

EDITORIAL

FAN

July 2005 - No. 33

FAO Aquaculture Newsletter



Feeding the future world: the role of aquaculture

The Earth is inhabited by nearly 6.5 billion people, more than half its population live in only six countries. Although population growth has slowed since the 1960s, the number of humans will increase between nine and 10 billion by 2050. The rise will be biggest in some Asian countries and Africa. This is a concern to many, particularly for people planning on how to feed the future world.

Fish is one of the most widely used low-cost protein sources in many parts of the world. However, it is clear that the availability of fish harvested from capture fisheries to support the growing demand for fish protein will be inadequate. Thus, the world will need to turn to producing fish, i.e. aquaculture. Asia, as the cradle of aquaculture, contributed almost 90 percent to the global production of 54.8 million tonnes (with a value of US\$ 67.3 billion) in 2003. During the ten-year period from 1993-2003, total aquaculture production showed an average annual increase of 9.4 percent. According to FAO statistics and research, it is assumed that we will require 80 million tonnes of fish from aquaculture by the year 2050, just to maintain the current level (not the global requirement of consumption). Although the above figures are highly simplified, in a nutshell, we will need to produce a lot of fish to feed the world over the next couple of decades. This is of course another concern to many governments, and especially a challenge for us at FAO's Fisheries Department to ensure that such endeavours to increase production will be sustainable.

The FAO Committee on Fisheries Sub-Committee on Aquaculture at its Second Session recognized the increasing contribution of aquaculture to people's livelihoods and to countries' economies worldwide. It also noted the significant challenges ahead to ensure that the further development of the sector is sustainable. The Sub-Committee on Aquaculture thus requested FAO to conduct a "Prospective Analysis of Future Aquaculture Development". The goal of this analysis is to serve as basis for a discussion of the longer term direction of the Sub-Committee's work towards sustainable aquaculture development worldwide.

A work of this magnitude is not a one-person's brain effort; it requires the contribution of many people. The FAO Fisheries department is now conducting the Prospective Analysis through a series of consultative national and regional reviews, involving regional expert meetings and communications worldwide. You or your organization may be asked to provide information, data, or insight into this Analysis. If you are approached we hope that you will contribute the best that you can.

The final Analysis is expected to be completed by May 2006. It will be presented to the Third Session of the Sub-Committee on Aquaculture to be held in New Delhi, India in September 2006.

Cover photos:
Small-scale hatcheries in Eastern Uganda
Photo Credit: John Moehl
(see article page 25)

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Tuna Farming

Alessandro Lovatelli¹ and Francesca Ottolenghi²

The Bali 2005 Conference (9-13 May 2005) organized by the World Aquaculture Society (WAS) included for the first time a full day session dedicated to tuna farming. The session was organized by Ms Francesca Ottolenghi, Conzorzio Mediterraneo (Italy), and Mr Alessandro Lovatelli, FAO Fisheries Department (Italy) and co-chaired with Mr Constantinos Mylonas of the Hellenic Center for Marine Research (Greece).

During this session, five main subject areas were covered, namely: (i) current status, (ii) farming; (iii) reproduction, (iv) environmental impact, and (v) marketing of tunas. Three to four invited experts from different parts of the world delivered, under each of the subject areas, interesting and high quality talks using dynamic and informative PowerPoint presentations.

The opening presentation provided an overview of tuna farming at the global level with particular focus on the situation in the Mediterranean Sea, Australia, Japan and northern America. The main driving force behind this growth has been and still is the high Japanese market demand albeit a number of important biological constraints. In the Mediterranean farming of the bluefin tuna (*Thunnus thynnus*) started almost a decade ago expanding from the western basin (Spain) to the east (e.g. Croatia, Cyprus, Italy and Turkey) and to the northern shores of the African Continent (Algeria, Tunisia) At present, tuna farming (all species included) occurs in all continents, in 18 countries and in 14 oceans and/or seas around the world. In the case of North America, the entire production comes just south of the U.S.A. border in Mexican waters. Mexican farming operations currently represent almost 10 percent of world production (35 000 tonnes).

A number of countries have channelled considerable research efforts in developing this relative new aquaculture industry, however, the successful and economical captive reproduction

of most tuna species has yet to be fully achieved. In the current farming practice, particularly for bluefin tuna, seed material ranging from small to large fish specimen is exclusively collected from the wild. This type of aquaculture has been defined by FAO as capture-based aquaculture (Ottolenghi *et al.* 2004).

Some technical considerations on general engineering aspects of the bluefin tuna farming were presented also in relation to the effects of the harvesting/slaughtering stress on meat quality of the reared fish. Among the other topics covered during the session was a major discussion on the use of baitfish species (pilchards, sardines, mackerel, herrings, squid, etc.) of different origin as feed. The absence of formulated feed is of concern to the industry particularly as poor food conversion ratio is obtained using baitfish. Scientific evidence in fact indicates that fish weaned on a formulated diet that replicates normal nutritional intake will perform considerably better than those fed on baitfish. Furthermore, the availability of an artificial feed would partly eliminate or facilitate farm logistics in sourcing, purchasing, transporting and storing the feed as well as eliminate the quality and health risks associated with the use of raw fish.

Another issue that was discussed at certain length was the environmental impact of tuna farms. In the case of bluefin tuna, the majority of the commercial operators have selected farm sites with an adequate water depth and circulation effectively allowing the dispersion of wastes generated by the farms. These conditions do minimise sediment build-up, prevent site eutrophication and the risk of contaminating the farmed products. These precautions, however, have not prevented environmental and other pressure groups to target tuna farming and other mariculture activities as the general perception is that this industry has an adverse impact on the environment. This type of pressure has constructively induced relevant institutions and other stakeholders to increase research on environmental impact and monitoring. Studies conducted in different Mediterranean tuna farms as well as in other countries have demonstrated that the impacts to the benthic communities and sediment chemistry are generally limited and transitory. In fact a few months are sufficient for environmental recovery of the farmed site. Furthermore, the general farm practice of most

Mediterranean tuna farms in confining the fish for a few months limits environmental impact in terms of space and time.

External pressures as the one described above as well as market requirements, particularly from Japan, are driving the tuna industry to continuously improve farming techniques and to adopt an integrated product safety and quality approach in the production process. All this has been paving the way in establishing good aquaculture practices

aimed at preventing or mitigating possible adverse impacts to the environment and safeguarding the consumers. The session ended focusing on market issues indicating that the future of the tuna farming industry will remain closely linked to the Japanese market at least for the moment.

GFCM/ICCAT Working Group on Bluefin Tuna Farming in the Mediterranean

The Ad Hoc GFCM/ICCAT Working Group (WG) on Sustainable Bluefin Tuna Farming/Fattening Practices in the Mediterranean was set-up following a 2002 decision by the General Fisheries Commission for the Mediterranean (GFCM) which, in view of the expansion of bluefin tuna farming in the Mediterranean, decided that practical guidelines to ensure the sustainability of this activity were required. At its first meeting (Rome, Italy, 12–14 May 2003) the WG produced a survey form that would enable to prepare a summary of the current situation of bluefin tuna farming in the Mediterranean, identify problem areas with respect to the issues to be addressed, and propose solutions. During the second meeting (Izmir, Turkey, 15–17 December 2003) the WG finalized a first snapshot on the current situation of bluefin tuna farming based on the information made available in the survey forms and progressed with the drafting of the guidelines. The summary snapshot consisted of three documents covering capture fisheries,



Farmed bluefin tuna (*Thunnus thynnus thynnus*) during harvesting

farming and marketing/trade of bluefin tuna in the Mediterranean. The WG held its third and final meeting in Rome, Italy, from 16 to 18 March 2005. The meeting was attended by 19 experts representing 10 Mediterranean countries, Japan and the European Commission and, representatives from the Secretariats of the GFCM and the International Commission for the Conservation of Atlantic Tunas (ICCAT). The WG completed its mandate and finalized and adopted the “Guidelines on Sustainable Bluefin Tuna Farming Practices in the Mediterranean”. Furthermore updated summaries on capture fisheries, farming and marketing/trade of bluefin tuna in the Mediterranean were also prepared by selected participants of the WG.

Copies of the “Report of the Third Meeting of the Ad Hoc GFCM/ICCAT Working Group on Sustainable Bluefin Tuna Farming/Fattening Practices in the Mediterranean. Rome, 16–18 March 2005. FAO Fisheries Report. No. 779. Rome, FAO. 2005. 108p.” can be obtained by contacting Alessandro Lovatelli (e-mail: Alessandro.Lovatelli@fao.org).

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Preparedness and Response to Aquatic Animal Health Emergencies:

A Regional Workshop held in Jakarta, Indonesia

21 - 23 September 2004

Rohana P. Subasinghe¹
and Melba B. Reantaso²

Background

The epidemic spread of aquatic animal diseases is an increasing event in Asia. We have witnessed devastating impacts of Epizootic Ulcerative Syndrome (EUS) in freshwater fish during the 1980s and the 1990s; Viral Nervous Necrosis (VNN) in marine fish since 1990s; White Spot Syndrome Virus (WSSV) in penaeid shrimps from early 1990s to-date; and the emerging Taura Syndrome Virus (TSV) in *Penaeus vannamei*. There are still a number of unresolved diseases such as akoya pearl oyster mortalities in Japan and abalone mortalities in China. Indonesia is currently faced with a serious epizootic, possibly Koi Herpes Virus (KHV), causing large-scale mortalities with significant economic losses, among cultured common and koi carp (*Cyprinus carpio*) populations, beginning early 2002 until present. More recently, during last quarter of 2003, an outbreak of KHV also occurred in common carp and koi carp in Japan. Many countries in the Asia-Pacific have, thus, to various degrees suffered the consequences of disease outbreaks.

The above examples of disease outbreaks demonstrate the vulnerability of aquaculture and wild resource production to wide scale infectious disease emergencies and the significant impacts which new diseases can have on local economies. Unless appropriate health management and biosecurity measures are continuously put in place and effectively implemented, the risks of major disease incursions and newly emerging diseases will continue to threaten the sector. Hopefully, past experiences in dealing with disease epizootics will provide useful lessons towards better preparedness for, and improved responses to similar events when they occur in the future.

In the case of KHV, affected species are widely traded within and between countries in the region and outside, and therefore pose a considerable risk of a trans-boundary epizootic. Common and koi carps are important commodities, as foodfish and a high-value ornamental fish, respectively. Many rural communities depend on these species to support their livelihoods both in Indonesia and in several neighboring countries. Effective prevention and control measures complemented by extension, educational programmes and capacity building for farmers/producers are essential to reduce the risk. A strong national approach along with a well planned regional strategy are required to ensure the operational capability is in place to effectively respond to disease emergencies. Equally important is a clear understanding by both governments and their industries of the benefits from investing and participating in emergency response systems.

It is clear from our knowledge and experience that the capacity for early detection and effective response to disease emergencies is inadequate in many countries in Asia due to several factors such as, limited diagnostic capacities, lack of information, insufficient human resources and infrastructure, and lack of financial resources. Limited understanding of the gravity of the problem often results in failure to provide priority action at national and regional levels. This urgently needs rectifying to avoid further introduction of exotic pathogens and spread of emerging diseases. KHV is a prime example, requiring immediate attention from relevant international research and development agencies, as well as the private sector. Concerted action is essential for controlling this serious epizootic and to regain both consumer and producer confidence.

In order to review and evaluate the national and regional status on emergency preparedness and response to infectious diseases in aquatic animals, and to find avenues for providing guidance and assistance for national and regional improvements, FAO in partnership with the Government of Indonesia, the Network of Aquaculture Centres in Asia-Pacific (NACA) and the WorldFish Centre (WFC) organized a workshop entitled "Emergency Preparedness and Response to Aquatic Animal Diseases in Asia". The Workshop reviewed the regional experiences in responding to disease emergencies, including the work accomplished through an FAO Technical Cooperation Programme project in Indonesia aimed at providing technical assistance to improve national capacity to respond to the ongoing carp disease epizootic. The Workshop was intended to assist Indonesia and countries of the Asian region in:

- (i) identifying actions to reduce the impacts of KHV on aquaculture and small-scale fisheries; and
- (ii) strengthening preparedness and response to serious aquatic animal disease emergencies.

Workshop Report

Fifty two participants including 33 international persons participated in the workshop which was inaugurated by the Hon. Minister of Fisheries of Indonesia (Fig. 1, see page 8). The workshop included presentations on various experiences in dealing with disease epizootics. The report of the workshop, including the manuscripts of the presentations made, discussions and recommendations are currently being compiled. This document will be published this year in form of an FAO Fisheries Technical Paper including a Manual on Preparedness and Response to Aquatic Disease Emergencies in Asia.

The workshop unanimously agreed that the areas of emergency preparedness and response are new challenges for the region and the initiative should be continued with possible assistance from FAO and other interested agencies. It was also agreed that the possibility of joint assistance programme by the FAO Fisheries (FI) and Agriculture (AG) Departments should be explored.

This activity was the first joint FI/AG activity on aquatic animal health and both FI and AG/AH are pleased with the positive collaboration and outcome of the workshop. Considering the importance and significance of trans-boundary

diseases to aquatic animals and animal production and the increasing significance and the value of the sector, it is considered important for FI and AG/AH to collaborate closely in sharing their experiences and mutually benefiting their activities worldwide. Efforts will be made to explore the possibility of working with EMPRESS programme in controlling disease emergencies in aquatic animals and aquaculture.

During the workshop, discussions were held with the Hon. Minister of Marine Affairs and Fisheries, Senior Fisheries officials and several representatives from the agencies participated/collaborated in the workshop on possible follow-up work and assistance to Indonesia. The Norwegian participant from the National Veterinary Institute of Norway is now establishing a formal bilateral collaboration with Indonesia on aquatic animal health.

The Indonesian Authorities made a specific request to FAO for assistance towards establishing an appropriate legal framework for aquatic animal health management and compliance to associated international agreements and treaties including trade.

Some of the key points discussed and agreed are given below:

- While national agencies have the primary responsibility for responding to disease emergencies, regional cooperation can provide essential support. There is already collaboration in aquatic animal disease control in Asia that has helped in responding to emergency aquatic animal disease outbreaks. These existing structures should be used to further strengthen cooperation to support national efforts to control serious aquatic animal disease outbreaks.
- There is a reporting system for aquatic animal diseases in Asia, organized by NACA/OIE/FAO. This reporting system, and the communication networks that support it at national and regional levels, should be further strengthened.
- Reporting of aquatic animal diseases involves fisheries and veterinary authorities. Veterinary authorities have responsibility for official communication to OIE on livestock and aquatic animal diseases that are important for international trade. As most veterinary authorities in Asia have limited experience on aquatic animal diseases, communication between fishery and veterinary authorities should be strengthened.

- Collaboration between countries on prevention of spread of aquatic animal diseases, particularly when sharing common borders and watersheds such as the Mekong basin, is also recommended for emergencies.
- Resource centres with specialist diagnostic skills are required to provide technical support for assisting countries deal with specialist aquatic animal disease problems. The further development of the resources centres and expert network of NACA is recommended to support harmonization among countries in diagnostics and upgrading skills.
- Collaboration and communication among countries should be promoted to influence international standard setting and notification of disease. It is important for the region to be more active in getting information on aquatic animal diseases in the region into the OIE standards.
- Collaborative research should be encouraged to understand and respond to significant and emerging diseases in the region. Involve the private sector since they are also part of the network.
- The region needs resources to draw on during emergencies. Core funding should be allocated to NACA to provide readily available resources to respond rapidly to emergencies. Donor should be approached for support.
- Joint activities between countries for testing of emergency response and regular meetings between countries and exchange of expertise should be encouraged. Regional training on emergency preparedness is recommended as well as the further development and designation of regional centres and resources to provide technical support to address emerging disease problems.

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Figure 1. Fifty-two participants composed of 22 local Indonesian and 33 international participants (experts from Australia, Canada, Japan, Indonesia, Malaysia, Norway, Philippines, Thailand), government officials (from Bangladesh, Cambodia, Lao PDR, Philippines, Sri Lanka, Thailand and Vietnam), as well as representatives of other organizations such as the Network of Aquaculture Centres in Asia-Pacific (NACA), Office International des Epizooties (OIE), and the Southeast Asian Fisheries and Development Center (SEAFDEC). Five FAO staff participated (R.P. Subasinghe, J. Lubroth, A. Vanhoutte of FAO Headquarters, T. Kimura of FAO Indonesia and S. Funge-Smith of FAORAP).



