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EDITORIAL

Aquaculture Development and "The Code of Conduct for Responsible Fisheries"

General concerns regarding the over-exploited state of most of the world's capture fisheries, and the attendant implications for the contribution of fisheries to world food supply, have led to calls for sound conservation and management of fishery resources, in particular, for effective implementation of measures which will ensure responsible practices in fisheries in order to achieve sustainable development of fisheries worldwide. Following the 1992 Cancún Conference on Responsible Fishing, and the 1992 United Nations Conference on Environment and Development, FAO was requested by its member countries to draft an International Code of Conduct for Responsible Fisheries. Subsequently, many experts and representatives from governments, intergovernmental and non-governmental organizations participated in several FAO technical consultations and in the 1993 and 1995 Sessions of the FAO Committee on Fisheries for the purpose of formulating the Code. In November 1995, government representatives attending the 28th Session of the FAO Conference adopted the final text of the Code.

The Code sets out principles and international standards of behaviour for responsible practices with a view to ensuring the effective conservation, management and development of living aquatic resources, while recognizing the nutritional, economic, social, environmental and cultural importance of fisheries, and the interests of all those concerned with the fishery sector. It is non-binding in nature and will be implemented on a voluntary basis, *although containing certain provisions which may be given, or have already been given, binding effect. The Code consists of five introductory articles: Nature and Scope; Objectives; Relationship with Other International Instruments; Implementation, Monitoring and Updating; and Application of the Code to Developing Countries. These introductory articles are followed by an article on General Principles which precedes the six thematic articles on: Fisheries Management, Fishing Operations, Aquaculture Development, Integration of Fisheries into Coastal Area Management, Post-Harvest Practices and Trade, and Fisheries Research.*

Article 9 of the Code of Conduct contains provisions relating to aquaculture, including culture-based fisheries, and, in particular, to its responsible development both in areas of national jurisdiction as well as within transboundary aquatic ecosystems, to the use of genetic resources, and to responsible practices at the production level. Specifically, this Article includes requirements for appropriate legal and administrative frameworks, and invites States to collect, share and disseminate data related to their aquaculture activities to facilitate cooperation on aquaculture development planning for sustainable use of resources shared by aquaculture and other activities. The Article calls for advance evaluation of the effects of aquaculture development, environmental assessment and monitoring, as well as for protection of livelihoods of local communities and their fishing grounds from irresponsible aquaculture developments. States are encouraged to consult with neighbouring states before introducing non-indigenous species, and to implement codes of practice and procedures for introductions and transfers of aquatic organisms, with a view to fostering responsible production, sale and transport of eggs, larvae/fry, broodstock or other live materials. Responsible choice of species, siting and management of aquaculture activities are being advocated, and recommendations relate, in particular, to responsible selection and use of appropriate feeds, feed additives and fertilizers, including manures, to effective fish health management including safe use of disease control chemicals, and to judicious disposal of wastes potentially hazardous to human health, in order to ensure food safety of aquaculture products.

In addition, and in support of the implementation of the Code, technical guidelines for the various articles are currently being elaborated by FAO. Interested persons are invited to send any technical documentation, as well as codes, standards, norms or other guidance material, which could be used for the formulation of guidelines related to responsible aquaculture development, including culture-based fisheries, to Mr U. Barg, FAO Fisheries Department. Readers interested in receiving a copy of the Code of Conduct for Responsible Fisheries should write to Ms M. Lizarraga, FAO Fisheries Department. The text of the Code is also available through FAO's information services on the World Wide Web: http://www.fao.org/waicent/faoinfo/Fishery/ficond.htm.

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Integrated fish/poultry farming in Bangladesh

NOTES ON IMPROVED FRESH FISH HANDLING METHODS

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Basics of fresh fish handling and use of ice

Throughout history, man has preferred to consume fresh fish rather than other types of fish products. However, fish spoil very quickly and man has had to develop methods to preserve fish very early in history.

Keeping and transporting live fish

The first obvious way of avoiding spoilage and loss of quality is to keep fish alive until consumption. Handling of live fish for trade and consumption has been practised in China with carp probably for more than three thousand years. Today, keeping fish alive for consumption is a common fish-handling practice both in developed and developing countries and at both artisanal and industrial level.

In the case of live fish handling, fish are first conditioned in a container with clean water, while the damaged, sick and dead fish are removed. Fish are put to starve and, if possible, water temperature is reduced in order to lower the metabolic rate and make fish less active. Low metabolic rates decrease the fouling of water with ammonia, nitrite and carbon dioxide that are toxic to fish and impair their ability to extract oxygen from water. Such toxic substances will tend to increase mortality rates. Less active fish allow for an increase in the packing density of fish in the container.

A large number of fish species are usually kept alive in holding basins, floating cages, wells and fish yards. Holding basins, normally associated with large fish culture operations, can be equipped with oxygen control, water filtering and circulation, and temperature control. However, more simple methods are also used, for instance large palm woven baskets acting as floating cages in rivers (China), or simple fish yards constructed in a backwater of a river or rivulet for large "surubi" (*Platystoma* spp.), "pacu" (*Colossoma* spp.) and "pirarucu" *(Arapalma gigas)* in the Amazonian and Parana basins in South America.

Methods of transporting live fish range from very sophisticated systems installed on trucks that regulate temperature, filter and recycle water and add oxygen to very simple artisanal systems of transporting fish in plastic bags with an oxygen supersaturated atmosphere. There are trucks that can transport up to 50 t of live salmon; however, there is also the possibility of transporting a few kilograms of live fish relatively easily in a plastic bag.

By now, a large number of species, inter alia, salmon, trout, carp, eel, seabream, flounder, turbot, catfish, tilapias, mussels, oysters, cockles, shrimp, crab and lobster are kept alive and transported, very often from one country to another.

There are wide differences in the behaviour and tolerance of the various species. Therefore the method of keeping and transporting live fish should be tailored according to the particular species and the length of time it needs to be kept outside its natural habitat before slaughtering. For instance, the lungfish *(Protopterus* spp.) can be transported and kept alive out of water for long periods, merely by keeping its skin moist.

Some species of fish, noticeably freshwater fish, are more tolerant than others to changes in oxygen in solution and the presence of toxic substances. This is probably due to the fact that their biology is adapted to the wide seasonal variations in water quality in most rivers. In these cases, live fish are kept and transported just by changing the water from time to time in the transport containers (See Figures 1 and 2). This method is widely used in the Amazonian, Parana and Orinoco basins in South America; in Asia (particularly in the People's Republic of China, where more sophisticated methods are also used) and in Africa.

In the case presented in Figure 1, aluminium containers with live freshwater fish are stored in the aisles of a public transport vessel. Containers are covered with palm leaves and water hyacinth to prevent the fish from jumping out of the containers and to reduce evaporation. The water in the containers is changed from time to time and an almost continuous visual control is kept on the fish. Dead fish are immediately put to smoke-drying (African style) in drum smokers, which are also transported in the vessels or barges.

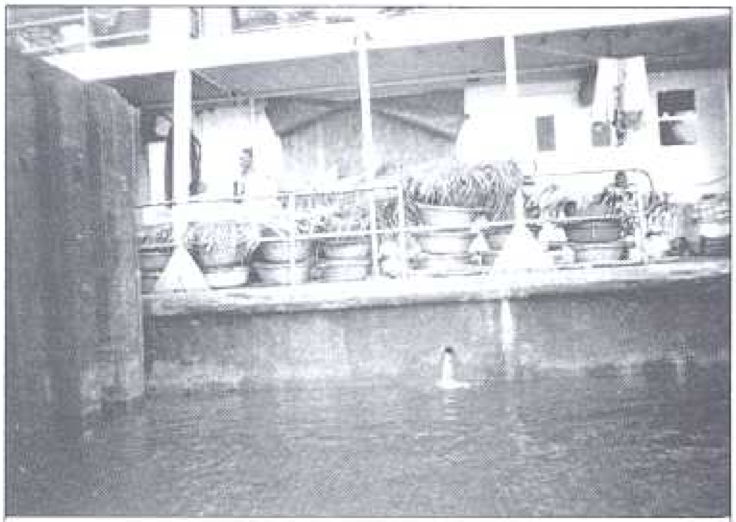

Figure 1: Transport of live freshwater fish in Congo

Figure 2: Street vendor of live fish in China

In the case presented in Figure 2, carp is kept in a metal container drawn by a bicycle. This is a rather common practice in China and other Asian countries. For instance, in Bangkok, live catfish is sold daily by street vendors.

The most recent development is the keeping and transporting of fish in a state of hibernation. In this method, the body temperature of live fish is reduced drastically in order to reduce fish metabolism and to eliminate fish movement completely. The method greatly reduces death rates and increases package density, but careful temperature control should be exercised to maintain the hibernation temperature. There is an appropriate hibernation temperature for each species. Although the method is successfully used to transport live "kuruma" shrimp (*Penaeus japonicus*) and lobster in pre-chilled wet sawdust, it should be considered as an experimental technique for most species.

Although keeping and transporting live fish is becoming more and more important, it is not a viable solution for large quantities of fish.

Chilling fish with ice

Historical evidence shows that the ancient Chinese utilized natural ice to preserve fish more than three thousand years ago. Natural ice mixed with seaweed was also used by the ancient Romans to keep fish fresh. However, it was the development of mechanical refrigeration which made ice readily available for use in fish preservation.

In developed countries, particularly in USA and some European countries, the tradition of chilling fish with ice dates back more than a century. The practical advantages of utilizing ice in fresh fish handling are therefore well established.

Ice is utilized in fish preservation for one or more of the following reasons:

(i) Temperature reduction. By reducing temperature to about 0°C, the growth of spoilage and pathogenic micro-organisms is reduced, thus reducing the spoilage rate and reducing or eliminating some safety risks.

Temperature reduction also reduces the rate of enzymatic reactions, particularly those linked to early *post mortem* changes; thus extending, if properly applied, the *rigor mortis* period.

Fish temperature reduction is by far the most important effect of ice utilization. Therefore, the quicker the ice chills the better. Although cold-shock reactions have been reported in a few tropical species when iced, leading to a loss of yield of fillets, the advantage of quick chilling usually outweighs other considerations. The development of *ad hoc* fish handling methods is of course not ruled out in the case of species that could present cold-shock behaviour.

(ii) **Melting ice keeps fish moist.** This action mainly prevents surface dehydration and reduces weight loss. Melting water also increases the heat transport between fish and ice surfaces (water conducts heat better than air). The quickest practical chilling rate is obtained in a slurry of water and ice.

If, for some reason, ice is not utilized immediately after catching the fish, it is worthwhile keeping the fish moist. Evaporative cooling usually reduces the surface temperature of fish below the optimum growth temperature of common spoilage and pathogenic bacteria; although it does not prevent spoiling.

