms

The best source of economic data is farm records from either commercial, pilot, or experimental farms. Although there are many forms of farm records, most of them simply list the input and output of the farm operation both in physical (kilogram, ton, pound) and value (units of money) terms. The collection and analysis of data on costs and earnings based on farm records provide the information necessary to (1) determine the relative profitability of various production techniques or systems, (2) compare the productivity of major inputs such as land, labor, and capital with that of alternative production activities, and (3) improve the efficiency of the farm operations.

Input Records

These are variable inputs or costs which vary with the level of production such as fry, feeds, fertilizers, labor, and pesticides.

Output Records

Output records should show in detail the following: date of harvesting, species harvested (with its amount and unit price), and the disposition of the product.

Gross revenue should include cash and credit sales of the products and the imputed values of the quantities consumed on the farm (imputed values may be estimated by using the market price of the product). Change in the value of the inventory should also be included in the computation of gross revenue.

Any business, large or small, public or private, should maintain an efficient record keeping system. All business transactions should be recorded in full in paper. Many businesses/projects fail because of inadequate record keeping.

Adequate records can provide answers to the following questions: (a) How much profit is the business/project earning? (b) How much is the business/project worth? (c) How much do credit customers owe the business? (receivables) (d) How much does the business owe its creditors? (liabilities) (e) How much should the business pay for tax, fuel, electricity, and water, etc.?

Source: Prof. Serena V. Luntao, lecture notes in *Aquaculture Management Training Course*, April 18-May 23, 1990. SEAFDEC/AQD, Tigbauan, Iloilo, Philippines.

LINKING FARM AND POND FOR SUSTAINABLE FARMING

Dr. Clive Lightfoot, a Farming Systems Specialist at the International Center for Living Aquatic Resources Management (ICLARM), recommends integrating aquaculture with agriculture as a way to intensify farming while at the same time improving the environment for farming. Aquaculture or fish farming provides a way to use agricultural by-products to make marginal lands more productive. Fish convert plant and animal waste into high-value protein.

For example, in Malawi, southern Africa, analyses of the uses and characteristics of different land types suggest many ways to combine land and pond 'crops'. Pond mud could be used to revitalize vegetable plots. Pond water could irrigate vegetables and water animals. Animal manure, along with crop residues, weeds, leaves and rotten fruit and vegetables could fertilize ponds as well as the soil. Other crop by-products, like corn and rice bran, could also be fed to fish.

In parts of India, such ecological analyses also show several ways to link up farm and pond. For example, uplands are not only where people live and livestock shelter, but also where fruit trees and fish are raised. All sorts of cereals, pulses and vegetables are grown on the sandy loams of the cultivated uplands, particularly where some irrigation is available.

Even marginal or degraded lands can be modified to become more productive. "One Indian farmer we interviewed," said Dr. Lightfoot, "improved the poor yields in his flood-prone land. He dug out the flooded area, made several mounds and planted fruit trees on them. While the trees were still young, the farmer undercropped vegetables to provide immediate income. In the ditches, which now had more assured water, he planned to raise fish."

Dr. Lightfoot believes that scientists need to develop new farming systems which integrate crops, vegetables, trees, livestock, and fish, and which use all opportunities to recycle nutrients.

He laments that such an ecological approach to farming systems is rare. Research and development on various crops are usually done in separate institutions, which inhibits the integration of different enterprises. To develop new integrated farming systems, social scientists must work with biological scientists, but these scientists are separated by the disciplinary structure of universities, and the different departments, ministries, and research institutes at national and international levels.

New farming systems to be useful should be put into practice. New ways of encouraging farmers to participate in the research process, and later to adopt new farming methods must also be explored.

Source: ICLARM (International Center for Living Aquatic Resources Management) Press Release, April 1990.

GROWING CATFISH AND TILAPIA IN RACEWAYS

Leo Ray of Fish Breeders of Idaho, Inc., Idaho, USA, grows catfish, tilapia and trout in raceways. Growing trout in raceways is nothing new, but Ray, a past president of the Catfish Farmers of America and the U.S. Trout Farmers Association, has pioneered raceway culture of catfish.

He began raising trout, catfish, and tilapia in raceways, but not in a conventional manner. For catfish and tilapia, he drilled 700-feet deep wells to obtain 90 degrees F, 7,000 gpm artesian-flow water. He then constructed raceways, each with four sections. Between each section is a 2-foot drop. Each section is 24 feet long, 10 feet wide, and 3-1/2 feet in water depth. (Conventional raceways are usually much longer). The space utilized by fish is 770 cubic feet. The raceways are in pairs with a common center wall. Hot artesian water is blended with cooler water to give 80 degrees F water. This water passes by gravity through five sets of raceways in all, each raceway having four sections (80 sections total), from the top of the hill to the bottom. The upper raceways grow catfish, the lower tilapia.