Arun Padiyar, NACA

China/FAO/ NACA Workshop on healthy, safe and environmentally sound shrimp farming

*November 15-16 2005
Beijing, P.R. China*

Rohana P. Subasinghe

This workshop, jointly organised by the Ministry of Agriculture, China, the Food and Agriculture Organization of the United Nations (FAO), Rome and the Network of Aquaculture Centers in the Asia-Pacific (NACA), Bangkok, was an attempt by the Shrimp Farming and the Environment Consortium (<http://www.enaca.org/shrimp>), in partnership with the Chinese Fisheries Society, to continue work towards the implementation of "better management practices (BMPs)" globally in shrimp farming. The overall theme of the workshop is "healthy, safe and environmentally sound shrimp farming". The main objectives were:

- to share experiences in the management of shrimp aquaculture, with special reference to quality, food safety, and environmental factors;
- to review global principles for shrimp aquaculture and their application in China; and
- to identify follow up collaboration between China and other countries in the Asia-Pacific region that support healthy, safe and environmentally sound shrimp farming.

Mr Liu Zheng, Deputy Director of China's Fishery Administration, during the opening day, stated that China will actively promote the healthy, safe and environmentally-friendly shrimp farming methods to ensure the sustainable development of the sector. He said that shrimp has been a major aquaculture species for more than 20 years and played an important role in China's aquatic export. Statistics from the ministry shows that from 1996, the country's shrimp culture has experienced a recovery after 1993's outbreak of shrimp disease. In 2003, the country produced 780 000 tonnes of farm reared shrimp and exported about 120 000 tonnes of shrimp. Meanwhile, there has

been no report of trade dispute related to quality or safety problems so far this year in shrimp export. The European Commission also lifted the export ban on aquatic products from China in October 18 of this year. He admitted that there are still some problems still lagging the sector, citing the unbalanced development between different areas, frequent occurrence of some diseases in some aquaculture farms, and low quality of shrimp post larvae. He noted that the country is now taking measures to strengthen quality control and technical training to ensure a healthy development of shrimp sector.

In this workshop, shrimp aquaculture and food safety experts from FAO, NACA, INFOFISH, China, Thailand, Viet Nam, India and Ecuador shared their experiences on management practices for addressing food safety, quality and environmental issues affecting the shrimp sector.

An important recommendation from the meeting was the request for FAO and NACA to work further on the development of an internationally accepted set of principles for "healthy, safe and environmentally sound" shrimp farming". China will take an active and leading role in the development of the principles, and to actively promote regional and international cooperation on the development of responsible shrimp farming.

The workshop, attended by over 25 experts including international experts from Viet Nam, Ecuador, Thailand, Philippines and Malaysia. It was held with simultaneous interpretation and was conducted in both Chinese and English. Preparatory work by the China Fisheries Society is commendable. Following outcomes were observed:

- Preliminary discussions relating to best management principles and the need for better national strategies in addressing methods of production and management of quality and environmental impact were encouraging.
- Importantly, this was a first step towards the consensus process of establishing some global principals as to what constitutes best management practice.
- The wide diversity of aquaculture systems and context prevents the establishment of "global standards", but there is plenty of scope for agreement on what is acceptable and unacceptable management practice and methods. FAO is well placed to broker this dialogue between stakeholders.

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FAO Expert Workshop for the Preparation of Technical Guidelines on Health Management for Responsible Movement of Live Aquatic Organisms Colombo, Sri Lanka, 1st to 4th November 2005

The objective of this consultation will be to produce technical guidelines that will assist all countries that are in the process of developing, planning to develop, or revising current aquatic animal health programs, to meet basic international standards for protecting vulnerable aquatic resources and competitive access to national and international seafood markets. The technical guidelines will also assist governments in preparing national aquatic animal health management plans and strategies for protecting their aquatic resources from disease incursions, thus making national aquaculture and harvest fisheries programmes sustainable. These international guidelines will take into account the international trade standards set by the World Trade Organisation under the Agreement on Application of Sanitary and Phytosanitary Measures (SPS Agreement) and scientific standards set by the World Organisation for Animal Health (OIE – formerly Office International des Épizooties).

The participants will include a limited number of specialists, selected on the basis of their technical competence, experience and knowledge of aquatic animal health management and certification. One or two representatives with terrestrial animal disease control expertise will be included to provide an avenue for exchange of experience between the two animal production sectors (continued on page 24).

Promotion of small-scale aquaculture and poultry farming for food security in Haiti: TCP/HAI/2903

Valerio Crespi¹
and Emmanuelle GuerneBleich²

INTRODUCTION

This article presents a Technical Cooperation Programme (TCP) project associated with the FAO Special Programme for Food Security (SPFS) in Haiti. The project entitled "Diversification Component of the SPFS in Haiti" (TCP/HAI/2903) started in September 2002 and ended in October 2004. This integrated project focussed on improving the contribution of poultry and fish production to household food security. Two FAO technical units were involved directly in this project; the Animal Production Service (AGAP) for the poultry component and the Inland Water Resources and Aquaculture Service (FIRI) for the fish farming component.

The Republic of Haiti, with over half of its population of 8.1 million below the poverty line, is the poorest country in Latin America and the Caribbean. The economy of Haiti, dominated by the agricultural sector, contributes around 32 percent to the GNP, and occupies up to 60 percent of the national labour opportunities. Agriculture is mostly based on traditional, smallholder and production systems, often with considerable involvement of women. The food supply/caput/day of protein at the moment is around 40 gms, 20 grams less than the recommended FAO target of 60 grams.

OBJECTIVES

The overall objective of the project was to increase income and food security and to improve access to a variety of local diets. Integrated poultry and aquaculture production systems were promoted to increase local food production that is sustainable and economic.

Employment opportunities, especially for women and the youth, were generated as well. The poultry and fish culture activities took place in the areas of Dubreuil, Torbeck, Massey (Southern Department) Laverdure, Pérodin (Artibonite Department). The ultimate beneficiaries of the project were the poor and food insecure rural communities, including female-headed households.

PROJECT APPROACH

A participatory rural appraisal was undertaken at the beginning of the project in order to facilitate the exchange of information and opinion among stakeholders and targeted beneficiaries. In particular, it allowed the synthesis of information about resource supply, production systems and exchanges as proposed in the project strategies. The main conclusions of the appraisal were:

- that marketing opportunities existed given the high demand for poultry meat and eggs in the urban centres as well as fish products; domestic production was not sufficient to meet this demand;
- poor farmers lacked the resources to obtain high quality chicken and fish fingerlings or suitable feeds in sufficient quantities;
- insufficient knowledge and technical skills of poor farmers on poultry and fish production;
- inappropriate housing, absence of feed supplements and weak poultry health management resulted to high poultry mortalities; losses were mostly reported on young chickens (0-8 weeks of age) and often were attributable to Newcastle Disease (ND).

The first phase of the project identified: (a) the most favourable sites for the construction of ponds and chicken houses; and (b) farmer beneficiaries based on the following criteria: general interest, motivation and previous experiences. For both components, farmers, technicians and extension staff were trained. For the aquaculture component, training topics included pond construction, pond fertilization, fingerlings stocking, feed supply, fish harvesting and processing. For the poultry component, training subjects included animal husbandry, feeding livestock management and animal health with a focus on Newcastle disease control. Existing training materials available in and outside the country were modified, translated into Creole and distributed to farmers.

RESULTS

Aquaculture Component

About 50 rural farmers were selected and a total of 63 earthen ponds were constructed and/or renewed in the four selected sites (21 ponds in Welch, 26 ponds in Dubreuil, 4 ponds in Massey and 12 ponds in Laverdure, see Fig. 1). Ponds had an average surface of 150 m² and were fed by the existing local hydraulic system.



Jean Parnell Dimanche

Fish farmer from Laverdure, Artibonite Department with harvested common carp (about 800 grams)

The project carried out several campaigns of fish stocking. A total of 21 000 (3 to 5 grams) fingerlings were freely distributed in the sites during the first production cycle. Forty five fish ponds were stocked using a density of 2-4 fingerlings/m². The main cultured species were Nile tilapia (*Oreochromis niloticus*), common carp (*Cyprinus carpio*), grass carp (*Ctenopharyngodon idellus*) and silver carp (*Hypophthalmichthys molitrix*).

Four food production units were installed in each site consisting of small feed mills utilizing agriculture by-products (e.g. rice bran, corn, millet, etc.), in lieu of expensive commercial feed. Fish reared in polyculture utilize different food niches in an aquatic system thereby harnessing maximum possible amounts of nutrients and energy in the form of fish. One production cycle lasted from 6 to 8 months using chicken manure as main source of fertilizer and agriculture by-products as supplementary feed. At the end of one production cycle, fish reached a marketable size ranging from 350-800 grams, an indication of favourable environmental conditions for good growth. A study on the profitability of fish farming carried out showed that the main costs for the farmers were those related to labour for pond construction, purchase of fingerlings and feed expenditures. Average yearly production estimated for ponds of 150 m² was 70–80 kg, a good indication of the profitability of such aquaculture venture and especially if coupled with good management. The rate of investment of this fish farming units is from 64.1 to 103.7 percent, where fixed costs for the construction of a pond of 150 m² can be recovered after two production cycles.

Poultry Component

Five sites were selected for the poultry activities and a total of 608 poultry houses were built with the following breakdown: Massey (19), Welch (80), Dubreuil (102), Laverdure (30) and



Valerio Crespi, FAO

Poultry vaccination operation against Newcastle disease (Dubreuil, Southern Department)

Pérodin (305) (see Fig. 1). These poultry houses protected chicken from diseases and predators and reduced the heavy losses encountered during young age. Two pilot vaccination campaigns, under the overall management of the producers association, were carried out by training village vaccinators. A total of 25 000 chickens were vaccinated during these two operations, which covered not only all the project sites but also extended to all the poultry owned by the beneficiaries. Mortality rate was reduced from 65 percent to 51.35 percent. A total of 22 770 eggs and 12 168 chicks were produced during the time frame of the project. Only in some cases where adult hens were sold as producers prefer to keep them to increase their production. The first phase of the project has proved the general motivation of the producers to follow simple improved husbandry technologies. The project carried out simple interventions including improvement in housing, animal health and supplementation especially of the chicks and these has lead to a positive response from the beneficiaries.

INTEGRATED CHICKEN-FISH FARMING

The integrated units created during the project represented 43 percent of the fish farming activities and 5.4 percent of the poultry activities. There are numerous advantages in having the two activities integrated in the production units, these are: (a) integration reduces costs on fertilizers and feeds in fish culture and maximizes benefits; (b) chickens can be raised over or adjacent to the ponds and the poultry excreta recycled to fertilize the fish ponds; and (c) raising chicken close to the pond maximizes the use of space, saves labour in transporting manure to the ponds and makes the poultry house more hygienic.

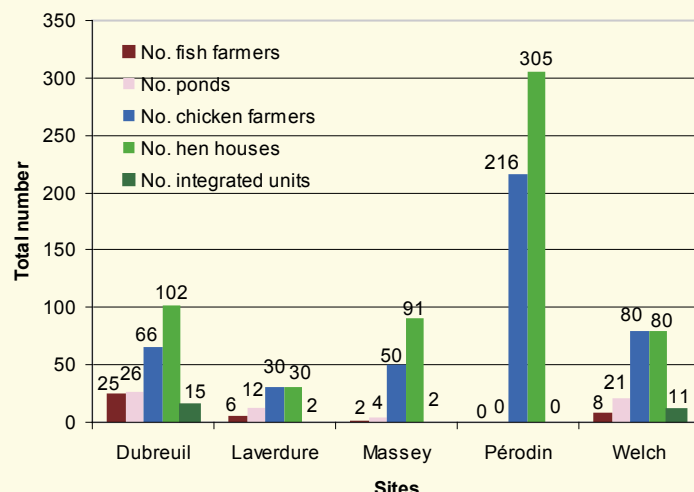
Water coming from fish ponds allowed the watering of the agriculture fields. Dead fish and fish side products were used to feed the chicken. The mills, provided by the project to crush agriculture by-products to produce feed for fish, were also used for poultry.



Jean Parnell Dimanche

An example of integrated production unit. A chicken house built close to the fish pond (Dubreuil, Southern Department)

Figure 1. Distribution of the chicken/fish farmers by site



A database was developed to store all the production data collected at site level for both components. The database allows basic data analysis for management purposes.

CONCLUSIONS

Social and political tensions during 2004 strongly affected the results of this project. The crisis and the flood disaster during the same year resulted to increased vulnerability of the beneficiaries. Erosion of social, economic, infrastructural and environmental assets increased violence and insecurity in urban areas. Despite these circumstances, the project, nevertheless, generated enthusiasm amongst the beneficiaries who applied new technologies of both components and achieved positive results.

The aquaculture and the poultry activities associated with the SPFS in Haiti have demonstrated that real benefits can be derived from affordable and practical interventions. The project provided the inputs for subsequent groups of beneficiaries to participate in the project. Access to major agriculture inputs through local management of the producers association and technical training also contributed to the success. The creation of income generation for women and young people in the selected villages was also a major achievement of the project.

This project has been positively received by donors. A follow-up proposal was formulated and the Organization of the Petroleum Exporting Countries (OPEC) has accepted to fund the project Phase II, as an extension using the model developed by this project.

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Valerio Crespi, FAO

A typical Haitian rural household (Massey, Southern Department)



Valerio Crespi, FAO

Farmers constructing a fish pond under the supervision of the project national consultant (Laverdure Artibonite Department)

Acknowledgments

The authors wish to thank the staff of the FAO Representation in Haiti, particularly Mr Amadou Moustapha Kamara and Mr Volny Paultre for their valuable assistance and support during the project.

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FAO assists rehabilitation of Tsunami devastated aquaculture sector in North Sumatra, Indonesia

Rohana Subasinghe¹ and Michael J. Phillips²

As part of its efforts to help Indian Ocean countries recover from the devastating effects of last December's Tsunami, the FAO held a three-day workshop in July 2005, in collaboration with the Network of Aquaculture Centres in Asia-Pacific (NACA), Directorate General of Aquaculture (DGA) and Provincial Government of the Ministry of Marine Affairs and Fisheries (MMAF). The workshop brought state, private, donor, NGO, and other partners involved in aquaculture rehabilitation in Aceh Province together to discuss and develop a strategy for sustainable aquaculture rehabilitation in the province.

AQUACULTURE IN ACEH

The aquaculture sub-sector in Aceh is socially, economically and environmentally important, and a significant part of the livelihoods of many coastal people. The main aquaculture system is brackishwater pond farming (locally known as tambaks) covering around 47 000 ha producing mainly milkfish and shrimp. According to official statistics, in 2003, around 6 100 tonnes of milkfish were produced, destined for local domestic food and bait for tuna long lining; and an estimated 10 300 tonnes of shrimp were harvested from tambaks, destined for export markets (via traders to Medan). A range of minor species were also produced in tambaks, including mullets, crabs, seabass. There were also a small number of fish cages in Simueleu Island producing high value groupers for export. The aquaculture production in Aceh was supported by inputs of fish and shrimp seed from local shrimp hatcheries and nursing of milkfish, and with feed, fertilizer and other inputs through local trading networks.

The tambak farming in Aceh province is dominated by traditional, low input farms producing shrimp and milkfish in polyculture and monoculture. Semi-intensive and intensive shrimp farms are also present, but make up a small proportion of the total area. Intensive and semi-intensive shrimp farming also increases towards Medan, and recently on the west

coast. Most traditional farmers are small-scale farmers (<2 ha). Land/farm ownership and employment patterns vary, and include owner-operated, rented, contract farming labour, as well as some community managed ponds. The varied ownership patterns and beneficiaries make post-tsunami recovery interventions potentially complex.

The number of people involved in aquaculture in Aceh is highly significant. According to Dinas Perikanan statistics, there are 14 859 brackishwater farming households. However, it appears that these figures (essentially only farm owners or operators) significantly underestimate the number of people involved, that includes labourers, suppliers of inputs, marketing, services. Each hectare of pond supports between 1 and 2 people/ha, including labour. For 47 000 ha of ponds, there are therefore likely to be up to 94 000 people involved.