Ice should also be utilized in chilling rooms to keep fish moist. It is advisable to keep chilling room temperature slightly above 0°C (e.g., 3 or 4°C).

However, water has a leaching effect and may drain away colour pigments from fish skin and gills. Ice melting water can also leach micronutrients in the case of fillets and extract relatively large amounts of soluble substances in some species (e.g., squid).

(iii) **Extended shelf life.** The overall reason for icing fish is to extend fresh fish shelf life in a relative simple way as compared to storage of un-iced fish at ambient temperatures above 0°C. However, extension of shelf life is not an end in itself, it is a means for supplying safe fresh fish of acceptable quality.

Most fish can be considered a commodity, that is, an article of trade. Unlike other food commodities, it is usually highly perishable. Therefore, it is in the interest of the seller and the buyer that the quality of fish must be ensured until it is consumed or further processed into a less perishable product. Ice and refrigeration, in general, by extending fish shelf life, convert fresh fish into a true trade commodity, both at local and international level.

Ice is used to make fish safe and of better quality to consumers. It is also used to make possible fish trade at local and international level. Fishermen and fish processors who fail to handle fresh fish appropriately ignore the essence of their business. The inability to recognize fresh fish also as a trade commodity is at the root of misunderstandings and difficulties linked to the improvement of fish handling methods and prevention of post-harvest losses.

Figure 3: Chilling fish with ice

For further information, please refer to : FAO Fisheries Technical Paper No. 348 "Quality and quality changes in fresh fish", a copy of which can be obtained from the author.

DEVELOPMENT OF TYPE II RURAL AQUACULTURE IN LATIN AMERICA

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Conceptual framework

In Latin America, in a very schematic way, aquaculture can be classified as rural and industrial. What has been known traditionally as rural aquaculture can also be divided into the following two categories:

Type I: The "poorest of the poor" aquaculture (very low cost/very low output). Most of it is known as subsistence aquaculture and comprises those producers who do not consume all of their production and therefore sell/barter a small part of it to the neighbours, in small domestic markets close to the farm and/or to the middle man.

Type II: The "less poor" aquaculture (low/medium cost, low/medium output). Well off farmers who are financially solvent and have managerial capacity and add aquaculture to the traditional agriculture activities. In order to qualify as a type II rural aquaculture, it is assumed that part of the production is family consumed, but most of it is supposed to be sold for economic benefit.

Paradoxically, this type II rural aquaculture, that apparently has an excellent potential, has hardly been touched by the Governments of the region and the development agencies. "Industrial" aquaculture has had the resources for its development almost independently of any Government intervention. On the other hand, although type I rural aquaculture has received for a long time the attention of the Governments and development agencies, their success has been much less than expected.

Background in Latin America

The possibilities of success of aquaculture or any other similar economic activity are necessarily related to the new socio-politic-economic scenario, a development model which implies a less interventionist State, more privatization and the intensification of the decentralization process.

Defining the role of the State in the light of the new rules of the game is premature because this is still an evolving process. In any case, the results of the type I rural aquaculture projects in this region have been below expectations even with definite support from the Governments. It is possible, however, that in certain cases, a decentralized management may offer a better support for the development of the sector.

Under these new conditions, it may be more feasible for the State to promote the type II rural aquaculture which involves an active participation of social groups with good management capacity. In the conceptual frame-work for the development of type II Rural Aquaculture, the active participation of the target group and the institutions, both public and private, is essential.

The development of this type of aquaculture has already started in several places in the Region, as a result of initiatives carried out by the Governments, Regional Institutions and/or NGOs.

Strategy for the formulation of a general development plan

FAO has given some assistance for the formulation of a general plan for the development of type II rural aquaculture in the Region. The main objective of the exercise was to develop a methodology for the formulation of a General Development Plan for this type of aquaculture. Figure 1 shows the different phases and institutional set up proposed for a Pilot Project for the final formulation of a General Development Plan.

The basic features of such a Pilot Project should be that:

• The Project is executed with a reduced number of pilot producers who are selected on the basis of their infrastructure facilities, managerial capacity and previous experience.

• For each of the selected development areas the creation of an Executive Directory and an Advisory Committee is proposed. All the participating Institutions (public or private) are represented in the Committee in order to benefit from their expertise in different areas of aquaculture. The idea is not to create any new organism but to assign specific roles to the existing ones.

• These Institutions are to provide human, material and financial contributions according to their capacities. The rest of the funds should come from local, national, regional or international donors.

• The Project should enter into agreements with the involved Institutions in order to offer to the participating farmers the technical assistance they need (including the formulation of each individual project), as well as to solve input supply, credit and marketing problems. Agreements with private enterprises are made when considered necessary.

• The Project should enter into agreements with pioneer producers, defining rights and duties for both sides. The Project should ensure the economic viability of the activity.

• The interdependence of Project-Producer relationship should not distort the true cost-benefit relationship. The producer should be able in the future to carry on with the same activity without the assistance of the Project.

Based on the results of this Pilot Project, the Executive Agency should prepare a general plan for the development of type II rural aquaculture.

Pilot studies in Colombia and Venezuela

On the basis of these considerations, the Regional Project Aquila II started an exercise in collaboration with the Regular Programme of FAO Headquarters in 1993. The objective was to establish the foundations for the development of type II rural aquaculture from the results of a few pilot studies. In order to carry out the exercise two zones in Colombia and Venezuela were selected according to the following criteria:

• The zone should have a good potential from the geographical and ecological considerations.

• For the preparation phase (appraisal, diagnostic), there should be an Institution in the zone with some field experience and willingness to enter into an agreement with FAO.

• There should be a significant target-group of farmers who qualify to become type II rural aquaculturists.

Two areas were selected, one in Colombia (Barrancabermeja) and another in Venezuela (San Cristóbal). With the assistance of a team of local consultants an evaluation of the suitability of these areas under study for the development of this type of aquaculture was carried out. This was followed by a discussion on the possible strategies for the formulation of a development plan. The results of this appraisal confirmed that there are (i) strong demands for this type of aquaculture; (ii) potential institutional capacities, and (iii) farmers/peasants with adequate capacities to join this activity.

As a follow-up of this exercise, a second phase was carried out in 1994 with some local multidisciplinary teams which looked into the economics of this type of aquaculture as well as the institutional arrangements for its development.

Results and discussions

Profitability

In the studies carried out as part of this exercise, profitability was the central theme. In fact, one of the pre-requisites that the aquaculturist has to fulfil in order to belong to the type II is that his activity must be economically viable.

In the case of San Cristóbal (Venezuela), it was possible to obtain more detailed information on the existing facilities. The estimated profitability was calculated for 6 models with different systems and intensities of culture. The results of the studies on technical and economic parameters are summarized in Table 1.

The results of this study show that aquaculture is highly profitable under the technical, economic and financial conditions in force in the area at the time of the study.

In all cases, the operational and economic performances are excellent (satisfactory break even point). Therefore, the economic vulnerability due to a fall of production for technical or commercial reasons is diminished.

The debts payment and its services is easily absorbed by the cash flow which is positive in all periods.

The semi-intensive culture of tilapia on two scales (2,450 m2 and 9,200 m2) seems the most profitable of all alternatives. The semi-intensive culture of *Cachama (Colossoma macropomum)* on two scales (2,450 m2 and 7,350 m2), is less profitable than the culture of tilapia. This is mainly due to its cheaper price on the market.

The cultures of tilapia and trout in concrete ponds are both profitable.

It is important to note that the small-scale productions (2,450 m2) appear to be more profitable than the large-scale operations for both *Colossoma macropomum* and tilapia. This can be explained by the fact that the small-scale production units have a lot of hidden or unremunerated costs. In the case of the two small-scale operations under study, the labour costs of the work carried out by the family members of the aquaculturists were not taken into account.

In the case of Barrancabermeja (Colombia) most of the culture facilities tend to have an average size smaller than the ones in Venezuela: 49% of the producers own ponds with an area of 80 m2, 33 % with an area of 663 m2 and only 18 % of the producers with an area of 4,000 m2.

The existing information is not sufficient enough for studies on cash flow. Nevertheless, taking these limitations into account, the financial analysis concluded that unlike Venezuela, the relatively small-scale productions (<2,000 m2) in Colombia do not seem to be economically profitable. The explanation could be that the costs in Colombia are higher, but this should be confirmed through a more detailed study of local experiences.

For the small or very small aquaculturist, income is always a positive and encouraging factor and it contributes to improving his standard of living. Nevertheless, from a point of view of profitability such financial analysis should not be based on unpaid costs or hidden subsidies.

Most of the small farmers (less than 1000 m2 of ponds) in Barrancabermeja are achieving a surplus production. From an individual point of view, they cannot be considered as model type II rural aquaculturists, even if they have a surplus of production. The problem is the low profitability due in part to the sub-utilization of the existing technology. Any attempt to expand the productive capacity would be restrained by the size of the land available and the high cost of more intensive technology which is beyond the investment capacity of this target group.

One alternative could be to form associations of type II producers in order to achieve a higher scale of production output. This could be achieved if the properties were geographically close; the fixed individual costs could then be reduced by using collective facilities and services.

Another way to attain an acceptable level of profit for these small-scale farmers is the formation of collective/cooperative marketing system and thus eliminating the middleman and ensuring better profit margins.

Institutional arrangements

The other component to which special importance is given is the institutional arrangement for the development of aquaculture in each area. A list was prepared of private institutions and firms in each area based on their capacity to make some contribution for the development of type II rural aquaculture projects. In this sense the exercise went beyond the bio-technological aspects, making alternative proposals to solve problems of inputs supply, credit, marketing, etc. The list includes Development Foundations, Regional Corporations for Development, Development Corporations for Basins/Rivers, Foundations for Agricultural Research, Fisheries Department of the Ministry of Agriculture, Universities, Financial and Training Organizations, private firms who produce fingerlings and fish feed, and NGOs who can intervene in the process.

Conclusions

The present study has collected a large quantity of useful information. Nevertheless, there is a need for additional work to get a better idea of what is this type II rural aquaculture and what are the factors influencing production and distribution in the areas studied? Some of the methodologies (Rapid Rural Appraisal, Participatory Rural Appraisal, Geographic Information Systems) developed in recent years could help to complete this diagnosis.

It is hoped that the investigators and promoters of aquaculture development in all Latin American countries will identify areas with adequate characteristics for type II rural aquaculture.This exercise is only the beginning of a process aiming at setting up of a methodology for the development of type II rural aquaculture. In this sense, the future efforts will have to follow a sufficiently wide and flexible approach to the theme to enable its adequate evolution.