Ray notes that there are two densities to consider in producing catfish - pounds per cubic foot of space and pounds per water flow in cubic feet per second (CFS). The pounds per cubic foot of space is primarily limited by social factors. The pounds per CFS is limited by water quality. Catfish have a peck order but this breaks down at high density stocking. How high? Ray routinely harvests 10,000 to 14,000 pounds of catfish for each section of raceway, and he calculated that he had up to 1/3 fish and 2/3 water by weight in a section. Based on water flow, he produces 40,000 to 50,00 pounds per CFS. He starts off by stocking 2 to 4 pounds of fish per cubic foot of space. Lower densities are used for small fish.

Regarding water quality, Ray lists three major factors: dissolved oxygen, ammonia, and settleable solids. A 2-feet drop waterfall for each section of raceway replaces approximately 50%

of the oxygen. Water entering the first section of a raceway contains about 7 ppm dissolved oxygen (DO). Fish remove 2 ppm and the waterfall adds 1 ppm. The second section then receives 6 ppm DO, and so on. Water exiting the fourth and last section of a raceway contains about 3 ppm DO. As water flows down a ditch to the second set of raceways, DO is replenished to near saturation. The water, then, is reused and reused - five sets of raceways in all. The loss of DO can be calculated based on pounds of feed utilized. Ray calculated that the oxygen required to metabolize 50 pounds of feed is approximately 2 ppm from one CFS of water.

Approximately 0.2 ppm of ammonia is produced per CFS from metabolism of 50 pounds of feed. Feeding 200 pounds of feed in one CFS of water for four sections, ammonia at discharge would be 0.8 ppm. As water from the first set of raceways enters the ditch, bacteria begin to break ammonia down to nitrite, then the less harmful nitrate.

Settleable solids are a major concern for raceway growers, and the Environmental Protection Agency (EPA) stipulates that solids cannot exceed 5 ppm. In Ray's operation, solids collect behind a screen. A PVC stand-pipe is lifted periodically and solids go by underground pipe to two settling basins. These basins contain duckweed and aeration. The sludge is pumped to the fifth set of raceways containing tilapia.

With his raceway system, Ray annually produces 500,000 pounds of catfish. He does his own processing. If we assume that last year 300 million pounds of catfish were produced by the whole industry, then Ray's small raceways produce 1 out of every 600 catfish grown in the United States.

Not everyone, however, has access to gravity flow water year-round. Nevertheless, much can be learned from Ray's method of growing fish. He has demonstrated that raceway culture need not be limited to trout. The physical dimensions of his raceways, stocking density, reuse of water, and water management are all lessons to learn. And now one catfish farmer has built on Ray's technology. Kelley Farmer, pioneer catfish farmer from Dumas, Arkansas, is growing catfish in raceways. Water, held in a reservoir, flows by gravity through raceways, collects in a pond below and is pumped up to the reservoir for reuse. Too costly? The cost of pumping is more than offset by the savings in harvesting and other operations. Two of Ray's raceways with a total of eight sections can produce 80,000 pounds of fish per crop. If we assume that 4,000 pounds of fish are produced per acre in conventional ponds, it would take a 20-acre grow-out pond to produce 80,000 pounds. Will raceways be the way catfish and other species are grown in the future? Think about it.

Source: James W. Avault, "How Will Fish Be Grown in the Future," **Aquaculture Magazine**, Vol. 15, No. 1, January/February 1989.

ARTIFICIAL REEFS CAN DO MORE HARM THAN GOOD

Artificial reefs (AR) can be found in many parts of the world. Japan is the pioneer and leading builder, followed by the United States. Japan has over 200 years of traditional and later sophisticated AR experience, while American anglers have used artificial reefs for more than 100 years.

In the US, the technique is popular mainly because it improves the catch of sports fishermen. This differs from the socioeconomic value of artificial reefs in southern Japan where emphasis is on development of coastal fisheries, extensive mariculture, and rehabilitation of degraded marine areas. The Philippines' AR program therefore should parallel that of tropical Japan from which it has much to gain in techniques, design, site selection, and other vital considerations.

Coastal resource enhancement for extensive mariculture and searanching has many advantages for an archipelagic country like the Philippines, including production on a sustainable-

Artificial reefs should not be treated as "fun projects" by well-meaning but misinformed enthusiasts. Nor should they be employed as public relations gimmick to promote resource enhancement. This technology, if not properly used, can only do more harm than good.

yield basis and greater social benefits to poor coastal communities. To achieve these, the country must develop and enrich near-shore fishing grounds through such mechanisms as appropriate applications of artificial reefs. **With its depleted coastal resources, the Philippines need artificial reefs not as a fishing device but as a fishery management tool.**

Tires or bamboo modules should be avoided because these only serve as fish aggregating devices which encourage overfishing. Furthermore, tires release toxic chemicals, bamboos easily deteriorate, both are unstable for habitat development and ultimately end up littering the ocean floor as what happened in Thailand.

The best approach presently held by most experts is to construct artificial reefs that will serve the intended purpose. The present scheme, using scrap materials to recreate the features of natural reefs. does not in fact improve the habitat conditions nor achieve the coastal enhancement it is supposed to promote. Thailand has already recognized this error, and has recently abandoned the use of tires in its four-year (1988-91) coastal enhancement program and adopted concrete modules instead.