IMPACT OF THE TSUNAMI AND EARTHQUAKE

The Tsunami of 26th December 2004 severely affected aquaculture in Aceh province, and the island of Nias off the west coast of the province of North Sumatra. The impacts include the following:

Aquaculture facilities. FAO assessments suggest that at least 20 000 ha of tambaks have been effectively put out of production by the Tsunami, with over 13 000 ha of ponds severely damaged or lost, a major loss of a significant source of income and employment for the province.

Households. FAO assessments suggest that at least 40 000 people directly employed in aquaculture in Aceh have been affected, with significant knock-on effects to households dependant on aquaculture. Loss of life was most severe on the west coast, but the Tsunami has destroyed a source of livelihood for many thousands of people living on the east coast where tambak farming was well established.



Public services. Public services, including the Dinas Perikanan (Fisheries Department) at District and Provincial levels, the Ujung Batee Regional Aquaculture Development Centre and Universities in Aceh lost staff and facilities during the Tsunami, severely affecting their capacity to support rehabilitation.

Private services. Private sector organizations, including the tambak farmer associations, also lost members during the Tsunami. Input suppliers, including shrimp/fish collectors, feed business and traders were also directly and indirectly affected. The business of aquaculture has effectively stopped in the major farming areas of the east coast, and disappeared from the severely impacted west coast. Interventions are therefore required for the rehabilitation of livelihoods of people dependant on aquaculture in the short, medium and long-term.

REHABILITATION EFFORTS AND NEEDS

Over the past several months, since the Tsunami tragedy, some immediate emergency assistance have been received for fisheries sector rehabilitation, in particular provision of crafts, parts, gear, and other materials necessary for re-establishing fishing activities by the affected communities. However, little assistance for re-establishing productive activities in the aquaculture sector has so far been provided to the communities and the state authorities. This shortfall needs urgent rectification.

It appears that one of the reasons for little rehabilitation work in aquaculture sector is the lack of an over-all strategy for sustainable aquaculture rehabilitation, which includes major areas such as environmental sustainability, social equity, and food

safety. No one organization or donor can support the considerable and diverse needs for rehabilitation of aquaculture in Aceh. Several organizations and donor/development agencies are now getting engaged in providing assistance to the communities and the state authorities. These agencies all have important and complementary skills and resources to offer. FAO and NACA thus advocate the adoption of a "partnership" approach, with partnership between government and major supporting donors and technical agencies to promote collaboration and communication in supporting the rehabilitation of aquaculture.

As aquaculture rehabilitation has already begun and various relief groups are working towards sector rehabilitation, it is imperative that the necessary guidelines, principles and norms for rehabilitation are set and agreed, as soon as possible to ensure rehabilitation and rebuilding of the aquaculture sector is environmentally sustainable, socially equitable and economically viable.

The workshop agreed on an implementation plan for sustainable rehabilitation of the aquaculture sector, including a set of environmental principles guiding the process rehabilitation of brackishwater aquaculture ponds in Aceh (see page 37).

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Farmers reconstructing aquaculture ponds under the cash for work programme

Excerpts on Aquaculture and Inland Fisheries during the Fifth Session of the Advisory Committee on Fisheries Research (ACFR)

12-15 October 2004
FAO Headquarters, Rome

The Fifth Session of the Advisory Committee on Fisheries Research (ACFR) was held in Rome, Italy, from 12 to 15 October 2004. The Fifth Session was organized by Mr Ben Satia, Secretary of ACFR and attended by nine members of the Committee, members of the Secretariat and other officials of the Fisheries Department. The ACFR is the statutory body of FAO to advise the Director-General on research and research-related matters for fisheries and aquaculture. The agenda of the Fifth Session of ACFR include small-scale fisheries and human capacity development and a review of the FAO work programme, with a focus on inland fisheries and aquaculture and on fish utilization and trade. In the past, ACFR issues had been dominated by capture fisheries and marine fisheries issues.

A brief document, "Aquaculture – How can species choice and domestication drive sustainable aquaculture development?" was prepared as an information paper for consideration of the Fifth Session of ACFR. Relevant decisions and recommendations made by the Committee with respect to aquaculture and inland fisheries are provided below.

On Aquaculture, the Committee recommended that the Fisheries Department examine issues related to species choice in aquaculture, i.e. domestication processes, genetic improvement, and genetic conservation.

The Committee also recommended that FAO produce an authoritative and balanced review of the aquaculture sector, including commercial aquaculture, and the role of aquaculture in poverty reduction. The Committee stated that FAO needs to monitor and, in some circumstances, be involved in research that will address environmental and social impacts of aquaculture.

On Inland Fisheries, the Committee suggested that the Fisheries Department and regional fishery bodies dealing with inland fisheries should request better information from members on inland fisheries; that FAO should assist Members put in place appropriate data collection systems, especially in regards to lake and reservoir habitats.

FUTURE WORK

The Committee identified the necessity to increase its focus on aquaculture related activities; and elaborated the terms of reference on the topic of "Aquaculture: How can species choice and domestication drive sustainable aquaculture development?".

The Secretary of ACFR, Mr Ben Satia, has recently retired (see FAN 32) and Mr Ndiaga Gueye, (see next page) will become the new Secretary. Best wishes to them both.

Mr NDIAGA GUEYE

Mr Ndiaga Gueye has been appointed as Chief, International Institutions and Liaison Service, Fishery Policy and Planning Division (FIPL), effective 13 December 2005. A Senegalese national, Mr Gueye holds a Doctorate degree in Veterinary Science from the University of Dakar in December 1983. This academic degree was completed with several professional training in fisheries in Europe, Asia and North America. After four years in the Army, he was transferred, in 1987, to the Ministry of Fisheries and held the following posts: (a) Head of the Fish Inspection and Quality Control Service (1987-1988); (b) Deputy-Director of Fisheries (1989-1993); and (c) Director of Fisheries (1994-2004). As Director of Fisheries of Senegal for 10 years, he acquired good experience in the

negotiation and the follow-up of bilateral and international agreements as well as a good knowledge of the sub-regional and regional fishery bodies. Mr Ndiaga Gueye succeeds Mr Benedict P. Satia who retired in November 2004. In his capacity of Chief of FIPL, he is also Secretary of



the FAO Committee on Fisheries (COFI) as well as of the Advisory Committee on Fisheries Research (ACFR). Mr Gueye may be reached via e-mail at Ndiaga.Gueye@fao.org

Ms DORIS SOTO

On 15 May 2005, Ms Doris Soto joined the FIRI service as Senior Fishery Resources Officer (Resource Management). Ms Soto graduated from the "Universidad de Chile", Santiago, in Biology-Limnology in 1979, and in 1988 from the University of California, Davis, San Diego State, where she obtained her Ph. D. in Ecology under the Joint Doctoral Program between San Diego State University and University of California-Davis.

From 1990 until joining FAO, Ms. Soto has served as Professor of the Fisheries and Oceanography Faculty at the Austral University in Puerto Montt, the lake and fjord region in Southern Chile, where she has been teaching undergraduate courses in General Biology, Limnology and Environmental Management for Aquaculture. Ms Soto's research work focused on salmon farming environmental management and nutrient cycling in farms both in freshwater and marine environments; and

extensive research to evaluate the effect of escaped salmon and trout on aquatic ecosystems. Her research has contributed to scientific knowledge and also to decision making through the aquaculture environmental regulation program set up by the Chilean government and also through active interaction with the private sector. She has been an adjunct scientist at the Institute of Ecosystem Studies in Millbrook, New York since 1999. Since 2002 she was senior scientist in a Chilean Millennium project to evaluate the forest ecosystemic services to aquatic systems" (FORECOS) where she has been evaluating forest services to aquaculture and sports fishing. She has published numerous scientific papers and reports, guided graduate and undergraduate students, and also provided scientific technical advise to the Chilean Ministry of Fisheries, the Chilean Environmental Protection Agency, the Chilean Forest Service, as well as various fishermen associations.

In FIRI, Ms Soto will be working on aquatic environment and resources management issues related to inland fisheries and aquaculture.

Ms Soto is located in Room F-523, Ext.56149, e-mail: Doris.Soto@fao.org



Participants to the Technical Session of the Conference on Fisheries Management and Development, Tbilisi, Georgia, 15-16 June 2005

Towards sustainable aquaculture development in Georgia

Raymon Van Anrooy¹

Georgia, a former member of Soviet Republic, became an independent state in 1991. The country is bordering the Black Sea on the east side. Georgia is rich in hydrobiological resources. The Black Sea and the numerous rivers, reservoirs and lakes make the country suitable for marine and inland capture fisheries and aquaculture activities.

THE CURRENT SITUATION

While aquaculture in Georgia was well established in the 1950s, the number of aquaculture farms and hatcheries for restocking of inland waterbodies has gradually declined.

The official register of the Department of Fisheries (DoF) contains 84 inland water bodies (ponds, lakes and reservoirs) that are used for fisheries purposes. It is estimated that there are some 50 unregistered small waterbodies that are used for fisheries in addition to these official figures. In early 2004, it was found that there are at least 81 farms involved in fish pond production. In addition, at least six hatcheries are reproducing a range of species, including *Cyprinus carpio* (common carp), *Hypophthalmichthys molitrix* (silver carp), *Ctenopharyngodon idella* (grass carp), *Oncorhynchus mykiss* (rainbow trout), *Varicorhinus capoeta* (barb), *Carassius carassius* (crucian carp) and *Silurus glanis* (catfish).

The area of ponds, lakes and reservoirs currently being restocked with fingerlings is

approximately 3 200 ha and total aquaculture production may reach up to 1 000 tonnes of fish annually (among which are about 600 tonnes of common carp and 250 tonnes of grass carp). The total production of the 35 trout farms is small and estimated, in recent years, to be in the order of 120 tonnes of fish annually.

Most of the fingerlings (particularly those of common and grass carp) used by aquaculturists are produced in Georgia. Some aquaculturists produce their own fingerlings, while others have to buy fingerlings from nearby hatcheries. Unfortunately, a number of inland waterbodies (including ponds) cannot be restocked periodically because the owners or operators cannot afford to purchase fingerlings.

Approximately 70 percent of the eggs, fry and fingerlings for trout farms are produced in the country while the remainder is imported. Fingerlings of carp, trout and other species produced domestically are generally considered to be of poor quality. The absence of research programmes for genetic improvement, fish health management and fish feeding is considered to be one of the main reasons.

The lack of good-quality feed for trout culture in Georgia is another main constraint to the development of the sub-sector. Fishmeal for the production of fish feed is generally imported from Turkey and/or Denmark, which makes it very expensive (about US\$1.20 per kg). Aquaculturists sometimes also import commercial fish feed of well-known brands at



Akhaltsikhe trout Farm

high prices. Georgia's capture fisheries fleet catches considerable volumes of anchovy and other marine species, some of which could be used for the preparation of fishmeal and aquaculture feeds, but at present the anchovy caught is largely exported for hard currency. This practice prevents Georgian aquaculturists from taking advantage of the raw material produced within the country for the preparation of the required quantities of fish feed.

Pond culture of common and grass carp benefits from fertilization with both organic and non-organic fertilizers. Unfortunately, at present, the majority of aquaculturists cannot afford to invest in fertilizers because they do not have enough working capital or access to formal credit sources.

Aquaculture is considered to have good prospects for future development in Georgia. In the short term, the production of carp in ponds, lakes and reservoirs is being encouraged to support the domestic market demand, which is far from being satisfied. Demand for low-priced fish in rural areas and small towns is particularly high. Doubling the annual aquaculture production of carp to almost 2 000 tonnes seems a possibility with only slight improvements in access to and availability of fertilizers, fish feed and fingerlings. In the longer term, the establishment of an aquaculture extension and monitoring system, improvements in the supply of high-quality fingerlings and access to credit would make it possible for an annual production of around 5 000 tonnes of fish to be achieved.

The demand for trout at the domestic market seems to be showing a positive trend. As

current trout culture is constrained largely by limited access to and availability of domestically produced fish feed and fingerlings, it would be possible to increase domestic production of this species in a relatively short period provided that these two constraints are lifted.

FAO ASSISTANCE TO CAPTURE FISHERIES AND AQUACULTURE DEVELOPMENT IN GEORGIA

In 2003, the Government of Georgia requested FAO to provide technical assistance for the sustainable development and management of the fisheries sector. FAO approved the project TCP/GEO/2904 (A) entitled "Strengthening the capacity of the Department of Fisheries to support fisheries sector rehabilitation". Between August 2004 and July 2005, this project assisted the Department of Fisheries (DoF) of Georgia's Ministry of Agriculture with the following outputs, namely:

1. Review of the Currents Status of Fisheries Resources and Utilization in Georgia,
2. Master Plan for fishery sector development in Georgia (2005-2020),
3. Action Plan for fishery sector management and development in Georgia (2005-2008),
4. A final draft version of the Law of Georgia for Fisheries and Aquaculture,
5. A pilot Fishery Statistics System, and
6. Training of DoF staff through international study-tours, workshops and in-country training courses.

The policy and legal framework development process involved three large participatory workshops attended by all major fishery sector stakeholders, many consultations with sectoral and non-sectoral stakeholders, international expert advice and discussions with potential donor agencies. The Review, Master Plan and Action Plan have been agreed upon by the Ministry of Agriculture and are currently shepherded through the further governmental approval process by the Director of Fisheries, David Iakobidze. The final draft version of the Law is still under discussion between the various ministries involved in aquatic resources management. All documents are available in Georgian and English languages from the Ministry of Agriculture and they will be published in English as FAO Fisheries Circular No. 1007 before the end of 2005. The title of the Circular will be "Fisheries and aquaculture in Georgia: current status and planning".

THE MASTER PLAN AND THE AQUACULTURE SECTOR

The Master Plan for fishery sector development in Georgia (2005-2020) states the following long term objective for the aquaculture sector: to develop an aquaculture sector that produces the variety and quantity of good-quality products demanded by the market in an environmentally sustainable and socially and economically viable manner.

Specific objectives for aquaculture development in the country are:

1. Develop an aquaculture sector that produces fish that domestic consumers and the export market demand.
2. Produce at least 2 000 tonnes annually in the aquaculture sector by technology enhancement, increased access to: (a) good-quality and reasonably priced feeds and fingerlings; and (b) credit, microfinance and insurance.
3. Increase diversity in the aquaculture sector, using a variety of species (trout, carp, oysters, mussels, mullet, flatfish, sturgeon and the mollusc rapana), culture areas (such as ponds, cages and tanks) and systems (extensive, intensive and integrated aquaculture with agriculture and livestock raising).
4. Support the establishment of aquaculture associations that work on the development of codes of good practice and play an active role as sectoral representative bodies in discussions and negotiations with the Government of Georgia.
5. Obtain national-level self-sufficiency in fry, fingerling and fish feed production through private hatcheries and feed factories that have access to cheap credit and quality advice and support from national fisheries and agriculture research institutes.
6. Promote the role of aquaculture in rural poverty alleviation, community development and the achievement of food security in Georgia.
7. Develop and use technology that encourages economically viable culture systems of oysters, mussels and other marine organisms in the Black Sea coastal region.
8. Practise aquaculture in an ecologically sustainable manner and monitor its effects on genetic diversity and ecosystem integrity in order to minimize adverse consequences on the ecosystem and social and economic conditions.



Maia Metreveli

Akhalgaliagi carp Farm

9. Develop aquaculture based on native species; the introduction of non-native species or genetically altered stocks may be possible only after potential associated risks have been scientifically assessed and government approval has been obtained.
10. Develop and implement codes of good farm and fish health management practices in aquaculture.
11. Establish and implement a cost-effective fish health monitoring system with government support.

The Action Plan for fishery sector management and development in Georgia (2005-2008) calls for action in the field of aquaculture by the Government, donor agencies, research institutes and private sector aquaculture farmers. Prioritized activities for the period up until 2008 are: fingerlings and feed research, poverty alleviation through aquaculture development and the establishment of demonstration farms for capacity building in aquaculture. FAO has been approached to continue assisting the country in some of these areas.