For further reading, the following FAO document can be obtained from the author:
Entre la acuicultura de los "mas pobres" y la de los "menos pobres".
Programa Cooperativo Gubernamental FAO-Italia
Proyecto Aquila II (GCP/RLA/102/ITA)
Documento de Campo No. 21

FIGURE 1: INSTITUTIONAL ARRANGEMENTS AND PHASES OF A PILOT PROJECT FOR THE FORMULATION OF A GENERAL DEVELOPMENT PLAN

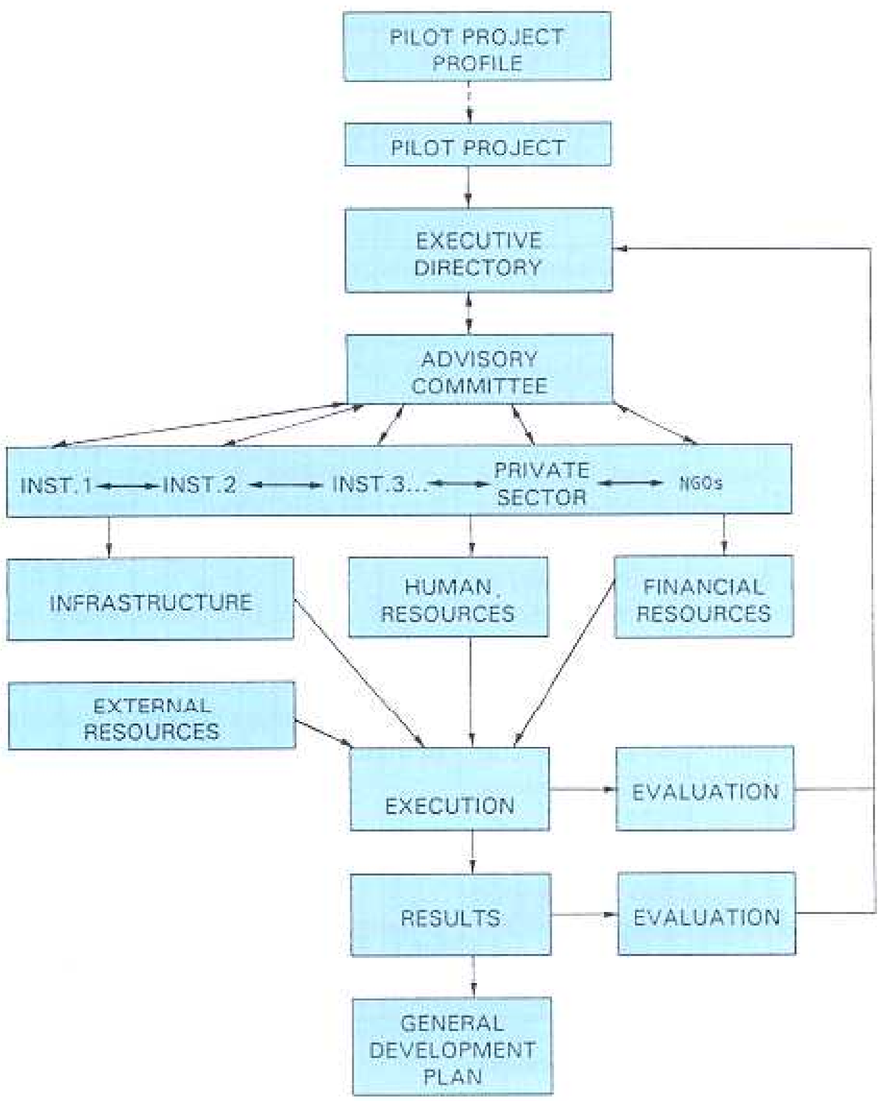

TABLE 1 : BIO-TECHNICAL AND ECONOMICS OF SIX MODELS OF CULTURE OPERATIONS

Species/Model	Cachama 1	Cachama 2	Tilapia 1	Tilapia 2	Tilapia 3	Trout 1
Production systems	Semi-intensive	Semi-intensive	Semi-intensive	Semi intensive	Intensive	Intensive
Structure	Earth ponds	Earth ponds	Earth ponds	Earth ponds	Circular concrete ponds	Rectangular concrete ponds
Water flow	Stationary	Stationary	Stationary	Stationary	Continuous	Continuous
Total water surface -pre-growth -growth(m²)	- 2,450	- 7,350	- 2,450	1,200 8,000	- 150	30+200 400
No. of ponds/tanks -pre-growth -grwoth	- 1	- 3	- 1	4 4	- 3	2+4 2
No. stocked fingerlings	2,450	7,350	7,350	24,000	7,500	15,120
Size	3	3	10	10	0,4	1.5
Stocking density -pre-growth(fishes/m²) -growth (fishes/m²)	- 1	- 1	- 3	20 3	- 50	500-75 34
Fertilizers -organic (kg/month) -inorganic (kg/month)	6 8	780 12	260 8	780 12	-	-
Feed (kg/cycle)	4,961.25	14,883.75	3,969.00	12,960.00	3,543.75	5,103.00
Feed type (% protein)	24-28	24-28	24-30	24-30	45	45
Survival	90	90	90	90	90	90
Feed convertion ratio	1.5:1	1.5:1	1.5:1	1.5:1	1.5:1	1.5:1
Individual weight at harvest (g)	1,500	1,500	400	400	350	250
Cycle duration (months)	10	10	6	6	6	12
Cycles duration per year	1	1	2	2	2	1
Total production (kg/year)	3,307.5	9,922.5	5,292.0	17,280.0	4,725.0	3,402.0
Productivity (t/ha/year)	13.5	13.5	18.5	18.7	315	54
Total initial investment	299,000.00	979,000.00	319,000.00	1,189,000.00	530,000.00	500,000.00
Total production cost	304,178.55	1,076,874.89	614,941.50	2,161,876.00	724,543.50	717,159.00
INCOME (Gross)	595,350.00	1,786,050.00	1,323,000.00	4,320,000.00	1,181,250.00	1,190,700.00
IRR	96.46	71.10	221.83	181.35	85.84	94.71
BREAK EVEN POINT	79,184.72	574,832.36	127,842.50	726,714.79	184,113.99	138,559.47

AQUACULTURE EXTENSION SERVICES IN THE PHILIPPINES

(Abridged from FAO Fisheries Circular No. 892)

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BACKGROUND

The Philippines is one of the major producers of fish and fishery products, ranking among the highest as shown by the fact that within the recent two decades it has ranked 11th to 14th among world fisheries producers. In aquaculture, it is 5th or 6th among world producers. It is the highest producer of milkfish, second highest producer of red seaweed and ranks high in the production of tuna, tilapia and shrimps. Its fish supply has attained positive balance and is now a net exporter of fishery products. In 1991, the country exported fishery products valued at US$467.7 million while import was only US$96.1 million.

Located just north of the equator in the western rim of the Pacific Ocean, the Philippines as an archipelago has some 7 100 big and small islands; it has a long coastline aggregating 34 600 km. The climate is tropical and is within the cyclonic range of the southwesterlies during May through October each year. The country has a land area of 300 000 km², inshore coastal water area of 266 000 km², offshore oceanic waters of 1 934 000 km², and total territorial water area of 2 200 000 km².

The country has many lakes and rivers: inland waters aggregate 600 000 ha (6 000 km²). The surrounding seas are extensive, but in general the country has a narrow coastal shelf aggregating some 184 600 km², but the shelf drops down abruptly to the deep offshore waters.

Demography

The country is well populated and the population is growing fast. By latest estimate in 1991 the population stood at 62.1 million. It is growing at the rate of 2.0 to 2.5 percent per year, a relatively fast growth.

AQUACULTURE

Status

The Philippines has a long tradition of aquaculture. During the 15th century foreign traders observed the existence of coastal fishponds in the country. For a long time, these coastal brackishwater fishponds represented the main aquaculture activities in the country. In recent year, besides brackishwater culture, freshwater pond, pen and cage culture, and culture of oysters, mussels and seaweed have been developed. These developments have resulted in substantial increase in production from about 400 000 t in the early 1980s to about 700 000 t in 1992.

Philippine aquaculture can readily be divided into six major systems: (1) brackishwater fishponds; (2) freshwater fishponds; (3) fishpens mainly in freshwater; (4) fishcages mainly in freshwater; (5) seafarming for molluscs; and (6) seafarming for seaweeds. Although production from brackishwater fishponds has fluctuated, it still maintained the highest position in production as well as value with production of 234 875 mt valued at PPs 19.3 billion in 1992 (Table 1). In the same year, the production volume and value for the other systems were: freshwater fishponds - 48 752 mt valued at PPs2.2 billion; fishpens - 33 395 mt, PPs1.3 billion; fishcages - 34 292 mt, PPs1.2 billion; molluscs - 35 562 mt, PPs449 million; and seafarming for seaweeds -349 505 mt, PPs1.5 billion.

Six major species groups stand out as the main aquaculture candidates in the country. These are milkfish, tilapia, jumbo tiger shrimp, oysters, mussels and seaweeds. Based on 1992 statistics, the production of milkfish was 145 554 mt valued at PPs5.8 billion; seaweeds - 349 505 mt, PPs1.5 billion; jumbo tiger shrimp - 75 996 mt, PPs12.5 billion; tilapia - 48 006 mt, PPs2.2 billion; mussels - 20 458 mt, PPs278 million; oysters - 15 103 mt, PPs170 million. Here, it should be noted that seaweed production is highest in volume but that of the jumbo tiger shrimp is highest in value. The volume of production and value remained high for milkfish.

Given the proper environment for growth, the Philippine aquaculture industry still has high potentials for accelerated expansion and development. The freshwater fishpond industry is underdeveloped and can expand and improve its production per unit area. Mariculture of cultivable marine species has the greatest prospects for further expansion. The cultivation of different species of economic seaweeds can expand rapidly if there is demand and market prices are favourable. Likewise, mariculture of shellfish including various species of oysters, mussels and other bivalves, can also increase. Fishpen culture in protected marine areas and netcage culture in both freshwater and marine situations can further expand. There are some scope for intensification of production in both freshwater and brackishwater ponds. Diversification of species used for culture has good prospects for species like catfish and prawns besides tilapia and the carps in freshwater ponds; groupers, giant perch, snappers, siganids, other penaeids besides milkfish and the tiger shrimp in brackishwater ponds; and high value finfishes (groupers, snappers, giant perch) in marine netcages and pens.

The Aquaculture Division of BFAR

The Bureau of Fisheries and Aquatic Resources (BFAR) has an Aquaculture Division which is responsible for the formulation and implementation of aquaculture development and research programmes (Figure 1).

It has under it the Sections on Freshwater Fisheries, Brackishwater Fisheries, Mariculture and Fish Health. In addition, the BFAR maintains and operates the National Freshwater Fisheries Technology Research Center, located in Muñoz, Nueva Ecija province; the Tanay Freshwater Experimental Station in Tanay, Rizal province; and the National Brackishwater Aquaculture Technology Research Center, located at Pagbilao, Quezon province.