An inhibiting factor is the cost of designed reefs. However, once all costs and benefits are identified and prorated over expected functions and life span of the regenerated reefs, this factor may not be as restrictive as it appears.

To achieve the success of the Japanese AR program, the Philippines should refrain from using a trial-and-error approach in design and site selection, especially in view of the high cost of materials involved. A careful study should be made both for the most cost-effective reef designs and suitable sites before large-scale implementation of this long-range program. Present scientific literature provides adequate information on how to correctly build and site artificial reefs. Right evaluation of designs, cost-benefit factors, and other parameters should be incorporated into the AR program. A planning team of engineers, marine scientists, and socioeconomists should be tasked to conduct this study.

There is too much publicity about the use of artificial reefs made of tires and bamboo. Artificial reefs should not be treated as "fun projects" by well-meaning but misinformed enthusiasts. Nor should they be employed as public relations gimmick to promote resource enhancement. This technology, if not properly used, can only do more harm than good.

The seriously depleted state of the country's fish resources demands an effective enhancement program that will restore fish stocks to a sustainable level. The present AR program is a step in this direction as it presumes to establish fish habitats that will increase fish biomass. However, the design and materials of local artificial reefs (scrap tires and bamboos) make them effective only in aggregating fishes but not in regenerating destroyed fish environment. Changing the design with high density, durability, and stability under water, therefore, would ensure permanent foundation for settling organisms that will be the basis for a food chain to support new fish populations. The primary aim is to rehabilitate degraded coastal fishing grounds which takes time. Thus the AR program must be planned along such long-term consideration.

The program also needs instituting catch regulations, as concrete reefs will also attract fishes. More forceful implementation of such regulations can only be done by coastal fishermen themselves, if organized into associations or cooperatives and granted exclusive territorial use rights over municipal waters.

Source: Excerpts from report prepared for then Dept. of Agriculture Secretary Carlos Dominguez. 22 August 1988. by Dr. Flor Lacanilao. Chief, SEAFDEC/AQD.

NEW PUBLICATIONS OF SEAFDEC/AQD

- ***Diseases of Penaeid Shrimps in the Philippines.*** M.C.L. Baticados, E.R. Cruz-Lacierda, M.C. de la Cruz, R.C. Duremdez-Fernandez, R.Q. Gacutan, C.R. Lavilla-Pitogo, G.D. Lio-Po. 1990. SEAFDEC Aquaculture Department, Tigbauan, Iloilo. 46 pp. ISBN 971-8511-27-X. Domestic, P150; foreign, US$35.
- ***Milkfish Hatchery Operations.*** R. SJ. Gapasin & C.L. Marte. 1990. SEAFDEC Aquaculture Department, Tigbauan, Iloilo. 24 pp. ISBN 971-8511-28-8. Domestic P80, foreign US$30.
- ***Sea Bass Hatchery Operations.*** M.M. Parazo, L.Ma.B. Garcia, F.G. Ayson, A.C. Fermin, J.M.E. Almendras, D.M. Reyes, Jr., E.M. Avila. 1990. SEAFDEC Aquaculture Department, Tigbuan, Iloilo. 38 pp. ISBN 971-8511-29-6. Domestic P100, foreign US$30.
- ***Biology and Culture of Siganids.*** M.N. Duray. SEAFDEC Aquaculture Department, Tigbauan, Iloilo. 1990. 47 pp. ISBN 971-8511-30-X. Domestic P150, foreign US$35.
- ***Pagkilala sang Semilya sang Danggit.*** Aquaculture Extension Leaflet (AEL) No. ID (Ilonggo). 1990. 2 pp. Domestic, free.
- ***Pagbisto nin Semilya kan Turus.*** AEL No. 1E (Bikol).1990. 2 pp. Domestic, free.
- ***Pagkilala sa Binhi ng Samaral.*** AEL No. 1F (Tagalog). 1990. 2 pp. Domestic, free.
- ***Identifying Sea Bass Fry.*** AEL No. 2A (English).1990. 2 pp. Domestic, free; foreign, postage cost.
- ***Anatomy of Adult Penaeid Prawns/Shrimps.*** Poster No. 3 (colored). 1990. 61x81.3 cm Domestic P60; foreign US$33.

Send orders, inquiries to: Sales/Circulation, Audiovisual-Print Section, Training and Information Division, P.O. Box 256, Iloilo City, Philippines. Send payments in money orders, bank drafts payable to: SEAFDEC Aquaculture Department.

Erratum

In the *Aqua Farm News*, vol. 8, no. 3, May-June 1990, p. 10, **Economically Important Seaweeds of Panay Island**, *Gracilaria arcuata, G. coronopifolia, G. eucheumoides*, and *G. salicornia* should read as "Human food, source of agar," not "...source of carrageenan."

AQUA FARM NEWS is produced bimonthly by the Audiovisual-Print Section, Training & Information Division of the Aquaculture Department, Southeast Asian Fisheries Development Center, P.O. Box 256, Iloilo City, Philippines.

Entered as second class mail matter at the Iloilo City Post Office on August 3, 1984.