Copies of the above mentioned documents and more news on FAO ongoing fishery sector assistance to Georgia can be obtained from: Raymon van Anrooy, Fishery Planning Analyst of FAO (Raymon.vanAnrooy@fao.org) or Mamuka Meskhi, FAO Assistant Representative in Georgia (FAO-GE@fao.org).

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Highlights from the FAO Database on Aquaculture Production Statistics

Alan Lowther¹

The FAO Fisheries database of statistics on aquaculture production and values has been updated to include data for 2003. Total aquaculture production of aquatic animals (i.e., excluding aquatic plants) for 2003 was reported to be 42.3 million tonnes² with a farm-gate value of US\$ 61.0 billion. With the inclusion of aquatic plants, the production increases to 54.8 million tonnes with a value of US\$ 67.3 billion. Growth in global aquaculture remains strong as these figures represent an increase in production of 6.2 percent from the total aquaculture production reported for 2002, and a 5.8 percent increase when only aquatic animals are considered. Considering the ten-year period from 1993-2003, total aquaculture production shows an average annual increase of 9.4 percent.

For aquaculture of aquatic animals, China continues to far exceed the production of other nations accounting for over two-thirds of the global total. The top ten producing countries for 2003 are listed in Table 1. These countries account for 88.0 percent of the total global production. The top seven producing nations are all from Asia and, in 2003, the countries of Asia were responsible for 88.8 percent of production, followed by Europe (5.2 percent), South America (2.4 percent), North America (2.1 percent), Africa (1.2 percent) and Oceania (0.3 percent).

The species with the greatest production volume was the Pacific cupped oyster (*Crassostrea gigas*) with 4.4 million tonnes, followed by three species of carps – silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idellus*) and common carp (*Cyprinus carpio*). In terms of ISSCAAP (International Standard Statistical Classification of Aquatic Animals and Plants; <http://www.fao.org/fi/statist/fisoft/asfis/asfis.asp>) groups of species, by far the most production is in the group consisting of carps and other cyprinids. In addition to the three carps already mentioned, the bighead carp (*Hypophthalmichthys nobilis*) and the Crucian carp (*Carassius carassius*) also had production over 1.5 million tonnes in 2003. The top ten ISSCAAP species groups in terms of production are listed in Table 2. If aquatic plants are included, the species with the highest production is Japanese kelp (*Laminaria japonica*) with a production of 4.6 million tonnes.

For 2003, carps were the species group with the highest reported value – US\$ 15.4 billion. They were followed by shrimp and prawns (US\$ 9.3 billion), miscellaneous freshwater fishes (US\$ 5.6 billion), salmons and trouts (US\$ 5.6 billion), clams and cockles (US\$ 4.3 billion) and oysters (US\$ 3.8 billion). The highest reported value for a single species was US\$ 3.8 billion for the whiteleg shrimp (*Penaeus vannamei*), followed by Pacific cupped oyster, giant tiger prawn (*Penaeus monodon*) and Atlantic salmon (*Salmo salar*).

While production from capture fisheries has been relatively constant over the last twenty years, the growth of aquaculture has resulted in aquaculture being responsible for an ever-increasing share of global fisheries production. This share has increased from 3.9 percent in 1970 to 31.9 percent in 2003 (Fig. 1) and likely will continue to increase for the near future. Naturally, as aquaculture production increases, a larger proportion of the fishery food supply will come from aquaculture. This is particularly striking in China where more than three-quarters of the fish food supply comes from aquaculture. The share of the fishery food supply from aquaculture for the rest of the world is less (20 percent in 2003), but is also increasing (Fig. 2). Food supply is calculated by subtracting the part of the catch that is used for meal, oils and other non-food uses. Furthermore, it is assumed that all aquaculture production is for human consumption.

Table 1: Top ten countries in aquaculture production of aquatic animals in 2003

Country	Production (tonnes)	Percent of world total
China	28 892 005	68.3%
India	2 215 590	5.2%
Indonesia	996 659	2.4%
Viet Nam	937 502	2.2%
Japan	859 656	2.0%
Bangladesh	856 956	2.0%
Thailand	772 970	1.8%
Norway	582 016	1.4%
Chile	563 435	1.3%
USA	544 329	1.3%
Rest of world	5 083 023	12.0%
Total	42 304 141	100.0%

Note: Includes fish, crustaceans, molluscs and amphibians

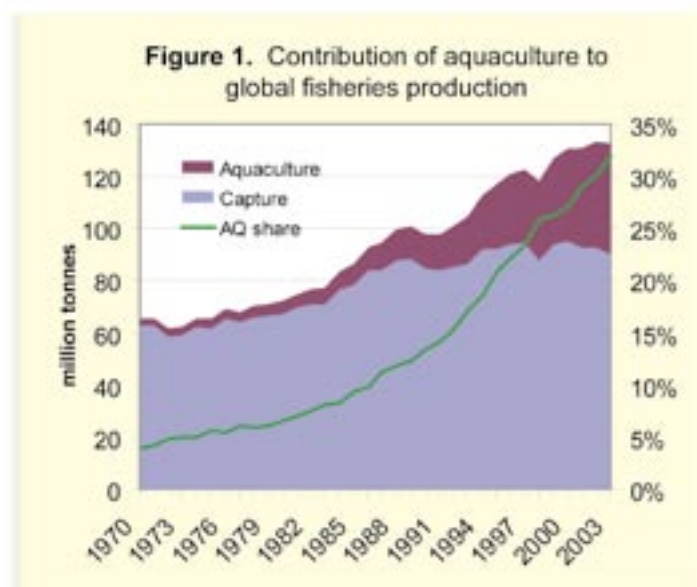
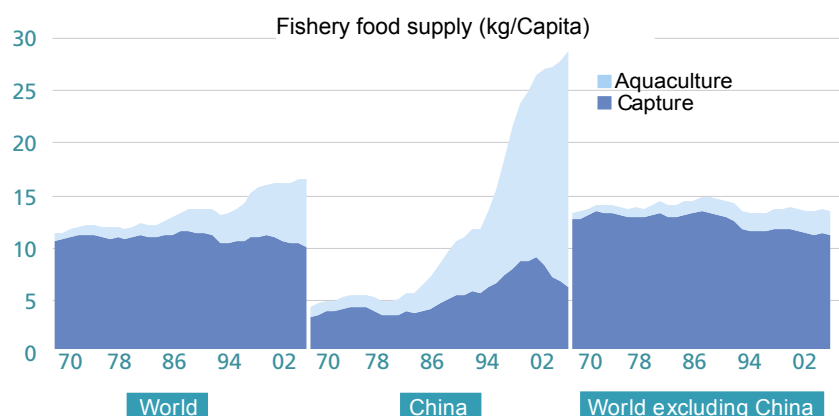


Table 2: Top ten ISSCAAP species groups for aquaculture production of aquatic animals (not including aquatic plants) for 2003

Species group	Production (tonnes)	Production % of world total	Value (million US\$)
Carps, barbels and other cyprinids	17 215 123	40.7%	15 351
Oysters	4 496 659	10.6%	3 794
Miscellaneous freshwater fishes	4 250 076	10.0%	5 636
Clams, cockles, arkshells	3 788 296	9.0%	4 276
Salmons, trouts, smelts	1 828 760	4.3%	5 602
Shrimps, prawns	1 804 932	4.3%	9 323
Tilapias and other cichlids	1 677 751	4.0%	2 036
Mussels	1 589 464	3.8%	996
Miscellaneous marine molluscs	1 232 293	2.9%	628
Scallops, pectens	1 178 468	2.8%	1 693
Other species	3 242 319	7.7%	11 649
Total	42 304 141	100.0%	60 984

Figure 2. Relative contribution of aquaculture and capture fisheries to food fish consumption



The entire aquaculture database can be downloaded from the FAO Fisheries website at www.fao.org/fi/statist/fisoft/fishplus.asp. FISHSTAT Plus is a powerful and easy-to-use software package that allows the user to query the databases for aquaculture production and values, as well as the other FAO Fisheries Statistics databases, including global capture fishery data, fishery commodities data, and regional databases. In addition, the databases can be queried online using FIGIS (Fisheries Global Information System) at the FAO Fisheries website: www.fao.org/fi/. For more analysis of the given statistics, the reader may wish to examine the latest version of the State of World Fisheries and Aquaculture, 2004, published by FAO and available online at <http://www.fao.org/sof/sofia>.

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²All production quantities in this article are in live weight equivalent units

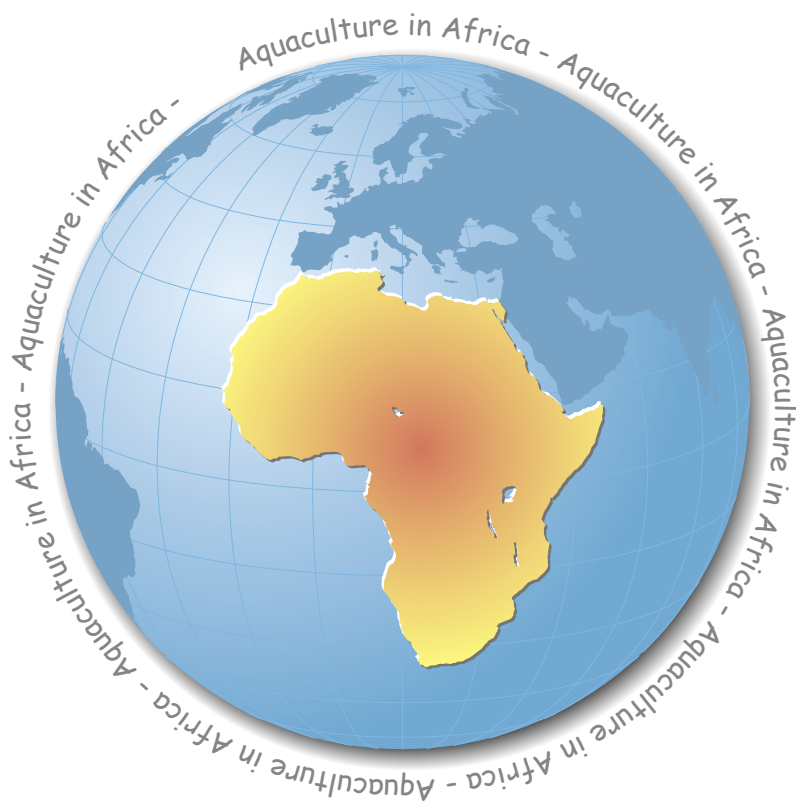
FAO Expert Workshop for the Preparation of Technical Guidelines on Health Management for Responsible Movement of Live Aquatic Organisms Colombo, Sri Lanka, 1st to 4th November 2005 (continued from page 10).

The working documents presented at the Expert Workshop will form the basis for suggestions and recommendations that will be compiled into two documents:

- FAO Technical Guidelines for Responsible Fisheries: Health Management for Responsible Movement of Live Aquatic Organisms and
- FAO Fisheries Technical Paper – Compliance to FAO Technical Guidelines for Responsible Fisheries: Health Management for Responsible Movement of Live Aquatic Organisms.

A Technical Secretariat comprising Rohana Subasinghe and Melba Reantaso (FAO-FIRI), Barry Hill (OIE-Aquatic Animal Health Standards Committee), Sharon McGladdery (Canada's Department of Fisheries and Oceans), will be responsible for technical coordination.

This workshop will immediately follow the FHS/AFS Sixth Symposium on Diseases in Asian Aquaculture (DAA VI) (www.daasix.org) to be held in Colombo from 25-28 October 2005.



BACKGROUND

Uganda has embarked on an ambitious programme to support aquaculture development for income generation, including exports, and increased domestic fish supply. These efforts are confronted by the often-encountered regional challenges of unreliable seed supply, inadequate feed supply, lack of access to capital (credit), often ineffective information flow (extension) and under-developed markets. To assist in addressing the first dilemma, the Government of Uganda requested assistance from FAO through a Technical Co-operation Programme (TCP). This request was answered by the implementation of the TCP project Assistance to Fish Farmers in Eastern Uganda (TCP/UGA/0167 and TCP/UGA/3001) and the subsequent elaboration of the project's motto: *Rural aquaculture development through improved access to quality fish seed – promoting farmer-friendly approaches and techniques to aquaculture through improved seed production, distribution and marketing.* The project was active from 2002 through 2004.

Small-scale for-profit hatcheries as catalysts for aquaculture development in Eastern Uganda and as models for successful South-South co-operation

The project focused its effort on three zones designated by the name of the closest principal administrative district: Iganga, Kamuli and Tororo. These zones were, however, selected based on an objective set of technical criteria combined with an estimate of the level of concentration of fish culture activity (critical mass), and not on administrative boundaries. A zone was considered to have a working radius of approximately 50 km and encompasses a significantly large number of fish farmers to constitute an economic demand to support a private seed production enterprise in each zone. Among the practicing fish farmers, there were to be at least five "model" farmers in each zone with a minimum productive water surface of 500 m² who would be willing to participate in training and adopt improved management practices.

In each zone, the project selected another farmer to specialize in seed production based on the individual's motivation and available resources (a chief prerequisite being that the person operated a fish farm with at least five ponds and/or a total water surface area of at least 1 500 m²). The project then elaborated a hypothesis

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Project staff with Iganga Hatchery Operator



Project staff assisting farmers operating the Kamuli hatchery

for seed production and distribution whereby a hatchery should produce for sale at least 1 600 tilapia fingerlings and 1 100 *Clarias* fingerlings every six weeks. This level of production would provide an attractive level of profit for the hatchery operator and permit the stocking of four grow-out ponds per cycle for farmers practicing tilapia/catfish polyculture.

These seed providers were initially seen as being nurseries; tilapia and catfish fry purchased from a large-scale hatchery and raised to fingerling size by each of the nursery operators. With the adoption of improved technologies, the project aimed at achieving an 85 percent survival rate for tilapia and 40 percent for catfish. To assist in these efforts, the project provided technical assistance through the Technical Co-operation among Developing Countries (TCDC) programme. These important inputs were provided by Mr Bau Pham from Vietnam and Mr Arkom Chimooti from Thailand.

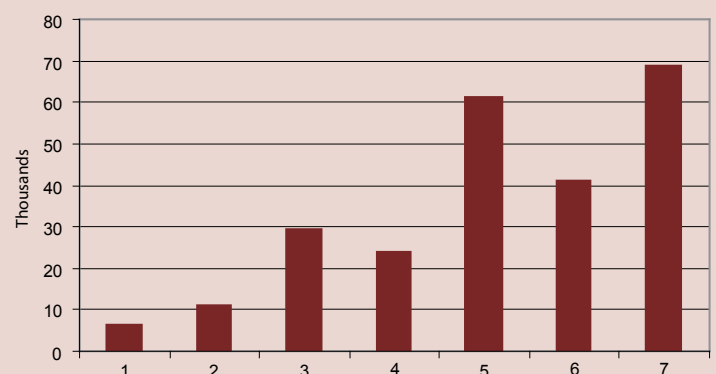
RESULTS

In addition to formal and informal training sessions as well as a study tour to Thailand, the three nursery operators received technical assistance throughout seven production cycles (a cycle being 30-40 days). Over this period, survival increased from 2 to 47 percent and 54 to 90 percent for catfish and tilapia, respectively. The three facilities sold a total of 242 034 fingerlings over this period; 48 percent of which were catfish. Average seed sales per facility for the three most recent cycles when production had stabilized (Fig. 1) were 10 600 and 8 400 for catfish and tilapia fingerlings per cycle, respectively. Analyses of all three facilities concluded that seed production was profitable, with positive net returns after opportunity costs for tilapia and catfish production reported for all three farms for the last production cycle.

Techniques practiced by operators included nursing of fry purchased from other hatcheries as well as natural, semi-controlled and fully-controlled spawning and nursing. While no special techniques were employed for tilapia reproduction, catfish spawning was generally accomplished through hyphophysation using catfish pituitary. Using semi-controlled condition, catfish brooders spawned in ponds and fertilized eggs were transferred to either to specially prepared ponds or to concrete tanks. Under controlled conditions, males and females were stripped, eggs fertilized and incubated in tanks.

Off-farm purchase of fry and nursing were found to be the most profitable if transport costs of fry are not too expensive. Nursing-only procedures allow operators to react more quickly and precisely to market demand, as they can vary the quantities of fry they purchase. Spawning and nursing ("full cycle") seed

Figure 1. Total seed production for each of the seven cycles



production require more resources, but does make the operator independent of external fry suppliers.