The BFAR, through these facilities, implements genetic research on tilapia in cooperation with the International Center for Living Aquatic Resources Management (ICLARM); and carries out research in brackish-water aquaculture with the cooperation of the European Union and the ASEAN Aquaculture Development and Coordination Programme (AADCP).

The extension functions of BFAR up to 1986 were implemented by the Fisheries Extension Division through the 13 regional offices with a total manpower complement of 700 extension officers. Of this, 320 were assigned to render aquaculture extension services. These field extension officers were supported by the national extension specialists through planning and evaluation of the extension programmes, training and packaging of technologies, and advisory services.

The series of government reorganizations and the subsequent changes in the fisheries organization had adverse effects when in 1987 under Executive Order 116 the BFAR was transformed from a line to a staff agency. As a staff bureau the extension functions among others were transferred to the regional offices of the Department of Agriculture (DA). As a result, the BFAR personnel assigned at the regional offices were placed under the direct supervision of the DA.

The implementation of Executive Order 116 in January 1987 turned the fisheries extension workers into generalists and they were referred to as Agricultural Technicians (ATs). Although the shift was aimed at improving effectiveness of the delivery of the agricultural extension system, the abrupt implementation caused disorientation. An effective generalist extension approach should have been coupled with substantial training in fisheries, which was not done. To complicate matters, the improper deployment of individual extension workers had led to the unavailability of extensionists to respond to specific concerns of the clients on fisheries which were not within their field of expertise.

Under the present set up, the Fisheries/Aquaculture Extension Delivery System is under the management of the Regional Office of the DA.

The central and field organization of the aquaculture extension service is operated under the Fisheries Sector Program (FSP) and National Fisheries Outreach Program (NFOP) schemes of the Department of Agriculture.

The Fisheries Sector Program is an inter-agency programme to rehabilitate, conserve and regenerate the fisheries resources while at the same time alleviating the poverty level of the marginal fishermen. This Program started operation in 1989 with funding loan from the Asian Development Bank (ADB).

To facilitate the implementation of the activities of the various agencies, the DA created the Project Management Office (PMO) as an overall coordinating body to manage the Program. Subsequently, Regional Fisheries Management Units (RFMUs) for the different regions of the country and Provincial Fisheries Management Units (PFMUs), respectively headed by the Special Assistant for Fisheries Development (SAFD) and Provincial Agricultural Officers (PAO), were established to implement the various sectoral projects under the major program components.

Coastal Aquaculture in the Philippines

To institutionalize and implement the FSP activities, the DA relies on regular DA employees who are fisheries specialists or agricultural technologists with fisheries background. However, it appears that there are not enough specialists at present who can handle the planned activities on a full time basis because of their other responsibilities.

The PFMU is composed of a team leader and several Community Fishery Officers (CFOs). Each municipality will have at least one CFO who will handle fishery activities and projects. The PFMU is a regular unit under the Provincial Agricultural Officer (PAO) and will continue to exist beyond the life of the projects/programmes in order to ensure that proper management of local aquatic resources is pursued continuously.

Besides the involvement of local government units (down to the village level), private organizations have also been organized and these have started to take active part in rural development and livelihood projects. Some of these involve fisheries and aquaculture and other aspects of agricultural production.

Extension policy, plans and programmes

The aquaculture extension policies, plans and programmes are embodied in the Medium Term Fisheries Management and Development Plan (MTFMDP) and complemented by the mandates for the Fisheries Sector Program (FSP) and the National Fisheries Outreach Program (NFOP) of the DA.

The MTFMDP 1993-1998 is the basic framework for development policy making to attain sustainable and sound management and development of aquaculture in the country.

The primary policies to be pursued over the MTFMDP are: (1) enhancement of the overall productivity of fisheries and aquatic resources within ecological limits; and (2) upliftment of the socio-economic conditions of the small-scale fisherfolks/fishfarmers.

In particular, the specific objectives to attain under the above policies are the following:

- To double aquaculture productivity from 1.2 metric tons/hectare/year to 2.4 metric tons/hectare/year
- To double priority bays/gulfs for coastal resource management implementation from 12 to 24
- To improve operating efficiency of fishing fleet by seven percent and according to international standards
- To organize fishery law enforcement and provide support facilities to 50 percent of coastal municipalities
- To reduce post-harvest losses by five percent and promote value-added products.

Aquaculture will be the fastest-growing of the three fisheries sectors. Production from this sector will grow at 5.8 percent per year, from 0.74 million mt to one million mt, during the Plan period from 1993 to 1998. Western Mindanao, Southwestern Luzon, and Central Luzon Regions will account for the majority of this output, contributing 41.6 %, 18.6 % and 16.1 %, of the country's aquaculture output, respectively.

Aquaculture which will be a major source of increased production in the fisheries sector will adopt specific plans and programmes to attain the projected targets. In general, production from brackishwater ponds will be increased through the promotion of semi-intensive or other yield-increasing technologies within ecological limits. Freshwater aquaculture production will be increased by encouraging area expansion, genetic improvement of cultured species, promoting increase in stocking rates and culture of high yielding varieties. Fishpen and fishcage culture will be extended to include protected marine areas. Seafarming of shellfishes, finfishes, crustaceans and seaweeds will be initiated and expanded in suitable areas.

Specific policy directions, plans and programmes for the different key resources as formulated are summarized below:

Milkfish and shrimp

Policy directions

- Support exemption of fishponds from the application of the Comprehensive Agrarian Reform Law (CARL).
- Strengthen Fisheries Lease Agreement (FLA) as a negotiable instrument in application for credit.
- Promote semi-intensive culture of finfishes.
- Support lower tariff rates for imported feeds and feed ingredients.
- Revision of Fishpond Lease Agreements (FLA) fees to reflect equitable rent.

Projects

The strategic directions for improving productivity of milkfish and shrimps will focus on the following:

- Commercialization of milkfish hatchery technology.
- Government-private sector development of milkfish broodstock in ponds.
- Promotion of milkfish culture in pens.
- Support of continued research on milkfish broodstock, hatchery, nutrition and fry handling.
- Intensified extension services on semi-intensive culture using environment-friendly technology.
- Research on diseases and environment.

Tilapia and carp

Policy direction

- Continue genetic improvement of tilapia and carp.

Projects

As potential areas for growth in fisheries, additional freshwater areas will be targeted to increase production. The efforts will be focused on the following:

- Programmes for genetic improvement.
- Promotion of polyculture methods.
- Management of major inland waters.

Seaweeds

Policy directions

- Promote Philippine Natural Grade (PNG) carrageenan.
- Develop and improve genetic quality of seaweeds.
- Diversify seaweeds products.

Projects

- Genetic improvement of *Eucheuma* spp.
- Stock assessment of seaweed resources.
- Development of farming technology.

Crabs

Policy directions

- Resource assessment and management.
- Seed production.

Projects

- Nationwide assessment and management of crab resources.
- Seed production and hatchery technology.

METHODS AND SYSTEMS OF EXTENSION

Aquaculture extension services cover both the brackishwater and freshwater fishponds, ricefish culture projects, seafarming projects, fishpens and fishcages, mariculture for molluscs and seaweeds and other related endeavours involving husbandry and culture of aquatic animals and plants.

Specifically, the methods employed by the aquaculture extension workers are as follows:

Description of methods and systems

Individual methods

The individual extension methods employed by the aquaculture extension workers are:

- *Office calls* - Individual office callers are given one-on-one technical advice by the specialists or extension officers who are based in the national, regional, provincial or municipal offices.
- *Letters/inquiries* - Clients who are far from the office of the extension workers sometimes send letters of inquiry or to request for technical brochures.
- *Home/field visits* - Upon request, home or field visits are also employed by the extension workers. However, targetted cooperators are regularly visited by the extension workers.
- *Demonstrations* - In conjunction with home/field visits, if called for, methods or result demonstrations are also used by the extension workers.

Group methods

The group methods used include the following:

Meetings - Meetings either initiated by the government or by the private sector is commonly used extension method to disseminate information and to transfer new techniques and practices.

Demonstrations - Method and result demonstrations are usually employed in teaching new techniques in aquaculture. This is usually done in the demonstration farms/centers.

Trainings/workshops - Trainings and workshops are commonly used in the transfer of newly developed technologies. Such trainings are usually done in the training centers.

Demonstrations

To provide suitable show window for aquaculture technologies that have been developed for the different cultivable resources, the government usually put up projects or demonstration farms in strategic areas in the country. Interested citizens who want to start such projects or those already engaged in the same type of activity are welcome to visit such projects. Likewise, demonstration of specific techniques in aquaculture such as induced spawning through hormone injection is organized by the Extension Officers.

For the demonstration of newly developed aquaculture technologies, the government agencies concerned usually utilize private farms, on condition that such farms remain open to the interested public.

Trainings and visits

Trainings and visits are employed in a modified manner. It is locally called cooperator approach whereby the selected clients who are willing to adopt a new technology and also willing to teach other farmers and provide access to their data are given intensive training and provided regular visits by the extension worker. Nearby fishfarmers who wish to adopt the tested technology of the cooperator are free to visit the farm of the cooperator and observe the techniques and practices used.

Mass media

Publications, news releases, radio and television are also used to disseminate information and transfer simple technologies. The BFAR and other concerned agencies usually put out appropriate hand-outs on various aquaculture subjects.

Field trips, field tours and workshops

These are usually used to supplement lectures and demonstrations during trainings. These are specially used when the training deals with a specific subject such as fishpen culture of milkfish, when tours to the culture sites are made.

Extension schools and farmers training centers

The Department of Agriculture usually provides venues or facilities for the conduct of training and extension in agriculture in established agricultural centers. In these existing centers, some of the facilities are also used for aquaculture extension training courses.

In the 60s and 70s there was a proliferation of fisheries schools in the country. Because of their large numbers (approaching 100 in total), they were very inadequately equipped and the training they rendered was very inadequate. To solve this problem the government abolished a large number of these schools and left only a few of the selected ones with good quality instructors and with fine facilities and were placed under the Department of Education, Culture and Sports (DECS).

To provide for the practical training needs for fishermen and fishfarmers, four Regional Institutes for Fisheries Training (RIFT) were established. For hands-on practical training of fishermen, four Regional Fishermen's Training Centers (RFTC) were established in strategic areas of the country. These centers continue to function at present although their activities are dependent on availability of funds.

Transfer of Culture Technologies

The transfer of culture technologies through the above mentioned extension methods are usually done upon request of clients or through selected cooperators. This strategy was adopted due to lack of adequate manpower to cover all the fishfarmers.

Following are some of the aquaculture technologies that are presently being transferred to the aquaculture clients:

Genetically improved farm tilapia (GIFT)

Since 1976, tilapia has become the most important species cultured in freshwater fishponds. Although some species of carps (cyprinids) have been introduced earlier, there is a lack of market demand for this group of cultured species. However, due to lack of knowledge of hatchery operators and farmers on broodstock development, the quality of stock of farmed tilapia has continued to deteriorate.

In response to this problem, the Bureau of Fisheries and Aquatic Resources in collaboration with the International Center for Living Aquatic Resources Management (ICLARM) and the Central Luzon State University (CLSU) has developed a new strain of tilapia which is a product of cross-breeding of four strains of tilapia from Kenya, Senegal, Egypt and Ghana with the domesticated four Philippine *Nile tilapia* strains from Singapore, Thailand, Taiwan and Israel. The product resulting from the 36 successive cross-breeding is now being introduced to the freshwater fishfarmers.

Sex-reversed tilapia

The technology of sex reversal has long been developed but adoption is rather slow. Tilapia fry treated with methyl testosterone are held in nets suspended in ponds instead of in indoor tanks so that the farmers can easily adopt the method.

Improvement of tilapia culture techniques

The traditional stocking density of tilapia is 10 000 fingerlings/ha. Semi-intensive culture using 30 000 to 50 000 fingerlings/ha is now being promoted. Commercial pellets are given as supplemental feeds in addition to pond fertilization.

Polyculture of carp with tilapia

The techniques of polyculture of carp and tilapia have been transferred to the fishfarmers and are now successfully practised. This will promote the wider use of carps in pond culture.

Semi-intensive milkfish culture

The technology of semi-intensive milkfish culture is now widely adopted by the fishfarmers. With supplemental feeding, higher stocking density of 9 000 to 10 000 fingerlings/ha/crop are being used instead of the usual 3 000/ha/crop. Production per hectare has increased from 500-1000 kg/ha/yr. to 2 000-4 000 kg/ha/yr. Prospect of further increase is anticipated.

Culture management of milkfish using the modular method

By redesigning the ponds used for the culture of milkfish, multiple stocking can be achieved. Through this method multiple harvests of as much as six times or more during the year from the same pond can also be accomplished instead of the usual two or three harvests. Production has also increased from the usual one or two mt per year to four to six mt per year. As this technology requires close management of the ponds and their stock, the practice is still limited to the more progressive milkfish farm operators of the country.

Semi-intensive and intensive shrimp culture

Extensive method of shrimp culture is predominantly practised by traditional fishfarmers. However, because of the increasing demand for shrimp not only in the local market but also for export the semi-intensive and intensive methods were promoted and were adopted by the fishfarmers with success. Production increased from 500 kg/ha/year to more than 3 000 kg/ha/year. However, the intensive system of shrimp culture is now being discouraged due to its adverse environmental effects while the semi-intensive and improved extensive methods are being promoted.

Seafarming/mariculture

The seafarming of shellfishes, seaweeds, finfishes and crustaceans is a growing industry in the country.

Oyster and mussel culture is already an established industry. The methods used are stake, hanging and tray; sometimes with modifications to suit the environment.

Seaweed culture is one of the important seafarming industries in terms of export. Species of *Eucheuma* are the most widely cultured species. Also cultured are species of *Gracilaria* and *Caulerpa*.

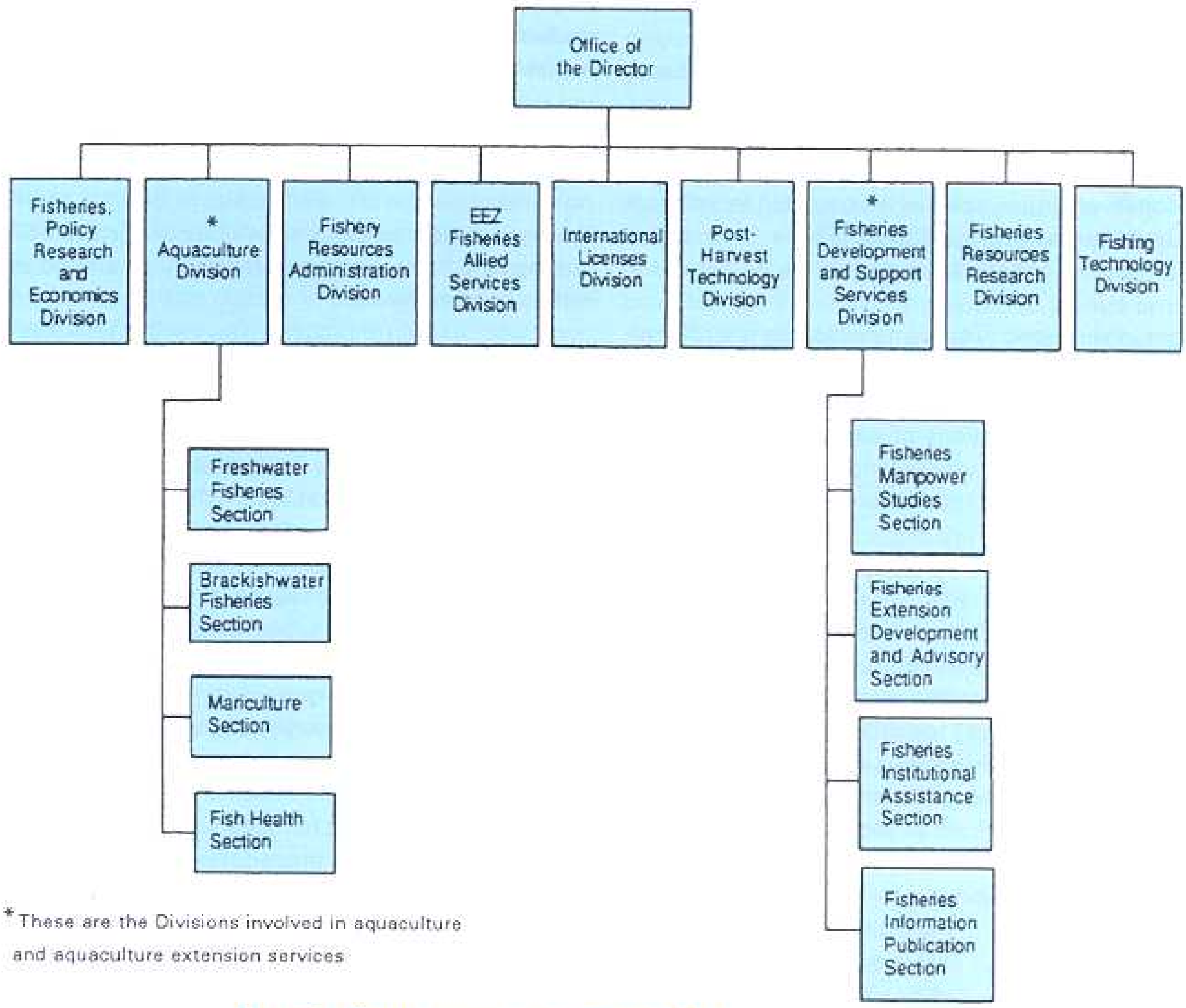

FIGURE 1: ORGANIZATIONAL STRUCTURE OF BFAR

Finfish culture in marine waters is still in its infancy stage. Among the species that are now being cultured are groupers, siganids, giant perch and to some extent, the snappers. Culture can be done in ponds, netcages or pens.

For crustaceans, crab culture and crab fattening for the mangrove or mud crab is growing in importance because of the high demand and good prices of this commodity in the local as well as in the foreign market. At present, juveniles and young crabs can be grown in cages usually made of bamboo or wood. If properly fed using trash fish, they grow rapidly and can be harvested in a few months. Supply of seed for culture is still adequate, but is expected to be scarce in the near future.

Input Supplies, Equipment and Subsidies

Most of the farm inputs are locally available. Feed and feed ingredients, fertilizers and pesticides although partly imported can be purchased from local dealers.

The supply of stocking material or seed are cheap when available. The price of seed increases when there are critical shortages. New types of facilities or equipment such as pumps and paddlewheel aerators were introduced when new and intensified culture systems were adopted. These have to be acquired from outside sources.

Except in very special cases no subsidies are offered to the aquaculture industry. This is done during the occurrence of calamities such as severe typhoons, floods, volcano eruptions or earthquakes, wherein stocking material (fry/fingerlings) are supplied or soft loans are given to aquaculture projects victimized by such calamities.

Seed Supply

Supply of fish seed particularly those that are produced in hatcheries like tilapia and carp are not a problem. However, for those that are gathered from the wild like milkfish fry and those of groupers, siganids, giant perch and to some extent shrimps, there are certain periods of the year when there is shortage of supply for fry of these species.

Subsidies and/or credit facilities

The government do not offer subsidies for farm inputs. However, credit facilities are available. Under the FSP, the amount of PPs1.555 billion is budgeted for credit and the government approved PPs30 million as additional credit seed fund for 1993 for aquaculture, bringing the total seed fund allocation for this subsector to PPs650 M.

To further address the credit requirements of the aquaculture subsector, the DA also entered into Memorandum of Agreements with the Development Bank of the Philippines (DBP) and the Quedan and Rural Credit Guarantee Corporation (QUEDANCOR) for their participation in implementing the FSP Credit Component. To date, the seed fund has totalled PPs350 M with the Land Bank of the Philippines (LBP) allocating PPs290 M; the DBP PPs30 M and the Guarantee Fund for Small and Medium Enterprises (GFSME) PPs30M. In some cases high interest rates (20 percent or higher) and the requirements of prime collateral are hindering the process of utilization of available credits. The industry can readily use available credit at 12 percent or lower interest rates and under liberal security terms.

Control mechanisms

The aquaculture extension services under the FSP and the NFOP are monitored regularly as embodied in these programmes.

Monitoring procedures at all levels of management

The FSP project monitoring and evaluation framework involves two levels. The first level is the progress monitoring and evaluation level which involves the monitoring of current operations on a regular recurring basis of the various components and activities using pre-designed monitoring reports. This is to ensure that implementation is proceeding in the desired direction and in accordance with the prescribed standards of cost, time, quantity and quality. It also allows for the various management levels to introduce the remedial measures when necessary. The progress evaluation conducted periodically, is designed to enable the management to make strategic decisions regarding the effects of procedures, standards, and policies on the achievement of target outputs.

The second level of the framework is the project benefit monitoring and evaluation (PBME) which essentially involves the verification and measurement of the effects that result from the outputs of the various components and activities of the programme. The information generated from this level is needed to make decisions on whether or not to modify the design of the FSP or the individual components and activities to ensure efficient coverage of their respective targets, as well as to whether or not to amend the methodology on development approaches to make it consistent with the programme design.

To facilitate the preparation of monitoring or progress reports by all the implementing agencies, input forms have been prepared for both monthly and quarterly reports. The forms are essentially the same for all agencies although there are additional forms for the Regional Offices and BFAR. Likewise separate forms have been designed to monitor all training activities conducted. The most important consideration in monitoring implementation process is the formulation of Work and Financial Plans based on predetermined targets and outputs against which performance could be measured and evaluated.