LESSONS LEARNT AND FUTURE PERSPECTIVE

The availability of good quality seed when and where needed was catalytic to aquaculture development and likely to be sustainable as long as the seed providers are making suitable profits. In the overview, the project has been successful enough for the Government of Uganda to initiate similar activities in six new zones. Private, for-profit, seed supply certainly can be an important source of revenue for the operator and provide a critical service for fish farmers in the neighboring zone. There is, however, a critical mass of active fish farmers and/or fishponds which must be present to establish and maintain the market. The areas circumscribing the three project zones assembled between 50 and 100 fish farmers; the economic threshold to reach "critical mass" requires further analysis.

Operators have been viewed as potential extensionists. Not only do they have a vested interest in promoting productive aquaculture in their areas, but the involvement of private service providers is very much in line with prevailing government policies. However, the practicalities of these arrangements warrant further evaluation.

Transport is an import issue in the process; both of fry to operators and of fingerlings to growers. Transport costs can be very high. On the supply side to operators, these costs can be minimized if fry from large hatcheries are sent via public transport (successful trails of this transport mechanism have already been done).

While it was initially considered that the operators would transport fingerlings to growers as part of their extension support, this has proven to be the exception. Most often growers purchase their fingerlings directly from the operator and transport the fish themselves. This offers an opportunity for added mortality if the seed is not well cared for during transport and stocking. Distribution methods should be monitored and appropriate trainings provided as necessary.

The operators participating in the project are innovators. As such, they need guidance and motivation to diligently continue seed



J. Moehl, FAO

Toroto operator with catfish broodstock



J. Moehl, FAO

Arkom Chimooti working with Iganga hatchery operators



Sunfish hatchery in Kajjansi which provided much of the fry for the three project operators

production and not let their attention be distracted by other newer, and possibly more exciting ventures. This will likely require some level of extension support over a number of years.

The necessary initial burst of technical support provided by the two TCDC experts was most productive and can be seen as a model for other similar interventions. These experts were able to satisfactorily transfer practical and doable technologies to their Ugandan colleagues; farmers, extensionists and administrators all gaining from the South/South experience.

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Ornamental Fishes: a Sustainable Livelihoods Option for Rainforest Communities

Randall E. Brummett¹

**The following is an invited article by
Randall E. Brummett of the WorldFish
Center in Cameroon.**

Editors' note

The ornamental fish sector is an extensive and global component of international trade, fisheries, aquaculture and development. However, the scope of this sector and the impact on human and aquatic communities are often unappreciated and often not accurately known. Global statistics reported to FAO from Members indicate that the export value in 1996 of ornamental fishes was US\$ 206 603 000.00. Since 1985 the value of the international trade in ornamental exports has increased at an average growth rate of approximately 14 percent per year. Developing countries account for about 63 percent of the export value. The value of the entire industry, when non-exported product, wages, retail sales and associated materials are considered has been estimated at US\$ 15 000 000 000.00. Such a vast and important industry has the potential to contribute to the sustainable development of aquatic resources, but may face challenges due to increased attention to environmental and social issues.

FAO Fisheries has not been actively involved with the ornamental fish industry other than maintaining import and export statistics and some publications². However, the issues that Mr Randy Brummett raises below are of concern and indicate that there may be opportunities to use the ornamental fish sector to help improve livelihoods. We thank Mr Brummett for his contribution.



Figure 1. The Ichthyological provinces of Africa, based on Roberts (1975) as modified by Lévêque (1997) and redrawn according to new hydrological basin mapping published by FAO (2000). 1 = Maghreb, 2 = Nilo-Sudan, 3 = Upper Guinea, 4 = Lower Guinea, 5 = Congo Basin, 6 = Quanza, 7 = Zambezi, 8 = East Coast, 9 = Southern, 10 = Malagasy.

In addition to some 8 million people, the Lower Guinea Rainforest (Fig. 1) harbours 400 mammal species, 1,000 bird species and over 10,000 species of plant (CARPE 2001). From the available literature, 29 families, 119 genera and some 500 species of fish have been reported (Teugels & Guégan 1994). Apart from the large number of small cyprinodonts (of which 70 percent are from the genus *Aphiosemion*), the freshwater fauna is dominated by the Siluriformes (6 families, 23 genera, ±100 species), the Characiformes (2 families, 20 genera, ±60 species), the Cichlidae (17 genera, ±50 species) the Cyprinidae (10 genera, ±80 species) and the Mormyridae (14 genera, ±50 species)³. Conservation International lists the Guinea Rainforest as a Global Biodiversity Hotspot.

However, much of this biodiversity is coming under threat even before it is completely documented (Stiassny 1996). Alien species (esp. *Oreochromis niloticus*, *Clarias gariepinus* & *Heterotis niloticus*), introduced for aquaculture and accidentally released into the Nyong River, have contributed to the disappearance of several indigenous species from commercial catches. In addition, the use of fish poisons has become increasingly frequent. Some of these are from local plants and cause only temporary harm, but most poisoners now use Lindane or Gammelin 20, an organochlorine insecticide used in cocoa production and highly destructive of the entire foodweb. Human deaths have been reported as a result of eating poisoned fish, and on the Ntem River in Southern Cameroon, insecticide fishing disrupted local aquatic ecosystems to the point where the electric catfish, *Malapterurus electricus* was able to extend its habitat into the small rivers where they were previously not found. Because of the powerful shocks emitted by this fish, women have been forced to abandon their traditional dam fishing in the area.

The greatest threat, however, comes from irresponsible logging. The Lower Guinea has already lost an estimated 46 percent of its forest cover to logging and conversion to agriculture and continues to lose forested watershed at an average rate of 7 percent per year (Revengea et al. 1998). In the process of removing the valuable timber, these (often illegal) logging operations also expose large amounts of bare earth and alter stream courses, increasing runoff and siltation. Road construction, saw mills and other infrastructure associated with logging attracts people into the forest, resulting in wholesale transformation of the ecosystem (Burns 1972; Garman & Moring 1993).

Against this backdrop, the WorldFish Centre in partnership with the UK Department for International Development (DFID), l'Institut de Recherche Agricole pour le Développement (IRAD), l'Institut de Recherche pour la Développement (IRD, France), the WorldWide Fund for Nature (WWF), the American Museum of Natural History, the Musée Royale pour l'Afrique Centrale (Tervuren, Belgium) and the Organization for Environment and Sustainable Development (OPED), a local NGO, has been studying the biogeography, ecology and management of the rainforest rivers of the Lower Guinea Ichthyological Province in Southern Cameroon. A comprehensive review

of the existing knowledge about this ecosystem was published by Brummett & Teugels (2004) and upon that base a series of field research projects are endeavouring to create new sustainable livelihoods options for rainforest communities that will raise revenues and conserve biodiversity, the ultimate goal being to establish functional village-based monitoring and management programs that would ensure the sustainability of commercialised and diversified natural resource exploitation. This article is a synopsis of key findings to date and progress on the implementation of a socially, economically and ecologically sound management plan for Lower Guinea Rainforest rivers.

Current Exploitation

Welcomme (1976) estimated the total number of first order rainforest streams at over 4 million with a combined total length equal to half of all watercourses in Africa, making these the largest single riverine ecosystem on the continent. Of the 8 million people who live in the Lower Guinea forest, 20 percent are more or less fulltime fishers and another 70 percent (mostly women and children) fish seasonally. Estimates from Cameroon put the productivity of capture fisheries in forest river basins at 0.5 tons/km²/yr (Mdaihli et al. 2003) or 260 000 tons for the entire forest. At the local retail price for fresh foodfish of approximately \$2.00 per kg, this translates into a cash value of over \$500 million per year.

Fishing in rainforest rivers is severely constrained by the large quantities of wood that decorate the streambed. By far the most common types of gear are passive set nets, traps and hook-lines of which there are a great variety in accordance with the diversity of the fish fauna. Also common, is a hook-and-line fishery dominated by small children and mainly targeting immature cichlids.

In Southern Cameroon, the main fishing seasons are during reproductive migrations ("dok") which take place as waters rise in May and October. Doks involving *Labeo batesii* and *Distichodus spp.* have been documented in the Upper Cross and the Ntem, respectively, (du Feu 2001, Djama 2001). There are two traditional fisheries allocated almost entirely to women. One, the "alok", involves the construction of small earthen dams across first order forest streams during the dry seasons (January-April &

Figure 2. A few of the lower guinea Rainforest fishes of potential interest to the international ornamental fish trade

A *Brycinus longipinnis* (Tai National Park, Ivory Coast)

B *Brienomyrus brachyistius*

C *Barbus camptacanthus*



Karsten Mody

A



R.E. Brummelt

B



R.E. Brummelt

C

July-August) to capture small Channids, Clariids and Mastecembelids (van Dijk 1999). The other female-dominated fishery is the use of woven basket traps (“aya”) to catch the freshwater prawn, *Macrobrachium vollehovenii*.

There is also a limited trade in ornamental fishes, dominated by middlemen based in the commercial capital, Douala. These entrepreneurs work with a handful of expert fishers who know where and when to find the fish. These men travel back and forth between the town and the forest, leaving orders for village women and children to fill and then coming back in a few days to collect the fish, paying the villagers a pittance for their work. Captured fish are typically held in tanks in Douala for a period of days prior to packing and shipping by air to Europe, where the poor handling they endure often results in mortalities of up to 85 percent.

Currently, fishing communities have limited regulatory authority over the rivers they fish. Some traditional rules apply, but these are easily and often used to create inequalities by leaders

who have mostly moved into town and exert their influence only through proxies. Logging companies and poachers have found an easy opportunity to exploit the forest without regard for local communities or the integrity of the forest and the associated riverine ecosystem upon which they depend for their livelihoods.

Seeking Sustainability

A key aspect of sustainable management systems is the valuation of resources from the point of view of indigenous people (Sheil & Wunder 2002). A first step in revaluing forest resources and enforcing sustainable management is the quantification of the biodiversity in question. Several attempts have been made at the generation of a workable Index of Biotic Integrity (IBI) such as that used to track changes in temperate zone streams, but parameterization has been a problem. The best effort to date in Central Africa is that of Kamdem-Toham & Teugels (1999), but gaps still exist. Existing datasets on aquatic biodiversity and ecology in Central Africa are weak, at best, and this makes it very difficult to develop quantitative tools (Lévêque 1997).

Coupled with this quantification/valuation exercise should be the development of improved management and exploitation strategies that could actually increase the value of aquatic ecosystems and justify their preservation, while at the same time improving rural livelihoods. Forest river ecosystems are currently unmanaged and unregulated in any formal sense (M.O. Baba, Director of Fisheries, personal communication, Yaoundé, April 2002), the most widely promoted method of increasing the productivity of aquatic ecosystems in Central Africa being to increase fishing pressure through the introduction of subsidies on motors and other fishing equipment, and this without any clear idea as to the size of the resource or level of current exploitation.

While some increased pressure might be warranted in some areas, the upper limit for this strategy is probably already in sight for most places. Careful regulation of fishing gear and seasons based on scientific data might be a more widely applicable strategy for increasing catches of certain species in some rivers. The greatest potential for improving profitability while conserving ecosystems might lie with species of value as ornamental aquarium fishes.

Aquariums for Poverty Reduction?

Fishes with potential as ornamentals are unusually abundant in African rainforest rivers (Fig. 2) and wholesale at an average of \$2.43 per fish. Keeping prices high and availability low is the difficulty involved in the capture, holding and transport of African river fishes.

More importantly, reproduction of forest river fishes has been difficult or impossible for the large commercial breeders in Singapore and Florida, most likely due to the fact that outside of the special and complex rainforest ecosystem, these fishes seldom reach sexual maturity.

Among those so far identified, several genera are of particular interest to the ornamental fish trade, including: *Aphyosemion*, *Benitochromis*, *Brienomyrus*, *Brycinus*, *Epiplatys*, *Mastacembelus*, *Chiloglanis*, *Doumea*, *Neolebias*, *Parauchenoglanis*, *Pelvicachromis* and *Procatopus*. Retail value of these fishes range from \$2.00 to \$20.00 in Europe. Partial enterprise budgeting for a delivery of 8.5 kg of ornamentals (the minimum amount to obtain discounted air freight) sold wholesale at \$1.00 per fish shows a substantial potential for profitability (Table 1).

The typical problem facing small-scale natural resource businesses is competition with unregulated poachers and larger-scale investors once markets are developed and the profitability of a product demonstrated (Sunderland & Ndoye 2004). Luckily, or unluckily, a recent survey of low order forest rivers in SW Cameroon found that the total value of the ornamental fish species existing in the wild at any of the sites sampled is insufficient to support any significant expansion of the current exploitation rate. Most of these species have very low fecundity and cannot be expected to rapidly repopulate heavily exploited streams (Kamdem-Toham & Teugels 1998).

Table 1. Partial enterprise budget for ornamental fish export from Cameroon to Germany

Costs	
Shipping per 208.5 kg (100 l water + fish + containers ≈ 5 boxes) @ \$3.00/kg	\$ 600
Veterinary fees in Germany	\$ 30
Local transport (300 km x \$0.16/km)	\$ 48
Fish feeds	\$ 22
Maintenance	\$ 100
Payment to fishers (\$0.25 per fish)	\$ 425
Government Tax (as of January 2005)	\$ 100
Total	\$1,225
Revenues	
Wholesale of 1700 fish (@ 5 g x \$1.00 per fish)	\$1,700
Profit per five boxes shipped	\$ 375

Figure 3. Some of the communities currently involved in the development of village-based ornamental fish businesses



R.E. Brummett

Nkoelon Fish Club, N'tem River



R.E. Brummett

Camp 7 Aquarium Fish Company, Moliwe River



R.E. Brummett

Monatelé Ladies Fishing Association, Sanaga River

Capture and export of wild-caught fish can thus only be profitable for a very few individuals, and is unlikely to add sufficient value at the community level to justify conservation.

Aquaculture might represent a viable alternative. By using existing fish reproduction and nursing technology, sexually mature broodfish of rarer and more valuable species captured from rainforest rivers can be artificially reproduced. Subsequent export of only those individuals reared in captivity will not only protect against over-exploitation of natural stocks. Because sexually mature broodstock will continue to be available only from the wild, local incentives to protect the ecological integrity of the river will be strong. International oversight and certification of exported fish as cultured will help ensure a competitive advantage to those producers who operate responsibly.

Based on these findings, WorldFish and its partners are currently piloting efforts to develop a socially, economically and environmentally sound strategy for the development of ornamental fish aquaculture in Cameroon. Expert fishers have been enlisted and are working directly with OPED and village groups consisting primarily of women and youth to develop and implement a viable business plan, which will replace the Douala middlemen with locally-based management entities (Fig. 3). Based on a quantitative stock assessment, a river management and monitoring plan is also being developed, to ensure the sustainability of this new enterprise, and to learn more about the aquatic biodiversity of the Lower Guinea rainforest.

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³The piscine biodiversity of the Lower Guinea Rainforest is not well sampled and what samples do exist are currently under review; hence the numbers indicated are only approximate.

Establishment of an Aquaculture Cooperation Network in Latin America and the Caribbean

Jose Aguilar-Manjarrez¹

FAO WORKSHOP ON THE "FEASIBILITY OF ESTABLISHING A REGIONAL COOPERATION NETWORK FOR AQUACULTURE IN LATIN AMERICA AND THE CARIBBEAN"

Background

The Inland Fisheries Commission for Latin America (COPESCAL) in its Ninth Session held at El Salvador in January 2003, recommended FAO to undertake a feasibility study on the establishment of a network similar to the Network of Aquaculture Centres in Asia and the Pacific (NACA) promoted by FAO. Also, the Twenty-fifth Session of the Committee of Fisheries (COFI) held in Rome, Italy in February 2003 reviewed the work done by NACA and several Members expressed their interest in the establishment of a similar mechanism in the Americas and the Pacific Islands, and requested the relevant support of FAO for a study on this purpose.

The concept of a network of aquaculture centres or a cooperation network for the development of aquaculture in Latin America and the Caribbean has been of interest for the countries of the region since long ago and much effort has been devoted to the establishment of a sustainable regional cooperation mechanism for the development of aquaculture in the region. However, the lack of commitment by the countries and the difficulties to identify donors interested in supporting aquaculture regional cooperation have impeded the establishment of a network or a regional mechanism in a sustainable manner.