Prospect for creating jobs

Unlike inland aquaculture (brackishwater and freshwater), there are better prospects of employment generation in mariculture or seafarming. Seaweed and fish cage/pen culture in coastal areas can offer viable alternative livelihood among coastal fishermen.

The present thrust of the ADB-assisted Fishery Sector Program of the Department of Agriculture in community-based coastal resource management requires the strong support of the non-government organizations active in fishing communities. The dual objectives of conserving the coastal resources and increasing the income of fisherfolks through the adoption of environment-friendly mariculture of seaweeds and finfishes can be met by effective training and extension programmes. Emphasis on training and extension programmes should be on environmental awareness and management, value orientation and skills development.

Additional Family Income

Mariculture of oysters, mussels and seaweeds offer the best opportunity for coastal fisherfolks to increase income as an additional livelihood. Studies on economics of oyster and mussel farming show that the net profit of PPs956-3 000 per hectare per crop can easily be made. Small-scale seaweed farming can also generate good profit.

Additional income for fishermen can also come from the supply of shrimp spawners to hatchery operators priced at PPs800-1 000 per piece depending on the stage of maturity and distance to hatchery site. Part-time work for fishermen in ponds during pond repair and preparation and harvesting will mean additional income. This type of work is seasonal and requires skill.

Women in fishing communities can engage in simple fish processing and marketing aside from their regular household chores. In the aquaculture industry the services of women are predominant in the operation of shrimp and fish hatcheries and in the processing and trade of aquaculture products.

Nutritional Benefits

Fish is an important staple food for Filipinos. Consumption of fish per capita is one of the highest in the world, estimated at 35-40 kg per year. Fish provides the Filipinos 70 percent of animal protein and 30 percent of total protein. About 80 percent of total fish production in the country is consumed locally and the rest are exported.

Conclusions

Training and extension are the important strategies of the development policies and plans of the aquaculture sub-sector. The BFAR is providing technical support and training for the enhancement of the aquaculture industry by operating the five National Fisheries Research Centers in Muñoz, Tanay, Pagbilao, Butong and Cavite. SEAFDEC Aquaculture Department undertakes yearly training programmes in the different aspects of aquaculture such as fish health, fish nutrition, breeding and hatchery management, culture methods and aquaculture management. It also undertakes outreach programmes in the different parts of the country where technology updates are needed. The Technology and Livelihood Resource Center (TLRC), a public training institution for small investors, offers to interested parties training on aquaculture techniques which can be adopted in small- and medium-scale operations.

Aquaculture organizations and cooperatives sponsor seminars and conferences on various topics of interest to the aquaculturists. Regional development councils also sponsor seminars and conferences on aquaculture to update aquaculture practitioners on the latest technologies. Researchers and other experts are invited to talk on important topics such as diseases, nutrition, environmental concerns and government policies. The joint efforts of the BFAR and the Agriculture Extension Services of the DA are aimed at providing an effective extension support to the fishfarmers. However, the activities of the Fisheries Sector Programme and the National Fisheries Outreach Programme of the DA should be closely coordinated with the other concerned government agencies such as the Department of Environment and Natural Resources, Department of Science and Technology, Department of Trade and Industry etc. Special efforts should be made to work together with the Local Government Units (LGUs) at the rural community level where the LGUs have become potent partners in aquaculture development in the rural communities.

So far, the Aquaculture Extension Services have made substantial contribution to the development of aquaculture in the Philippines, and there are great potentials for the development of small-scale mariculture of seaweeds, finfishes, molluscs and crustaceans which can offer new economic opportunities for coastal communities. The development strategy should be based on community participation for resource management, with training and extension services provided by the government and non-governmental organizations.

Table 1: Aquaculture production, by system and environment, 1983-1992

Volume: mt
Value: (Million PPs)

Year	Brackishwater fishpond	Freshwater fishpond	Fishpen mainly in freshwater	Fishcages mainly in freshwater	Seafarming for molluscs	Seafarming for seaweeds
1983	183 773 (3 123)	12 052 (112)	82 564 (1 107)	4 664 (37)	29 816 (169)	132 204 (251)
1984	198 729 (5 117)	13 111 (167)	81 966 (1 357)	7 070 (86)	34 923 (257)	142 088 (281)
1985	198 546 (6 522)	15 862 (282)	51 979 (1 202)	7 441 (136)	37 948 (279)	182 946 (304)
1986	207 274 (8 692)	15 503 (365)	41 296 (1 035)	9 373 (223)	28 579 (193)	168 868 (334)
1987	234 584 (9 131)	30 165 (612)	35 588 (732)	17 789 (361)	22 005 (155)	220 839 (431)
1988	240 206 (12 755)	32 922 (748)	23 814 (574)	18 260 (417)	27 947 (214)	256 405 (505)
1989	253 580 (12 838)	34 238 (855)	24 102 (654)	19 502 (479)	29 222 (241)	268 701 (605)
1990	267 814 (16 762)	35 816 (1 333)	24 379 (685)	20 931 (570)	31 000 (320)	291 176 (796)
1991	291 275 (18 449)	37 974 (1 360)	25 931 (815)	23 939 (676)	29 499 (3 161)	283 783 (1 040)
1992	234 875 (19 296)	48 752 (2 229)	33 395 (1 324)	34 292 (1 161)	35 562 (449)	349 505 (1 527)

Source: Bureau of Agricultural Statistics, 1993. Fishery Statistics, 1983-1992

NEWS ITEMS

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Training course in Chile

The Latin America and Caribbean Regional Training Course on "The nutrition and feeding of salmonids" was held at the Catholic University of Temuco, Chile, from 23 to 27 October 1995.

Chile is currently the largest aquaculture producer within the Latin America and Caribbean region with a total production of 135,092 metric tonnes (mt) in 1993 or 37% of the total aquaculture production within the region of 365,426 mt and the production valued at 365,511,000 US$ or 26.6% of the total value of aquaculture production within the region of 1,372,170,000 US$. Moreover, salmonids are the most widely cultivated finfish species within the region with a total production of 84,562 mt in 1993 or 51.3% of total finfish production and valued at 348,396,000 US$

In view of the economic and social importance of coldwater salmonid aquaculture production within remote coastal communities (in the case of salmon in Chile) and the vast and resource poor mountainous Andean region of Latin America (in the case of trout farming in Bolivia, Peru, Ecuador, Colombia etc.) it is essential that this sector be monitored and supported. Food and feeding representing the largest single operating cost item of salmonid aquaculture production operations.

The training course was organized as a joint activity between the FAO Regional Office for Latin America and the Caribbean (RLC) and FAO-FIRI, the Catholic University of Temuco, and the Association of Salmon and Trout Producers of Chile, with the support and collaboration of the following organizations and companies, namely Industrias Sodipol, Laboratorio Roche Chile, Veterquimica Ltda, Biomaster, and Trouw Chile S.A. The coordinators of the training course were Professor Aliro Borquez R. and Professor Alfonso Mardones L. (both from the Catholic University of Temuco); Professor Borquez also being the coordinator of the nutrition sub-group of the COPESCAL Working Party on Aquaculture.

The objectives of the regional training course were 1) to review and update current knowledge and understanding of experts and other interested parties (including feed manufacturers and farmers) within the Region in salmonid nutrition and feeding, 2) to demonstrate to other professionals within the Region the importance and key role played by nutrition and feeding within intensive farming systems, and 3) to stimulate cooperation between experts and researchers in salmonid nutrition and feeding within interested countries in the Latin American Region.

A total of 159 participants from 11 countries (region - Argentina 6, Bolivia 4, Chile 138, Colombia 2, Cuba 1, Paraguay 1, Peru 2, Uruguay 1, Venezuela 1; others - France 1, Norway 1, USA 1) attended the training course, with 83 participants coming from the private sector (ie. fish farmers, feed manufacturers, feed ingredient suppliers, and consultants) and the remainder being either government officers and university professors engaged in aquaculture/nutrition related activities (34 participants) or university post-graduate students (42 participants).

Apart from the formal lectures and discussions, a round table discussion was held on Wednesday 25th October where the invited TCDC Experts from the region orally presented their country reports. In addition, due to popular demand, a formal course examination (optional rather than mandatory) was held on Thursday 26th October in which participants could earn up to three post-graduate course credits; a total of 64 participants took this examination. Dr. Albert G.J. Tacon, Fishery Resources Officer, FAO, Rome, was the principal lecturer for the training course.

The major issues raised by the participants during the open and round table discussions were as follows:

• The lack of reliable published information on the dietary nutrient requirements of salmonids which can be applied to the formulation of practical salmonid feeds.

• The current dependence of salmonid aquafeeds upon fishmeal and fish oil, and the need to reduce the almost total dependence of the sector on these two finite commodities of uncertain supply, quality and cost in the future by using alternative more sustainable protein and lipid sources. However, it was also noted that Peru and Chile are currently the worlds top two producers of fishmeal and fish oil; producing 46% and 37% of the total world production of fishmeal and fish oil in 1993, respectively.

• The critical role played by nutrition in disease resistance and health management and the need to stimulate further research in this new and important field.

• The crucial role played by nutrition in broodstock management and egg quality and the need to stimulate further research in this important field.

• The potential deleterious effects of uneaten aquafeeds and excretory metabolites upon the aquatic environment, and the consequent need to further improve feed formulation (by reducing dietary phosphorous and protein levels, and by increasing non-protein dietary energy sources such as lipids) and on-farm feed management (including the use of improved feeding methods) so as to improve feed efficiency and reduce feed wastage and thereby minimizing negative environmental impacts.

• The possible negative effect of high lipid/energy diets on fish quality (ie. unwanted visceral fat, increased fillet lipid content, variable pigmentation).

• The need to develop simple and reliable techniques for estimating the standing biomass, feeding response and feed intake of fish housed within cages.

• The lack of legislation concerning the formulation and manufacture of commercial aquafeeds, including the uncontrolled use of antibiotics within aquafeeds.

• The need for increased government support to public sector R & D activities in nutrition and feed development.

• The need for research programmes and activities within public sector institutions (ie. universities and government laboratories) engaged in aquaculture nutrition/feed research to be tailored to solving the existing problems and bottlenecks.

The training programme was successful in that over 50% of the participants came from the private sector (including farmers from countries outside Chile such as Bolivia, Colombia and Argentina) and so the lectures and open discussions were targeted to the major issues (listed above) currently faced by the salmonid aquaculture sector. Moreover, the round-table discussions showed that the current issues and challenges faced by the salmonid aquaculture sector in Chile were also being faced by the other Latin American and Caribbean countries, although the relative importance of each issue varied from country to country depending upon the farming system employed (ie. intensive or semi-intensive; tank, cage or pond), the market value of the species cultured, and the feed ingredient resources available within the country in question.

Albert G. J. Tacon
Inland Water Resources and Aquaculture Service

Fish storage facilities in China

The project "Freshwater Live Fish Storage Techniques in Xiantao, Hubei province of People's Republic of China has been completed. The project became operational in June 1993 and was completed in June 1995.

The Xiantao District is located on the Jiangham Plain, about 90 km from Wuhan in the Hubei Province. It has a population of 1.28 million. The annual fish production from the district is about 52,000 t, including catches from enhanced capture fisheries in several lakes. Traditional Chinese polyculture and integrated fish/livestock/crop practices are common. The markets are well supplied with live fish during the winter harvesting period, but fish are of short supply during the rest of the year. Live fish is preferred by the local consumers who would pay about 50% higher prices for live fish. Moreover, out-of-season (spring/summer) prices for live fish may go as high as double than those of the winter season. Also, there is a lucrative export market for live fish in Hong Kong.

The project assisted the local authorities in designing and construction of facilities for holding 26 t of fish for short-term storage (for 7-10 days at a time). The facilities could also be used for intensive fish culture with design capacity of about 13 t. The project also has trained the local technicians on how to operate and maintain the facilities. The new facility built by the project is the largest short-term storage capacity available close to the markets in Xiantao City. It is expected that the private fish dealers and fish farmers would use this facility to take advantage of the higher prices that can be obtained, especially in the spring/summer months.

The Final Workshop of the Regional Study and Workshop on Aquaculture Sustainability and Environment (NACA/ADB)

The final workshop of the Regional Study and Workshop on Aquaculture Sustainability and the Environment was held in Beijing from 6 to 12 October 1995, hosted by the Ministry of Agriculture of the People's Republic of China. The Regional Study was jointly organized and supported by the Network of Aquaculture Centres for Asia-Pacific (NACA) and the Asian Development Bank (ADB) under a Regional Technical Assistance Programme (RETA 5534).

The study was recommended by the ADB-NACA Regional Study and Workshop on Fish Diseases and Fish Health Management (RETA 5358). The Workshop held in Pusan, Republic of Korea in 1990 concluded that the diseases of aquatic animals and plants are closely linked to the environment and that environmental issues, including fish and shrimp disease problems and control, must be considered in the broader context of fish farming systems, design, siting and management. A clear understanding of environmental problems and their economic impact through a farm level survey was regarded as crucial in assisting governments and farmers to formulate effective strategies for sustainable aquaculture.

The NACA Governing Council endorsed the project in December 1992 and it was subsequently approved by ADB in June 1993. The project started with a planning workshop held in June 1994 in Prachuab Khirikhan in Thailand, and was attended by the National Farm Performance Coordinators (NFPCs) from the 16 participating governments.

The Workshop on Aquaculture Sustainability and the Environment was attended by representatives from member countries, private sector, and international and regional agencies. Total attendance at the Workshop was about 100, including 11 consultants and resource persons. Dr Rohana Subasinghe, Fishery Resources Officer in charge of Fish Health, represented FAO at the workshop.

A draft Aquaculture Sustainability Action Plan (ASAP) was compiled during the workshop which reflects the views expressed by the Workshop's four working groups at the four technical sessions. The sessions covered the broad areas of Farm Level Management Issues, Wider Environmental Issues, Aquaculture Policy and Regional Cooperation. The ASAP was adopted unanimously at the final plenary session.

It is hoped that the ASAP will assist the member countries in establishing priorities for improving the environmental management of the region's dynamic aquaculture industries which contribute almost 20 million tonnes of fish, crustacea and other aquaculture products annually.

The following is an excerpt from the ASAP.

Implementation of Aquaculture Sustainability Action Plan

1. In the light of the comprehensive set of recommendations embodied in the action plan, the workshop considered that follow-up activities be undertaken at national and regional levels.

2 .It was recognised that the primary responsibility for implementation of the plan would lie with the governments, working in close association with the private sector and other agencies. The workshop recommends that the government consider placing priority on instituting time-bound prioritised programmes identified in the action plan, as the basis for improving the environmental sustainability of national aquaculture development.

3. The workshop recommended that NACA take the initiative in coordinating the regional activities which were vitally important in supporting the implementation of the national activities. NACA should prepare a detailed regional programme to meet the governments' needs as identified in the Action Plan for the consideration of the NACA Governing Council.

4. The workshop further requests NACA to seek the collaborative assistance of other organisations and agencies to implement the identified priority programmes. Among the approaches recommended by the workshop are:

> *i) the Asian Development Bank to include in its investment programmes support for the strengthening of facilities and personnel and other needs identified in the action plan*

ii) FAO to be approached to assist through its TCDC funding mechanism, particularly in strengthening regional aquatic animal health management capacity and other areas related to sustainable regional aquaculture

iii) that NACA approach other regional and international organizations and agencies, such as UNDP, World Bank, SIFR, GEF, DANCED, EU, ODA, OIE and others, to support environmentally sustainable aquaculture.

Rohana Subasinghe
Inland Water Resources and Aquaculture Service

FAO Technical Cooperation Project TCP/CRP/4558 (A) Shrimp Health Management in Luannan County, Hebei Province, P.R. China.

The shrimp culture industry in China provides significant economic and social benefits to the people of China. Over the past fifteen years, the industry has developed rapidly, and more than 30 billion RMB Yuan has been invested by the Government and entrepreneurs. Hatcheries have been developed to produce over 100 billion shrimp post-larvae per year and more than 2.4 million mu (15 mu = 1 ha) of grow-out ponds have been constructed. The auxiliary services for shrimp production such as feed manufacturing, post-harvest processing, and transportation and marketing have also been developed and the industry now plays an important role in the rural economic development in China's coastal areas. The development of shrimp culture has made great contributions, not only to the effective utilization of China's coastal resources but also to the promotion of socio-economic development in coastal areas by creating employment, generating income (both for the state and the local communities), and contributing to food security.

During recent years, shrimp culture in China's coastal areas has been severely affected by serious disease outbreaks, especially of viral and bacterial origin. According to recent estimates, more than 76% of shrimp culture areas in China have been affected by disease in 1993 alone. This has resulted in direct economic loss of over 3.5 billion RMB Yuan and indirect economic loss of 8.6 billion RMB Yuan to the national economy. It has been suggested that viral and bacterial pathogens, inadequate farm management, and coastal environmental degradation are the possible causes of the recent disease outbreaks.

The Government of the People's Republic of China attaches great importance to the sustainable development of shrimp culture in China and the importance of disease control and health management in shrimp culture has been recognised. The Ministry of Agriculture has decided to address the issue by developing manpower, providing training and establishing a shrimp health management centre in Luannan County. The overall objective of this new directive is to develop more sustainable and environment friendly shrimp culture industry in Luannan County through adopting appropriate and strategic health management programmes. It is also envisaged that these efforts will generate valuable information and help further strengthen the shrimp culture industry in China.

Considering the importance given by the Government of the People's Republic of China to sustainable shrimp culture FAO has provided technical assistance, through a Technical Cooperation Project (TCP/CRP-4558A) to assist the Government of China to develop an effective shrimp health management programme for the Luannan County. The support will include provision of technical expertise, training, and support facilities/services to the Luannan Country Fishery Technical Extension Centre.

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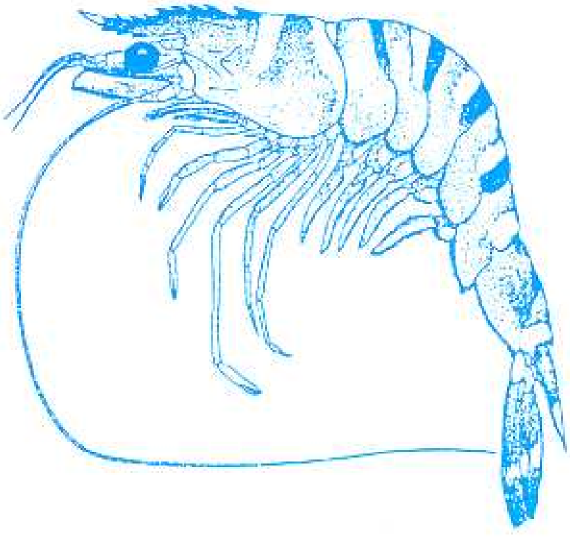
Inland Water Resources and Aquaculture Service



Use of DNA Markers for Aquaculture: A Contribution to Sustainable Use and Conservation of Genetic Resources

Joint FAO/IAEA Research Proposal

The rapid expansion of the human population (likely to double over the next two generations) and its expectations of enhanced quality of life are putting severe demands on natural fish populations. Recent calculations of global productivity and food chain efficiency show conclusively that the current fish harvest is unsustainable. It is also recognized that future increases in fish production must come from aquaculture as many of the major wild capture fisheries continue to decline.

The most rapid expansion of aquaculture will be in the Asian Pacific rim countries where freshwater fish farming is already by far the most important sector in terms of aquaculture production worldwide. An estimated 87% of the global production of finfish cultured for food occurs in Asia. In many areas of Asia, locally farmed fish are the sole source of animal protein available to the poorest members of the population. In the vicinity of large cities fish farming sometimes occurs on an industrial scale; most of the production, however, comes from family or community farms.

The science of applied genetics has contributed greatly to the steady increase in productivity in terrestrial agriculture and livestock. This has not been true of aquaculture. Although the yield from aquaculture is already high relative to agriculture in terms of production per unit of input or unit of area, aquacultural species are still, as far as genetic is concerned, much closer to the wild state than the major livestock and food crops. Compared with the major terrestrial food production systems, the productivity of aquaculture is correspondingly farther from its ultimate potential. Therefore, the opportunity for genetic gain is correspondingly greater, and the need for genetic improvement is correspondingly more urgent. The quality of many existing stocks, far from satisfactory to begin with, is believed to be deteriorating under the effects of inbreeding and inadvertent negative selection, especially in small or artisanal farms in developing countries. There is a great disparity between the need for increased aquaculture production and the genetic quality of the stocks available to meet that need.

The management of aquacultural broodstocks has posed many unique problems to scientists and fish farmers over the years. These problems include the large numbers of individuals used in aquaculture, the difficulties of tagging and therefore constructing pedigrees for stocks, the expenses required to establish separate rearing units to maintain families and lines for management and improvement purposes. These have been major difficulties which have hindered the rapid genetic improvement that should be possible in fish because of their high fecundity and the genetic variability which makes them good candidates for selective improvement and genetic manipulation. Conventional stock improvement (animal-breeding) procedures as used in livestock and some fish breeding programmes in developed countries require large numbers of separately maintained subpopulations which can not be considered under the cost and management constraints which exist in most developing country situations. The only method of selective genetic improvement widely used by small fisheries stations and individual farmers is mass selection, which has often led to inbreeding depression and/or negative selection that more than nullifies the expected gains. The DNA microsatellite marker technology will contribute to the genetic improvement of aquaculture broodstocks available to artisanal and small-hold farmers in several ways, including novel and cost-effective selection procedures for small breeding programmes, mapping of genes that enhance production and/or the unique adaptation of local breeds, etc.