In order to comply with the mandate of the fisheries bodies mentioned above, FAO conducted a study to determine alternatives for the creation of a regional cooperation network for the support of aquaculture in Latin

America and the Caribbean. The results of this study were utilized as an input for the basis of discussion of the present workshop.

The workshop was held in the Hotel Country Inn & Suites, Panama Canal Amador of Panama, Republic of Panama from 6 to 8 December 2004. Twenty experts from 9 countries of Latin America and the Caribbean, Canada and the United Nations and one observer of OSPESCA (Organization of the Fisheries and Aquaculture Sector in Central America) attended the workshop. FAO support included technical inputs as well as provision of funds to cover meeting expenses of participants, and for interpretation.

The workshop analyzed the present status of aquaculture in Latin America and the Caribbean: its contribution to economic and social development and the main problems that affect its development; as well as the background on regional cooperation for the development of aquaculture. The main objective of this FAO-organized workshop was to determine the technical, institutional, political and financial feasibilities of establishing a network of aquaculture centres in Latin America and the Caribbean based on an FAO study and on additional information from other similar initiatives such as those reported by the Asia-Pacific Economic Cooperation (APEC) and the Latin American Organization for Fisheries Development (OLDEPESCA).

Main Outcomes of the workshop

- Conclusions and recommendations produced by the workshop are inclusive of all current efforts to develop proposals for a regional aquaculture cooperation network and may constitute a potential step forward in such efforts.



Doris Soto, FAO

Devin Bartley, FAO

Environmental monitoring at salmon farming cages in Reloncavi, Southern Chile

- The workshop recommended that one single intergovernmental cooperation network for the development of aquaculture should be created and that all interested countries of the American continent would be invited to participate. The Network would be willing to establish links through inter-regional cooperation taking into consideration the experience of similar networks.
- The type of cooperation mechanism, key subjects that should be addressed by the Network, geographical scope of the cooperation mechanism, possible structure of the network and sources of financing were discussed and agreed by the workshop participants.
- Experts were informed of, and invited to contribute to, FIRI's initiatives on: NASO's (National Aquaculture Sector Overviews), the forthcoming regional and global reviews of aquaculture development trends and DIAS (Database on Introductions of Aquatic Species).

Workshop report

The workshop report - Report of the Workshop on the Feasibility of Establishing a Regional Cooperation Network for Aquaculture in Latin America and the Caribbean. Panama, Republic of Panama, 6-8 December 2004. FAO Fisheries Report. No. 773. Roma/Rome, FAO. 2005. 43p. (see List of Publications on page 46; available at: <ftp://ftp.fao.org/docrep/fao/008/y6009b/y6009b00.pdf>).

APEC WORKSHOP ON "FEASIBILITY STUDY FOR THE ESTABLISHMENT OF AN AQUACULTURE NETWORK FOR THE AMERICAS"

Background

APEC, an intergovernmental organization, through a Project entitled APEC FWG 01/2004 "A Feasibility Study on the Establishment of and inter-Governmental Mechanism for the Development and Management of an Aquaculture Network for the Americas", carried out a study similar to the FAO study. The aim of the APEC study is to determine if and how to develop an intergovernmental mechanism for the development and management of a regional network that would facilitate trade in aquaculture products within the Americas and in other parts of the APEC region.

The objectives of the APEC study include a diagnosis of the present regional situation in selected countries for the purposes of establishing an intergovernmental mechanism for the development and management of an aquaculture cooperation network, of determining the best institutional and organizational structure and network requisites, and of holding a regional workshop to present the network proposal and have it discussed and endorsed by interested parties.

This APEC workshop, held at the Holiday Inn SunSpree Resort in Mazatlán, Sinaloa, México from 26-28 April 2005, was hosted by the Government of Mexico and sponsored by

APEC FWG 01/2004 Project and the National Commission for Aquaculture and Fisheries (CONAPESCA) of Mexico. The workshop was attended by 5 economies through their focal points to the project: namely, Canada, Chile, Mexico, Peru and USA. Brazil and Ecuador, two non-APEC economies, were also invited to participate through their focal points. FAO participated as an observer.

The main objective of the workshop was to present and analyze the feasibility study for the establishment of an aquaculture network for the Americas (ANA) based on the work of two APEC consultants. The workshop received recommendations on the study and proposal for its official presentation to interested APEC +2 economies and identified guidelines on necessary actions for implementation.

Main Outcomes of the workshop

- The economy experts recognized that there is a strong need to establish and maintain an intergovernmental network in the region as a basis for successful regional cooperation to foster sustainable development of aquaculture throughout the Americas but also recognized that permanent political and financial commitments from governments and institutions are essential.
- The government of Mexico offered to host the core regional office for the network, including the provision of financial resources to cover costs for personnel, office space and equipment and basic operations.
- The workshop recommended that the network should be envisaged as an intergovernmental mechanism for regional cooperation in aquaculture in the Americas and as such should start with APEC + 2 economies and later open to other economies or countries in the region.

- The type of cooperation mechanism, major programs that should be conducted by the Network, major working areas, organizational and operational structure of the network; sources of financing, network benefits, interim focal points to assist in establishing the network; and strategy to establish and implement the network including guiding principles, goals and tasks were discussed and agreed by the workshop participants;
- Experts were informed of, and invited to contribute to, FIRI's initiatives on: NASO's (National Aquaculture Sector Overviews); Prospective Analysis of Future Aquaculture Development (PAFAD); and the forthcoming regional and global reviews of aquaculture development trends.

STRATEGY FOR COPESCAL

FAO will present at its Tenth Session of COPESCAL, to be held in Panama City, from 7 to 9 September 2005, a discussion paper comparing the two proposals (i.e. the workshops of Panama and Mazatlan) as clear as possible, and determine (a) if COPESCAL member countries are indeed in agreement to take commitments for the establishment of a regional network and (b) if they want to enter the network to be established by APEC, oriented basically to issues related to international fish trade, or if they are ready to take commitment for the creation of a regional network with a wider scope, including aquaculture socio-economic development. The most important consideration will be that all countries in Latin America and the Caribbean are included, perhaps through strengthening of COPESCAL. The outcomes of the discussions will be presented in the next issue of FAN.

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Pakistan sought FAO assistance to formulate a project on Agro-Processing and Agri-Business Enterprise Development and Knowledge Sharing in Livestock, Aquaculture and Horticulture

Melba B. Reantaso¹ and Divine Njie²

In response to a request from Pakistan's Ministry of Food, Agriculture and Livestock (MINFAL), FAO fielded a mission to Pakistan between 18 May and 4 June 2005 to formulate a Unilateral Trust Fund (UTF) project titled "**Agro-Processing and Agri-Business Enterprise Development and Knowledge Sharing in Livestock, Aquaculture and Horticulture**". MINFAL's specific request was for FAO's technical assistance in developing strategies and operational programs for demand-driven agro-processing and agri-business enterprises in the livestock, horticulture and aquaculture sub-sectors, and in facilitating the sharing and practical applications of best practices and lessons learned from countries that have successfully undertaken such programs to increase the income and profitability for small-scale farmers.

The three targeted sub-sectors experience various constraints which hinder development of agro-processing enterprises and agri-businesses. With regards to the aquaculture sub-sector, although endowed with vast natural freshwater, brackish water and marine resources, and located in close proximity to countries such as China, Vietnam and Bangladesh in which fisheries and aquaculture technologies have already been developed and successfully applied, Pakistan's fisheries/aquaculture sub-sector is relatively undeveloped and contributes only 1 percent to the Gross Domestic Product.

The proposed UTF project will employ knowledge transfer and learning from successful Asian examples in achieving the following in Pakistan: correctly identifying opportunities for economic growth with a focus on agro-processing and agri-business in the three sub-sectors; improving the investment climate; attracting local and foreign investment; providing guidance to investors; and linking potential investors with various stakeholders. The project comprises four components:

Component I: General Interventions;
Component II: Livestock sub-sector activities;
Component III: Horticulture sub-sector activities;
Component IV: Aquaculture sub-sector activities.

Component I addresses cross-cutting themes that are related to investment and knowledge sharing in the three sub-sectors. Component II targets the following five issues in the livestock sub-sector: increasing competitiveness; increasing investment directed at international trade; development of a market information system; training and capacity building; and community managed dairy collection and processing centres. Component III targets the horticulture sector and develops interventions aimed at: strengthening supply chains for fresh produce in the domestic market; customer targeted production and supply chain management for export oriented value chains; mobile fruit and vegetable processing; capacity building for cold storage and cold chain design and operation; and capacity building in small-scale fruit processing. Component IV outlines project interventions in the aquaculture sub-sector. Given that this sub-sector is mostly in the primary production stage, Component IV contains a number of start-up interventions which have high potential for success. These interventions are to be implemented on a pilot basis and, when determined to be technically feasible and economically viable within the existing conditions in Pakistan, immediately transferred to the private sector.

Transfer of technologies and pilot projects were major recommendations from the Conference on Aquaculture in the Third Millennium. The recommendations indicated that while considerable basic information on aquaculture species (both new and old) and farming systems are available, the lack of pilot-scale models to test technical and economic practicability



Left to Right: Mohammed Ali (FAOPAK Assistant Representative), Christopher Oates (FAO Consultant), Melba Reantaso (FIRI), David Hall (FAORAP), Sikandar Shah (MINFAL), Divine Njie (AGST), MINFAL Joint Secretary Mohammad Saleem Khan, M. Hayat, Shahzada Taimur Khusrow

hindered commercial applications. Most of the projects on aquaculture proposed in this UTF project are pilot operations of a number of technology packages that have already been developed, verified and successfully carried out in many aquaculture regions. There is currently a very strong interest on the part of GOP under the new economic environment, as well as renewed interest from the private sector, in these packages. The projects proposed in the aquaculture sub-sector will build capacity of both the public and private sectors, and forge public-private sector cooperation that will lead to development of business enterprise models and business investments for the benefit of fish farming communities and the country.

Seven sub-projects are proposed within Component IV to tackle issues related to policies and enabling environments (Sub-Project 1: National Aquaculture Strategy); capacity building and strengthening of fisheries administration (at various levels, i.e., government, small-scale farmers and business sector) (Sub-Projects 2-6: (2) Master Plan for Shrimp Culture Development in Coastal Areas of Sindh and Baluchistan Provinces; (3) Intensification and Diversification of Freshwater Aquaculture Production; (4) Aquaculture Development Opportunities for Small-Scale Farmers; (5) Cold Water Aquaculture Development; (6) High Value Mariculture Development); forging public-private sector partnership (Sub-Projects 2-7: (7) Marketing Study to Increase Value-Addition and Marketing of Pakistani Aquaculture Products); introduction of technology packages and business models which have been developed, verified and successfully implemented in many neighbouring countries in Asia (Sub-Projects 2-6);



Private carp grow-out farm owner, a 700 gm carp stocked in May (at 400 gm) and will be harvested after five months at which time it will be 2.5 kg/piece which is the preferred market size of Pakistan consumers

exploring utilisation of areas which have limited potential for development from other sectors (Sub-Project 2 and 5); improving the domestic consumption pattern of aquaculture products (Sub-Project 3); understanding and improving the marketing structure (Sub-Project 7); and knowledge sharing (all sub-projects). Successful implementation of these projects and ensuring a good transfer of technology and uptake by the private sector will contribute to sustainable contribution of aquaculture to the national economy, improve incomes and living standards of rural community beneficiaries, improve the nutritional standards of the Pakistani population through increased supply of aquaculture products to domestic markets, and increase foreign earning through increased export of products.

The UTF Formulation Mission was composed of four specialists, namely: Mr Divine Njie (FAO HQ, AGST, Team Leader, agro-processing), Mr Christopher Oates (FAO Consultant, agri-business), Mr David Hall (FAO RAP, livestock) and Ms Melba Reantaso (FAO HQ, FIRI, aquaculture). More detailed information about this UTF can be obtained from Ms Melba B. Reantaso of FIRI (Melba.Reantaso@fao.org) and/or Mr Divine Njie of AGST (Divine.Njie@fao.org).

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TCP/PAK/3005

“Support to Fishery Sector Policy and Strategy Formulation in Pakistan”

Cecile Brugere¹

This TCP/PAK/3005 “Support to Fishery Sector Policy and Strategy Formulation in Pakistan” was signed during the visit of FAO Director-General Jacques Diouf to Pakistan in April 2005, in a meeting with H.E. Mr. Sikandar Hayat Khan Bosan, Minister of Food, Agriculture and Livestock (MINFAL). It started its implementation through a two-day Inception Workshop, jointly organized by MINFAL, FAO and hosted by the Government of Punjab.

The Inception Workshop, held in Lahore, Pakistan on 9-10 June 2005, fine-tuned the organisation and coordination of activities, with sharper definition of responsibilities, roles, and time-frame. Recent events related to agreements made at the time of the signature of the project between the Government of Pakistan and the FAO DG, as well as inputs from workshop participants on the current situation of fisheries policy in Pakistan and their most pressing needs in terms of a strategy for policy *implementation* and linkages with potential UTF projects (see article on page 38), led to the reorientation of project goal, purpose, activities, as requested and agreed by the Government. Thus, the logical framework, developed by the participants of the workshop, took into account the current agricultural policy environment in Pakistan and the need of the government to adjust to on-going processes affecting the fisheries and aquaculture sectors.

The goal of the TCP is to create an enabling environment conducive to the sustainable development and management of the fisheries

FAO, Pakistan



Participants to the Inception Workshop of TCP/PAK/3005 held in Lahore, Pakistan on 9-10 June 2005, consisting of official representatives from MINFAL, Governments of Baluchistan, NWFP, Punjab and Sindh, as well as private sector representatives from Punjab and Sindh provinces; FAO PK Representative and Assistant Representative, FAO HQ officers (FIPP, FIRI), and International Consultants from STREAM-NACA and Poseidon

sector, with emphasis on its contribution to economic growth, poverty alleviation, food security and environmental conservation; and the purpose is to support the on-going fisheries policy development process and facilitate its implementation. Provinces of Punjab, Sindh, Balochistan and North West Frontier are targeted by the project to reflect the country's on-going decentralisation. Five main activities have been identified in order to achieve the project goal and purpose and emphasise bottom-up and participatory processes in policy formulation and implementation: (1) inception workshop; (2) technical and consultative evaluation of draft national policy and strategy; (3) development of a manual/guidelines on reaching policy consensus and implementation of policy; (4) consultation and capacity building on implementation of policy; and (5) specification of follow-up activities. Activity 2 will involve the technical evaluation of the policy document elaborated by the GOP (by international and national consultants and FAO staff) along with community consultations scheduled to be undertaken between August 2005 and February 2006 and the compilation of relevant legislation and legislative processes by a national specialist in legal fisheries matters. Activity 3 will produce guidelines that will address conflict resolution, trade offs, and present the use of Delphi technique in policy formation and implementation, for the Government. The guidelines will also highlight the importance of legislative issues related to the implementation process. Activity

4 will involve three levels of consultation on approaches to adopt for implementation of fisheries and aquaculture development policy and strategy: at community, provincial and federal levels, with outcomes from community consultations feeding in provincial workshops, and provincial workshop outputs feeding in the national consultation, thereby ensuring awareness of district and provincial priorities at higher levels. Activity 5, taking immediately after the national workshop, will bring all project partners together and focus on the development of umbrella project concept notes to attract funding for activities related to the implementation of the fisheries and aquaculture strategy document. It will also

include the finalisation of project outputs and their translation in Urdu prior to dissemination to stakeholders of the sector.

FIPP is the Lead Technical Unit for this project, supported by FIRI, LEGN, and FAORAP. More detailed information about the project can be obtained from Ms Cecile Brugere, Fishery Planning Analyst at FAO (Cecile.Brugere@fao.org) or Mr Mohammad Ali, FAO Assistant Representative in Pakistan (Mohammed.Ali@fao.org).

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Draft environmental principles on rehabilitation of brackishwater aquaculture ponds (tambaks) in Aceh Province.