Considering the importance of conservation and management of the genetic diversity of existing breeds and ensure that there is a just and equitable sharing of the benefits that will come from the utilization of these genetic resources, a five-year project proposal has been developed with the overall objective of helping the developing countries conserve and make effective use of their aquacultural genetic resources.

Development of DNA-based pedigree and marking systems, particularly the microsatellite DNA which is the focus of the present proposal, offers for the first time a procedure for cost-effective selection of aquacultural broodstock. With appropriate modifications DNA pedigree procedures can eliminate inbreeding in simple broodstock management procedures and also make it feasible to design more efficient selection programmes at greatly reduced cost and operational complexity.

The project will be executed by the joint FAO and International Atomic Energy Agency (FAO/IAEA) Division of Nuclear Techniques in Food and Agriculture with assistance from the Fishery Resources Division of FAO. The technical expertise is to be obtained from the Dalhousie University Marine Gene Probe Laboratory (MGPL), Canada, which has collaborated extensively with Asian research institutions on aquacultural genetics problems of small-hold farmers, and is a world leader in the development, utilization and technology-transfer of DNA marker technology, and the Stirling University Institute of Aquaculture (IOA) which has decades of successful research and training collaboration with developing countries in many areas of aquaculture including genetics. The project is envisaged to be implemented through the developing countries' National Aquacultural Research Systems (NARS laboratories) selected for their track records and ability to utilize effectively the DNA technology and for their record of collaboration with farmers and community organizations and NGOs.

The overall focus of the project will be on the indigenous breeds of major aquacultural species, socio-economically significant farming systems and key environments which are of particular interest to the NARS. The species to be targeted initially (except in Africa where the target will be an indigenous cyprinid) will be *Puntius gonionotus*, the Thai silver barb. Later on, national projects may chose to investigate other species and farming systems which have high national or regional priorities for development and/or conservation. The targeting of species, breeds and their associated genetic problems and opportunities will be an ongoing process in the proposed Aquaculture Microsatellite Network.

Puntius gonionotus and its close relatives are endemic to South and Southeast Asia. These species are important in wild capture fisheries and are becoming a very important species for aquaculture because of the ease with which they can be spawned and their good growth characteristics in managed ponds. *Puntius spp.* are not luxury fish and expansion of the farming of this species will benefit rural economies and welfare as much of the production is sold and consumed locally. The aquacultural systems used for the culture of *Puntius* are appropriate and are in general ecologically friendly.

The serious problems which are developing with the increasing popularity of this species include loss of valuable genetic diversity and low (and probably deteriorating) genetic quality of farmed stocks. The increased demand for this fish within Southeast Asia has resulted in the establishment of many new hatchery populations using broodstock from other hatcheries rather than new isolates from local wild populations. This practice can result in regional loss of genetic diversity, which is exacerbated by accidental and intentional release of hatchery stocks into the wild. Augmentation of natural with hatchery stocks is a widespread fisheries management practice for *Puntius* in the region. In many cases, the hatchery stocks are believed to have been established with a very small founder population and to be maintained with little or no attention to the compounding of inbreeding. At present, the natural and farmed populations are in danger of genetic degradation on a large scale.

The project will transfer the technical capability to use DNA genetic marker analysis (microsatellite DNA markers) for the solution of urgent problems in fisheries and aquaculture, with an emphasis on small-hold and artisanal farming systems, and on local and indigenous broodstocks. These problems include aquacultural disease and yield shortfalls caused by genetically inferior broodstock and the loss of irreplaceable genetic resources by breed displacement, genetic contamination, and failure to document provenance under rights established by the United Nations Convention on Biological Diversity. During the fist phase of the project DNA analysis capability will be transferred to approximately 10 countries in Asia and sub-Saharan Africa.

Implementation will involve 4 months of intensive training in the DNA technology and applications for developing country personnel, assistance in setting up laboratory capabilities, regular meetings and workshops, technical support, and, importantly formulation of a set of national research projects. These projects will be designed to ensure farmer and community-level participation in the identification and solution of the high-priority national broodstock improvement and conservation problems. FAO and IAEA are now seeking financial assistance from potential donors to implement this important and pioneering project.

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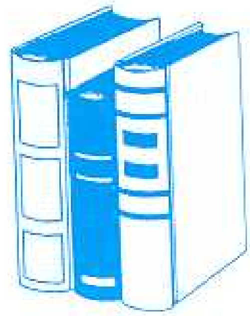
NEW PUBLICATIONS

A.G. Coche, J.F. Muir, T. Laughlin, D. D 'Ántoni. Simple methods for aquaculture. Pond Construction for freshwater fish culture - building earthen ponds FAO Training Series No. 20/1.

This is the fourth manual (comprised of two volumes, 20/1 and 20/2) in the FAO Training Series on simple methods for aquaculture. It deals with the practical aspects of civil engineering related to freshwater fish culture. In this volume, you will learn abut the general features of earthen ponds and fish farms, and how to select their location. You will also learn about building materials and equipment commonly used in fish farms. Finally, site preparation and the construction of various types of ponds will be explained to you in simple terms. In the next volume, you will learn how to design and build simple pond structures for the transport and control of water. You will also learn how to plan the construction of your small fish farm in more detail.

Aquaculture Production Statistics 1984-1993 FAO Fisheries Circular No. 815, Rev.7. Rome, FAO. 1995. 186 p. (FIDI/C815 (Rev7).

This publication is a compilation of aquaculture production statistics for fish, crustaceans, molluscs and other aquatic animals, residues and plants. The following combination of production statistics are presented: by species and by country; by country and by species, and by species and by environment. Values of production expressed in terms of US dollars are provided by country, species and species group, thus providing more detail than previous issues of Fisheries Circular No. 815. A number of charts facilitate the interpretation of the data. The statistics are for all years for which they have been collated by FAO (1984-1993). Where officially-reported national statistics are lacking or are considered unreliable, FAO makes estimates based on the best information available. Quantities produced are expressed as live weight equivalents and so are equivalent to the nominal catch statistics published in the FAO Yearbook of Fishery Statistics - Catches and Landings.



Rajbanshi, K.G. Aquaculture extension services review: Nepal. FAO Fisheries Circular No. 896. Rome, FAO. 1995. 37 p.

Nepal is a landlocked country of about 20 million people. Agriculture is the mainstay of the economy of the country; and it provides employment for 90 percent of the population and produces 60 percent of the GDP.

The contribution of the fisheries sub-sector to the GDP is very small and the per capita fish availability is less than 1 kg. Of the total fish production of about 17,000 mt, aquaculture contributes about 10,000 mt; and the rest comes from the capture fisheries in the rivers and lakes. With the increasing demand for fish for local consumption as well as for export to the lucrative markets in India, His Majesty's Government has given priority in the Eight Five Year Plan for the development of fish culture in ponds, lakes and paddy fields. Under the Department of Agriculture Development, the Fisheries Development Division is responsible for the overall development of fisheries in the country. However, in general, the fisheries (including aquaculture) extension services are provided by the agriculture extension services through the Regional and District Agriculture Development Offices. At the village level, the Progressive Farmers play a very important role in transferring culture technologies to the neighbouring farmers through demonstration and training.

So far, most of the aquaculture extension services have been provided through the implementation of two aquaculture development projects funded by the Asian Development Bank. The US Peace Corps Volunteers and the Japanese Overseas Cooperation Volunteers have also assisted in the operation of the aquaculture extension services.

Barg, U.C. Lignes directrices pour la promotion de la gestion de l'environnement dans le développement de l'aquaculture côtière (Etude fondée sur l'examen d'expériences et de concepts choisis).
FAO Document technique sur les Pêches. No.328. Rome, 1995. 133p.
Ce document s'adresse aux spécialistes du développement aquacole, aux planificateurs de l'utilisation des ressources côtières et enfin aux responsables gouvernementaux s'intéressant à la planification et à la gestion du développement de l'aquaculture côtière dans le contexte plus large de l'utilisation des ressources dans les aires côtières. Il est destiné à être utilisé pour la promotion de la gestion de l'environnement de l'aquaculture côtière. Des lignes directrices, basées sur un examen sélectif d'expériences publiées et d'idées générales, sont données en vue de l'amélioration de la gestion de l'environnement de l'aquaculture côtière. Les effets potentiels négatifs sur l'environnement de l'aquaculture côtière et sur cette aquaculture sont étudiés en considérant les principaux facteurs socio-économiques et biophysiques. Des méthodologies sont présentées pour l'évaluation et le suivi des risques sur l'environnement et de l'impact de l'aquaculture côtière. Diverses options de gestion de l'environnement sont décrites afin d'être utilisées aussi bien au niveau politique qu'au niveau des fermes aquacoles.
This document is also available in English and in Spanish.

New, M.B., A.G.J. Tacon and I. Csavas (Editors). 1995. Farm-made aquafeeds.
FAO Fisheries Technical Paper No. 343, Rome, FAO, 434p.

Handbook on Small-scale Freshwater Fish Farming
FAO Training Series No. 24.
The Arabic version of the "Handbook on Small-scale Freshwater Fish Farming" has been published. The English and French version are also available.

World Fishery Production. 1950-1993.
This publication is a special supplement to the FAO Yearbook of Fishery Statistics 1993. Vol 76. Catches and Landing in commemoration of the 50th anniversary of FAO.
FAO commenced its fishery statistical collection system shortly after its foundation, and has published the statistics in the FAO Yearbooks of Fishery Statistics. In 1970, a computer database was established for the catch statistics, which contains data for the period 1970-1993. For the years prior to 1970, statistics were incomplete and estimates of missing data were generally lacking. To commemorate FAO's 50th anniversary on 16 October 1995, it was considered appropriate to present, for the fist time, a complete historical series of catches for the period 1950 to 1993. This has been made possible following a complete revision of catch statistics, which include aquaculture, for the period 1950-1969.
A full set of the available statistics is provided in a database on the accompanying diskettes.

MEETINGS

Dr. Ziad Shehadeh of FIRI attended the ICLARM Research Planning Workshop for Africa and West Asia which was held in Cairo, Egypt, from 22-26 September 1995. The objectives of the Workshop were to obtain inputs and guidance from African aquatic resources experts on research targets for the two regions and to determine their relationships to the Central Laboratory for (Freshwater) Aquaculture Research (CLAR) at Abbasa. The Government of Egypt has offered ICLARM the use of the CLAR facilities.

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