1. Tambak (ponds) for rehabilitation should be located in areas that are environmentally suitable for fish and shrimp farming. The rehabilitation should not impact on biodiversity, ecologically sensitive habitats and ecosystem functions. Particular attention should be given to avoiding any negative impacts on mangrove forests.
2. The ownership or title to the tambak should be clearly designated, and the pond for rehabilitation should not be located in any existing or proposed green belt.
3. Tambak pond and water supply reconstruction should be done in ways that do not cause ecological damage, including risks from acid sulphate or disruption of water supplies. Aquaculture designs should as far as possible incorporate buffer areas between ponds and natural habitats such as mangroves. Techniques and engineering practices should be used that minimize erosion, leaching of acid sulphate soils and salinization during rehabilitation and subsequent operation.
4. Water supply systems should be rehabilitated in ways that ensure sufficient water supply and drainage. Care should be exercised to avoid salinization where tambak ponds are located near agriculture areas. Off-site impacts associated with discharge of effluent and solid wastes should be minimized during farming through good water management practices.
5. Wild broodstock collection and hatchery rearing of shrimp post-larvae and milkfish should not use destructive fishing techniques. Hatchery practices that promote quality and healthy shrimp and fish should be encouraged. No exotic species (*P. vannamei*) should be introduced during rehabilitation, due to the risk of impacting wild shrimp stocks in the Province.
6. Feeds and feed management practices should make efficient use of feed resources. Feed and fertilisers should be used efficiently in ways that maintain pond fertility and do not cause degradation of water quality or affect the health or food safety of farmed shrimp and fish.
7. Disease risks for farmed and wild fish and shrimp should be minimised through stocking of ponds with healthy shrimp and fish. Hatchery operators and farmers should be trained in reducing risks of shrimp and fish diseases through adopting simple risk reduction measures, emphasizing maintaining environmental quality.
8. Use of chemicals that may lead to residues or environmental risks should not be used. While antibiotics are not used in traditional farming, some chemicals used for pond preparation are a concern, and alternatives should be found and promoted.
9. Rehabilitation and operation of tambak farms should be done in a way that benefits local communities and the province. The rehabilitation of tambak farms is important for the livelihoods of many people in coastal areas and the priority should be to maximize employment and social benefits to communities. Careful consultation and planning is necessary involving communities to maximize benefits and not create social conflicts.
10. Planning for tambak rehabilitation should also consider the cumulative effects of individual ponds, and seek to ensure that developments are within the carrying capacity of the local area to sustain farming.
11. As many brackishwater ponds were not ideally located or designed, the overall concept of "Build back better" should be adhered to in rehabilitation of brackishwater pond.

FAO supported

ASEM Workshop on Disease and Health Management

23-27 October 2004,
Barcelona, Spain

Melba B. Reantaso¹

ASIA-EUROPE MEETING (ASEM)

The Asia-Europe Meeting (ASEM), officially established in 1996, is an interregional forum consisting of 7 members of ASEAN (Association of Southeast Asian Nations such as Thailand, Malaysia, Philippines, Indonesia, Brunei, Singapore and Vietnam), China, Japan and Republic of Korea; and 15 members of the European Union (i.e., Italy, Germany, France, the Netherlands, Belgium, Luxemburg, Denmark, Ireland, Greece, Spain, Portugal, Austria, Finland, Sweden, the United Kingdom plus the European Commission). The main components of the ASEM process include political dialogue, security and economy, and education and culture.

ASEM AQUACULTURE PLATFORM

The ASEM Aquaculture Platform has the objective of forming a platform for activities related to sustainable aquaculture between ASEM member countries through the following activities: (1) build and manage a platform; (2) thematic workshops; (3) dissemination within and beyond the platform; and (4) facilitate partnerships and source funding for new projects. Activities revolve around 3 societal concerns: (1) fair trade, food security and safety; (2) environmental sustainability; and (3) social equitability. The thematic workshops have very specific objectives: (1) to formulate very specific recommendations on future directions in research, trade and production between the two regions: Asia and Europe; and (2) to forge new alliances or reinforce

existing ones between EU and Asia partners for joint research, trade policies and production methods. The workshops are therefore seen as an important venue to bring together a selection of key players from both regions and from the different sectors involved to think together and reach consensus on tangible action points. Aquaculture animal health is one of 6 identified workshop topics. The other 5 themes are: (1) food security; (2) food safety, trade and regulatory aspects (legislation); (3) Education and training; (4) Environment and ecosystem presentation (biodiversity); and (5) Domestication and breeding.

ASEM WORKSHOP ON DISEASE AND HEALTH MANAGEMENT

Twenty-two presentations were made from 29 participants from 17 countries (Belgium, China, Columbia, Ecuador, France, Japan, Hungary, Indonesia, Italy, Malaysia, Netherlands, Philippines, Singapore, Spain, Thailand, United Kingdom, and Vietnam) representing governments, universities, research institutes, regional and international organizations, and private sectors. Workshop participants, divided into 4 groups, tackled the following subjects: (1) Molecular epidemiology and disease mechanisms; (2) Diagnostics, inter-calibration and certification of laboratories; (3) Epidemiology, health management and extension; and (4) Vaccines and new treatments. The workshop was convened by T.W. Flegel (Mahidol University, Thailand) and Victoria Alday (INVE).

The specific research suggestions resulting from the working group sessions reflect many of the recommendations from various activities/projects initiated and organised and/or co-organised by FAO particularly under the following TCP projects: (a) TCP/RAS 6714 (A) and 9065 (A) "Assistance for the Responsible Movement of Live Aquatic Animals"; (b) TCP/RLA/0071 "Assistance to health management of shrimp culture in Latin America"; (c) TCP/INS/2905 (A) - Health Management in Freshwater Aquaculture; as well as expert consultations organised by FAO such as (a) Expert Consultation on Research Needs for Standardization and Validation of the Detection of Aquatic Animal Pathogens and Diseases (1999, Bangkok, Thailand, refer to publication FTP 395); (b) Asia Regional Scoping Workshop on Primary Aquatic Animal Health Care in Rural, Small-Scale, Aquaculture Development (1999, Dhaka, Bangladesh, refer to publication FTP

406); (c) Expert Consultation on Surveillance and Zoning for Aquatic Animal Diseases (2002, Rome, Italy, refer to publication FTP 451); and (d) the most recently concluded Regional Workshop on Preparedness and Response to Aquatic Animal Health Emergencies (2004, Jakarta, Indonesia). These are clear indication of the efficient uptake of FAO initiatives.

FAO's presentation emphasized on the need for research on three interrelated subjects – epidemiology, risk analysis and biosecurity – all aimed at making good use of scientific research for disease prevention, control and management. These are the same subject areas that were emphasized in a document, Thematic Domain for 7th Framework Programme of Research (2007-2011): Biosecurity Risk Assessments for Responsible Aquatic Animal Health Management under Action 5 – Support Sustainable Development for the Aquaculture

Industry, submitted to EU's Fisheries Directorate-General in November 2004 and who considered these topics of major importance.

FAO, recognised as an important partner organization in addressing issues related to aquatic health management, will continue its important role in this regard as there will be more demand for improved aquatic animal biosecurity driven by multiple objectives towards resource protection (aquaculture, wild fisheries and the general environment), food security, trade, globalization, consumer preference for high quality and safe products, production profitability, investment and development issues, and new threats of emerging health problems (e.g. new diseases/pathogens, new hosts for well-known pathogens).

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Twenty four of 29 participants from 17 countries (Belgium, China, Columbia, Ecuador, France, Japan, Hungary, Indonesia, Italy, Malaysia, Netherlands, Philippines, Singapore, Spain, Thailand, United Kingdom, and Viet Nam) representing governments, universities, research institutes, regional and international organizations, and private sectors pose for a group photo during the ASEM Workshop on Disease and Health Management held in Barcelona, Spain from 23-27 October 2004.

Remembering TVR "Ramu" Pillay (1921-2005)

Friends of TVR "Ramu" Pillay



In India they call them stalwarts, people like Ramu Pillay. It is shorthand for an otherwise lengthy list of descriptions like tall stature, strength of character and far vision, and a long list of achievements. He would have been described a stalwart had he only worked in India. He would have been recognized as the father of modern aquaculture had he chosen to apply his energy, passion and wisdom only within Asia where 90 percent of the world's farmed fish is now produced. But still 30 years before the previous millennium ended, when the best available record of global aquaculture production was 3.5 million tons, he saw that the world needed to farm more fish, farm it scientifically, and farm it cleanly. That was vision. How he sought to turn much of it into reality is the story of how modern aquaculture evolved.

Ramu blazed an outstanding career in fisheries and aquaculture research long before he moved into the sphere of international aquaculture development. He authored more than a hundred research papers many of them seminal and continue to be cited by researchers the world over. Beyond doing research, he felt a greater need in its systematic and practical application. While in FAO, where he served with remarkable distinction, he set several milestones for aquaculture. The first was the 1966 regional conference on warmwater aquaculture that was probably the forerunner to the 1976 Kyoto Conference on Aquaculture. Besides organizing and technically backstopping innumerable national and regional projects on aquaculture

development he also had a hand in initiating the collection of reliable statistics on aquaculture production.

With the growth of capture fisheries leveling off in the early 70s, despite improvements in fishing gear and fish finding technologies (a worrying combination even then), Ramu Pillay saw an urgent need for a concerted effort to accelerate the development of aquaculture to meet the increasing demand for fish and fishery products. However, fish farming was in the main a traditional practice, at best an art, and generally regarded as a poor cousin to capture fisheries. It did not even figure in most governments' economic development plans, and where it did, there were not enough support especially in terms of scientific and technological resources. Aquaculture was so diverse that the proposed mechanism to deal with its research and development needs, which was to set up an international research centre, was seen as inadequate. Ramu Pillay saw in this situation the opportunity to focus global attention on the new sector and design a novel arrangement to address its diversity, lift it from obscurity in national and regional plans, and move it from a traditional practice to a science-based food production sector.

That broad vision of a global organizational arrangement crystallized into the Kyoto Strategy for Aquaculture Development. The core of the strategy was technical cooperation among developing countries. It was a strategy that aligned with FAO's mandate and UNDP's advocacy.

The Kyoto Strategy was the product of a series of regional meetings and a global conference that FAO carried out with UNDP support. Ramu Pillay was charged with the planning, oversight and running of the African, Asian and Latin American regional workshops (held in Accra, Bangkok and Caracas during 1975) and the Kyoto Conference in May 1976. The Strategy conceived of a global network of regional aquaculture centres established in Africa (ARAC), Asia (NACA), Latin America

(CERLA) and a regional programme in the Mediterranean (MEDRAP). Each regional centre and programme essentially comprised national institutions of excellence, or a network of such institutions for applied research and technology development, training and exchange of information. A fifth centre, the Fish Culture Research Institute in Hungary, or HAKI, by then strengthened through previous UNDP/FAO assistance, was later identified to provide these regional centres with support in key disciplines including pond design and engineering. HAKI's becoming a part of the global network owes much to Ramu Pillay's foresight. Hungary was one of the first European countries assisted by FAO for aquaculture development. Once rich in fisheries resources, a century of tampering with its rivers and wetlands led to its near total reliance on farming for fish supply. Ramu Pillay foresaw a similar global process in Hungary's transition, during the 1970s, from capture to culture fisheries. HAKI pioneered the transfer of highly productive Asian fish farming practices to Europe. With guidance from Ramu and its scientific advisory board, it grew into an international research, development and training centre that served well, through the global network, the needs of developed but especially developing countries.

To coordinate and develop this global network, UNDP supported the establishment in FAO of the project, Aquaculture Development and Coordination Programme (ADCP) and put Ramu Pillay in charge. As Programme Leader, he proceeded to translate the Kyoto Strategy into a global action programme. He recruited and welded a multidisciplinary team of scientists and mustered their expertise to develop regional system-oriented programmes of research, training and information that were carried out by the regional aquaculture centres. The centres were identified through consultations with governments and strengthened, with investments from governments, UNDP and other donors to become top caliber institutions of research and development. The regional programmes were developed for implementation with full participation of national teams of scientists, technologists, farmers and government planners, assisted by the ADCP Team. This infused the global programme elements of national and regional priorities relevant to local problems and needs. This and TCDC became the operating guidelines of the regional networks, probably exemplified best by the Asia-Pacific network, NACA, which established itself as an inter-governmental organization in January 1990.

Two of five is a fair record but Ramu Pillay might have done more to improve on it had he not retired in 1985. Nonetheless, the efforts put into developing their programmes and staff enabled the others to develop into centres of excellence and continue rendering useful research and development services to their regions.

Retirement from FAO did not mean retirement from aquaculture. Ramu Pillay became Director of the Svanoy Foundation for Aquaculture Development, Norway, from which he channeled private sector contributions for aquaculture development in developing countries. When this phase ended as well he resumed writing books. Besides the earlier publications (Planning of Aquaculture Development and Advances in Aquaculture) his other books are: Aquaculture Principles and Practices, 1990; Aquaculture and the Environment, 1992; and Aquaculture Development: Progress and Prospects, 1994. These have become standard texts for students and practitioners and been translated into several languages. Most retirees would have kept to writing. Ramu Pillay stayed active in aquaculture. He lectured, advised the Government of India, wrote and gave numerous keynote papers at technical conferences. His contributions to world aquaculture development were recognized much earlier, in 1976, when he was awarded an honorary life membership by the World Aquaculture Society.

He maintained a close relationship with NACA and was appointed honorary adviser by its Governing Council in 1995, helping to guide it to become the model that a number of recent network development efforts have found worthy to emulate (such as the recently founded Network of Aquaculture Centres in Central and Eastern Europe, or NACEE, and the one being developed in the Americas, the putative NACTA).

At that late stage in his career, he sparked the second of his two most important contributions to world aquaculture: The Conference on Aquaculture in the Third Millennium in Bangkok in 2000, designed as the sequel to Kyoto. He worked with NACA to write the Conference prospectus and develop its agenda, and then headed a multi-agency committee to steer it to completion. The chairman of the Bangkok Conference summed up Ramu's role in it by acknowledging that he "provided the spark, vision and encouragement" for all participants to join the Conference. He was thus the architect of the Kyoto Declaration on Aquaculture and the

prime mover of events that led to the Bangkok Declaration and Strategy for Aquaculture Development Beyond 2000, two of the most important milestones in the development of world aquaculture. Guided by the Bangkok Declaration, NACA included in its programme of work for the first five years of the new millennium what Ramu Pillay had envisaged in 1976: inter-regional cooperation in accelerating and expanding aquaculture development. This has made inter-regional cooperation an important part of the organization's programme, and has found concrete examples in many of NACA's joint projects with institutions and countries in other regions including the South Pacific, the Americas, Africa and Europe, some in direct partnership, others in consortia with international organizations. The latest of these is sadly born of a catastrophe, but he would have been proud to see that the regional and international organizations, to which he had given his touch and legacy in various forms and degrees, rapidly formed a consortium to collectively respond to the restoration and development needs of the communities devastated by the Indian Ocean tsunami.

Ramu Pillay made aquaculture his *raison d'être*, his life. But his influence on its development

had not been like the spawning of a sudden wave of interest and action. It was, as with his life, a deliberate, systematic and progressive process, more like stemming from a headwaters of vision, given momentum by perseverance and doggedness, gaining volume and gathering substance from the confluence of numerous tributaries of interests and objectives as they flow along, and eventually branching out into several streams and rivulets of purposes, each carving its course and nourishing the developmental landscape as it flows on to the sea. The active career of Ramu Pillay in fisheries and aquaculture research and development may be recorded in finite terms as 58 years, from 1947 to 2005. But the river flows on.

His passing is a great loss to his family. The aquaculture community share their grief and wish them comfort in their bereavement. He worked until his time came up, having just finished the second revision of his book "Aquaculture Principles and Practices." It was as if he did not want the world aquaculture community to feel the loss of his going away.

Stalwarts are never lost to the world; they live on in their legacy. Ramu, we thank you for the legacy.

Thankful Farewell to

Francis Christian Baldock (1947-2005)

From the Aquatic Animal Health Community of Asia-Pacific, 12 July 2005

The aquatic animal health community of Asia-Pacific and the world at large were shocked, speechless and deeply saddened to learn that Dr Francis Christian Baldock unexpectedly passed away at his residence in Brisbane, Australia on 6 July 2005.

In April 1996, twelve senior aquatic animal health scientists in Asia had the good fortune of first meeting Chris Baldock during the first Master Course on Aquatic Animal Epidemiology organized by the Australian Centre for

International Agriculture Research (ACIAR), the Aquatic Animal Health Research Institute (AAHRI) and the Network of Aquaculture Centres for Asia-Pacific (NACA). After that first encounter and two week interaction, everyone called him Chris. The rest is history.

In 1998, Chris joined the FAO Regional Technical Cooperation Programme on Responsible Movement of Live Aquatic Animals in Asia-Pacific (TCP/RAS/6714(a) 9605(A) - a project for 21 Asian governments implemented by NACA. He



actively participated in the extensive national consultation process from 1998-2000 and the three regional workshops. Chris also contributed significantly to the regional activities of FAO, NACA, and the Asia-Pacific Economic Cooperation (APEC) on programmes such as primary aquatic animal health care; risk analysis; surveillance and zoning; emergency preparedness and contingency planning; and aquatic animal health information systems.

He generously shared his time and expertise to contribute to the Fish Health Section's Symposia on Diseases in Asian Aquaculture – at DAA IV (Cebu, Philippines) as a Plenary Speaker; at DAA V (Gold Coast, Australia) as a member of the Local Organising Committee (Treasurer) and the Program Committee, as a Plenary Speaker, as Co-Moderator of the EUS Workshop, and as a Convener of the Epidemiology Training Course; and currently as a member of the International Scientific Programme Committee of DAA VI (Colombo, Sri Lanka, October 2005).

A driving force behind the International Society for Veterinary Epidemiology and Economics (ISVEE), Chris consistently worked on including aquatic animal health sessions during ISVEE conferences - in 2000 during ISVEE IX in Fort Collins, Colorado which also gave birth to the International Society of Aquatic Animal Epidemiology (ISAAE); followed by ISVEE X in Santiago, Chile in 2003; and shortly before his demise, he was actively organizing one of seven concurrent thematic sessions on Aquatic Animal Epidemiology, for ISVEE XI, scheduled to be held in Cairns, Australia in August 2006. We will remember the important legacies

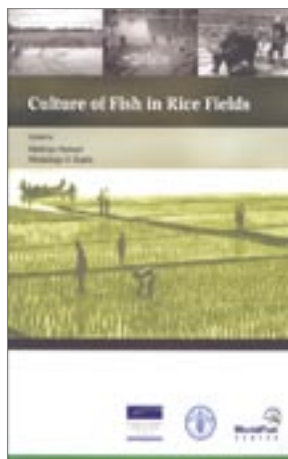
which Chris unselfishly shared with the aquatic animal health community – epidemiology, risk analysis, surveillance and reporting, information systems, emergency preparedness and contingency planning – approaches which had hardly been applied to aquatic animal health management in Asia prior to 1996.

Chris was a natural trainer, always carrying loads of humour. Workshop participants from Thailand, Philippines, Indonesia, Vietnam and the 37 countries represented during the risk analysis training courses in Thailand and Mexico will clearly remember Chris's natural wit, his excellent knowledge of his field, his skillful ability to communicate in very simple terms, and his extraordinary patience in explaining 'epi' concepts to an audience with very little background on the subject. We fondly remember his thoughtfulness to trainees, providing 'give-aways' or 'gifts' whether one answers his question correctly or not, the surprise assignments, and his definition of a workshop – "You *work*, and I *shop*!"

We will miss you Chris. But deep in our hearts, we know that you are happy where you are now - as you were happy where you had been. No amount of words can ease the sadness and sorrow of your loved ones, but we hope that Trish, Sara, Christian and Patrick will find comfort in knowing that everyone who had the good chance of meeting you are all thankful for such an opportunity – we shall remember you and hold you in high esteem. Yes, you have left us - but to a greater community of family, friends and colleagues whom you have inspired one way or another. Thank you for sharing your passion for life. May you rest in peace and may God's grace comfort all of us.

<http://www.ausvet.com.au/>
<http://www.daasix.org/newspage.asp?NewsID=66>

Halwart, M. & M.V. Gupta (eds). 2004. Culture of fish in rice fields. FAO and The WorldFish Center. 83p.



Rice is presently grown in 113 countries. Rice farming also offers a suitable environment for the culture of fish and other aquatic organisms. This publication synthesizes the available information on the role that aquaculture can play in rice-based farming systems towards food security and poverty alleviation.

The review describes the history behind integrating aquaculture with different rice ecosystems, the various production systems in operation such as concurrent, rotational and alternate, the modifications needed to the fields in order to integrate fish with rice farming, and the agronomic and aquaculture management that is necessary. The benefits of integration to communities-economic and environmental are also described with reviews of the experiences from various countries.

The real impacts of rice-fish farming and its future potential in terms of improved income and nutrition are significant but generally underestimated and undervalued. Notable changes have taken place in pest management in rice farming, and in fish seed production and availability making this a particularly relevant moment for emphasizing the importance of rice-fish farming. There is considerable potential for rice-fish farming to expand further in many countries and to contribute substantially towards global food and nutritional security.

For further information please contact: Matthias Halwart at FAO/HQ, (e-mail: matthias.halwart@fao.org). This publication can be downloaded at the following website: www.worldfishcenter.org/Pubs/CultureOfFish/CultureOfFish.htm.



Subasinghe R. & Lowther A. 2005. Towards improving global information on aquaculture. FAO Fisheries Technical Paper No. 480, Rome, FAO, 2005. 170p.



To work towards improving information on global status and trends for aquaculture, in January 2004 the FAO Fisheries Department convened two meetings of international aquaculture experts. The first of the two meetings, the Expert Consultation on Improving Information on Status and Trends of Aquaculture, was held

20-23 January. The 16 experts, chosen for their technical expertise, included participants from five continents and a mix of government aquaculture officials, academic researchers, and representatives of producers associations and regional aquaculture organizations. The Expert Consultation approved a draft Strategy and Outline Plan for Improving Information on Status and Trends of Aquaculture. Following the Expert Consultation, the Working Group of Experts on the FAO Aquaculture Questionnaire "FISHSTAT AQ" met from January 24-26 to suggest improvements to the data collection form used by FAO in its annual inquiry to member countries for aquaculture statistics. They were asked to deliberate improvements, while keeping in mind the relevant recommendations of the preceding Expert Consultation. Many of the same experts participated in the Working Group, but additional participants representing national providers of data to FAO, as well as two survey research specialists in questionnaire design, took part in the Working Group.

These meetings are seen as the beginning of the parallel process to what has been done for status and trends reporting for capture fisheries. The outcome there was the adoption of the Strategy for Improving Status and Trends Reporting on Capture Fisheries, which has been formally agreed on and accepted by the FAO Committee on Fisheries (COFI). The process for aquaculture status and trends was envisioned to produce a similar Strategy document for the aquaculture sector. The draft Strategy for aquaculture, the reports of

the two meetings, and background documents prepared for the meetings are contained in this volume. The background documents include an overview of current FAO procedures for collecting and reporting aquaculture statistics, a summary of the issues confronting attempts to improve data collection and reporting, and a collection of regional reviews in which countries have described their systems and strategies for the collection of aquaculture status and trends information.

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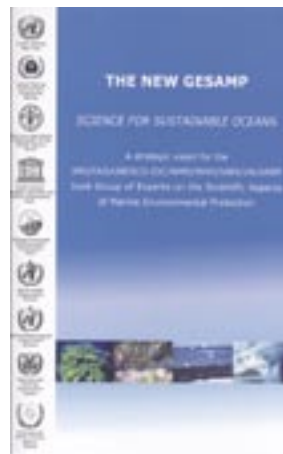


Franz, N. 2005. GLOBEFISH. Overview of Organic Markets: An opportunity for Aquaculture Products? FAO/GLOBEFISH Research Programme, Vol. 77. Rome, FAO. 2005. 102p.



This GLOBEFISH Research Programme covers the developments in the organic food sector in general and examines the potential for seafood products in particular. Organic seafood products are a sector which compared to other food products is still in its infancy. Organic aquaculture is described, covering standards, species, and products in the different producing countries. In this connection the possibilities and the major restraints are described. Ecolabelling based on sustainable capture fisheries is part of the analysis. The intention of the report is to assist producers in developing countries to take advantage of this niche market and be informed on basic requirements and trade channels in the dominant markets.

Administrative Secretary of GESAMP (IMO/FAO/UNESCO-IOC/WMO/WHO/IAEA/UN/UNEP) Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection). 2005. The new GESAMP: Science for Sustainable Oceans: A strategic vision for the IMO/FAO/UNESCO-IOC/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection. London, IMO. 21p.



This strategic vision for the New GESAMP, "Science for Sustainable Oceans", sets out the path which GESAMP intends to take when providing authoritative, independent, interdisciplinary, scientific advice to organizations and Governments to support the protection and sustainable use of the marine environment. It explains why GESAMP is

needed as an interagency organ of the United Nations system, how GESAMP plans to engage with the users of its advice and the broader scientific community, how it achieves a more professional business approach to planning, management, work methods and delivery of its advice. It also informs on the organizational relationships in the New GESAMP, its output, participation and membership and gives a summarized 3-year budget for full implementation of this strategic vision.

Further details can be obtained by writing to Uwe Barg at FAO/HQ,
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This publication can be downloaded in pdf at the following website: <ftp://ftp.fao.org/docrep/fao/007/y5897e/y5897e00.pdf>



FAO Report of the twenty-third session of the European Inland Fisheries Advisory Commission. 2005. Wierzba, Poland, 26 May–2 June 2004. (English/French). *FAO Fisheries Report*. No. 771. Rome, FAO. 2005. 43p.

The twenty-third session of the European Inland Fisheries Advisory Commission (EIFAC) was held in Wierzba, Poland, from 26 May to 2 June 2004, in concomitance with a Symposium on Aquaculture Development – Partnership between Science and Producer Associations. The session reviewed EIFAC's activities since 2002 in the fields of fishery biology and management, aquaculture, protection of the aquatic resource, and social and economic issues. EIFAC revised and decided its future programme of work, and in particular the activities which should be carried out until the next session of the Commission in 2006. The twenty-fourth session will be preceded by a Symposium on Hydropower, Flood Control and Water Abstraction: Implications for Fish and Fisheries.

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FAO Report of the Workshop on the Feasibility of Establishing a Regional Cooperation Network for Aquaculture in Latin America and the Caribbean. 2005. Panama, Republic of Panama, 6-8 December 2004. (English/Spanish). *FAO Fisheries Report*. No. 773. Rome, FAO. 2005. 43p.

The workshop examined the status of aquaculture in Latin America and the Caribbean, with a focus on its contribution to economic and social development and the major difficulties it faces. It also looked at previous occurrences of cooperation for aquaculture in the region with the presentation and analysis of a summary of past activities and mechanisms. The central issue placed before the workshop was the proposal to establish a new regional cooperation network for aquaculture, based on a study carried out by FAO and additional information on similar activities conducted by the Asia-Pacific Economic Cooperation Council (APEC) Fisheries Working Group and the Latin American Organization for Fisheries Development (OLDEPESCA). The workshop recommended the establishment of an intergovernmental cooperation network for aquaculture that would be open to all the countries of the Americas

and would establish linkages with equivalent mechanisms in other regions. It identified key issues for the network's attention, together with its possible structure and sources and modalities of financing. The agenda and list of participants are given in Appendixes A and B respectively. Appendixes C and D contain background documents prepared to facilitate discussion.

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FAO/Network of Aquaculture Centres in Central-Eastern Europe (NACEE). Report of the First Meeting of Directors of the Network of Aquaculture Centres in Central-Eastern Europe (NACEE). 2005. Szarvas, Hungary, 21-24 November 2004. (English/Russian). *FAO Fisheries Report* No. 774. Rome, FAO. 2005. 195p.

The First Meeting of Directors of the Network of Aquaculture Centres in Central-Eastern Europe (NACEE) took place in Szarvas, Hungary, from 21 to 24 November 2004, and was hosted by the Research Institute for Fisheries, Aquaculture and Irrigation (HAKI). The NACEE network membership currently involves 25 institutions from 13 countries of Central and Eastern Europe. During the meeting, representatives of 21 institutions from 12 countries presented their institutions, structure, programmes and activities. The objectives and expectations, basic functions, structure, organizational framework, networking mechanisms, contributions by NACEE members and next programme activities of NACEE were discussed and agreed by the participants. A Founding Document, formalizing the establishment of NACEE, was discussed and signed by the Directors of Member Institutions of NACEE. HAKI at Szarvas was confirmed as the Coordinating Institute of NACEE. During the meeting, NACEE Members were informed of, and invited to contribute to FAO/FIRI's initiatives on the NASOs (National Aquaculture Sector Overviews) and the forthcoming regional and global reviews of aquaculture development trends. It was agreed that the Second Meeting of NACEE Directors should be organized in conjunction with the FAO/NACEE Expert Workshop for the Regional Review of Aquaculture Development Trends in Central and Eastern Europe, and that both meetings would be held from 5 to 9 September 2005 in

Astrakhan, Russian Federation.
 For further details please contact:
 Uwe Barg at FAO/HQ, (e-mail: uwe.barg@fao.org), or Peter Lengyel, NACEE, Liaison Officer at HAKI (e-mail: lengyelp@haki.hu).



Roni P., Hanson K., Beechie T., Pess, G., Pollock M., & Bartley D. 2005. *FAO Fisheries Habitat Rehabilitation for Inland Fisheries: Global review of effectiveness and guidance for rehabilitation of freshwater ecosystems. FAO Fisheries Technical Paper No. 484, Rome, FAO. 2005. 116p.*



The degradation of inland aquatic habitats through decades of human activities has led to massive efforts to rehabilitate freshwater habitats for fisheries and aquatic resources in watersheds throughout the world. Many texts have been written on techniques for rehabilitation though

no comprehensive worldwide review of the effectiveness of techniques has been undertaken. We reviewed published evaluations of freshwater habitat rehabilitation projects including studies on roads improvements and sediment reduction, riparian and floodplain rehabilitation, placement of habitat structures in lakes and streams, addition of nutrients to increase aquatic production, and other less common techniques. In particular, we summarize what is known about the effects of various techniques for restoring natural processes, improving habitat, and increasing fish and biotic production. Recommendations on limitations of techniques, which techniques are effective, as well as information on planning, prioritizing and monitoring rehabilitation projects are also provided.

Despite locating more than 330 studies on effectiveness as well as hundreds of other papers on rehabilitation, it was difficult to draw firm conclusions about many specific techniques because of the limited information provided on physical habitat, biota, and costs, as well as the short duration and scope of most published evaluations. However, techniques such as reconnection of isolated habitats, rehabilitation of floodplains, and placement

of instream structures have proven effective for improving habitat and increasing local fish abundance under many circumstances. Techniques that restore processes, such as riparian rehabilitation, sediment reduction methods (road improvements), dam removal, and restoration of floods, also show promise, but may take years or decades before a change in fish or other biota is evident. Other techniques such as bank protection, beaver removal, and bank debrushing can produce positive effects for some species but more often produce negative impacts on biota or disrupt natural processes. Comparing the cost-effectiveness of different types of rehabilitation techniques was not possible because few evaluations reported various costs or economic benefits; however, estimates of average costs for various techniques are provided. Monitoring and evaluations clearly need to be designed as part of the rehabilitation action and we discuss the key steps to consider when designing monitoring and evaluation of rehabilitation actions at various scales.

Similar to less comprehensive reviews of rehabilitation, our review demonstrates three key areas lacking in most rehabilitation projects: 1) adequate assessment of historic conditions, impaired ecosystem processes, and factors limiting biotic production; 2) understanding upstream or watershed-scale factors that may influence effectiveness of reach or localized rehabilitation; and 3) well designed and funded monitoring and evaluation. These are the same factors that consistently limit the ability of published studies to determine the success of a given technique at improving habitat conditions or fisheries resources. Finally, our review suggests that many habitat rehabilitation techniques show promise, but most have not received adequate planning, monitoring, or cost-benefit analysis.



Health management and biosecurity maintenance in white shrimp (*Penaeus vannamei*) hatcheries in Latin America advertised in FAN 31 in English and FAN 32 in Spanish is now also available in Chinese. *FAO Fisheries Technical Paper. No. 450. Rome, FAO. 2003. 64p,*

