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Ensuring the sustainability of aquatic production.....

Is it correct to say “aquaculture has a bad reputation!”? Well, some forms of aquaculture have a bad reputation in the eyes of some of the public. The issues of concern to public include; chemicals and veterinary drug use, accumulation of environmental contaminants, escapees, net energy conversion during farming of top carnivores, mangrove clearance and land degradation, competition with other users of the aquatic and coastal environments, etc. Some of these issues are certainly true and worthy of considering, but the quantum to which the issues are highlighted is definitely biased. Certainly it is wrong to say “aquaculture has a bad reputation”, because aquaculture is so diverse and complex. We just can’t put all eggs in one basket and say all are bad! Unfortunately, the truth is that the bias has worked against the truth; in the international environmental arena aquaculture has a tarnished image.

Traditional or extensive aquaculture is still in practice in many countries in the world, producing large quantities of fish feeding low in food chain. These systems and their products support livelihoods of people, provide food, alleviate rural poverty and improve health among less fortunate communities. The “modern-day aquaculture”, which is perceived primarily as producing high value species (mainly carnivorous fish and shrimp) destined for import markets, is a different kettle of fish altogether. These systems and practices use significant amounts of natural resources and also produce considerable volumes of effluents and waste. The sustainability and the environmental acceptability of these systems and practices have been increasingly questioned and scrutinised. However, during the past decade, mainly owing to research and technological improvements, the sustainability and environmental acceptability of these practices have improved significantly.

While “modern-day aquaculture” is trying to improve its’ image and sustainability, and to produce fish acceptable to international markets and consumers, the global population is increasing rapidly, requiring more fish as food. Without much hope for fish from the marine catches, most of this demand has to come from aquaculture and inland fisheries. Even if we manage to increase the production to meet the demand, what guarantee do we have that fish will be easily accessible to all sectors of the global community? Can rural or urban poor communities be able to consume more fish in the future? Will there be a significant increase in fish consumption in Africa? How much do we know about the role of fish as food for poorest and unfortunate segments of the global population? What would be the role of inland capture fisheries and what opportunities would culture-based fisheries have to improve fish consumption among vulnerable populations?

The Fisheries Department is now working towards better understanding the role of inland fisheries in increasing fish production, improving access to fish and better nutrition and health. Some case studies are being conducted and more work is planned. Preliminary results of one of those studies are elaborated in this issue. As we move to a better understanding of the role of aquaculture, culture based fisheries and capture fisheries it will be important to balance environmental concerns with production and food security concerns. Accurate information on aquatic resources and the people that depend on them will be essential elements to ensure sustainability and avoid misperceptions.

Rohana Subasinghe
Devin Bartley

Cover photo courtesy of Arkadiusz Wołos,
Inland Fisheries Institute, Olsztyn, Poland:
Fishermen on Lake Łuknajno (Poland)

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Fishery based food security field schools: Bondo district, Lake Victoria, Kenya

Devin M. Bartley
Inland Water Resources and Aquaculture Service
FAO Fisheries Department, Rome
devin.bartley@fao.org

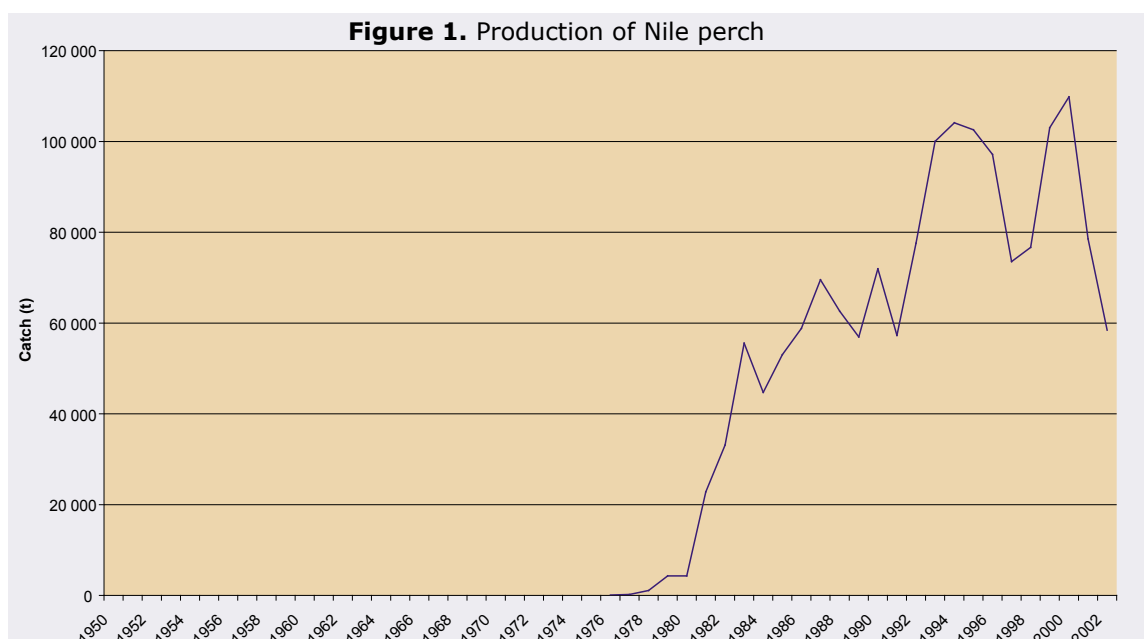
Beatrice Nyandat
Kenya Fisheries Department, Nairobi
samaki@saamnet.com

Deborah Duveskog
FAO, Kenya, Nairobi
DDuveskog@faonairobi.or.ke

Introduction

FAO, Kenyan fisheries and agriculture officers, and farmers and fishers of the Lake Victoria Basin are undertaking a project¹ on discovery-based learning methods in order to generate income, learn new activities and conserve valuable fishery resources. To understand better how this project is working, we undertook a mission to Bondo District, an agriculture and fishing area with approximately 12 000 fishers and more than 3 500 small sail and paddle boats. Approximately 73 landing sites and beach management units (BMU) have been established here to administer the fishery and provide for community development.

Nile perch (*Lates niloticus*) tilapia (*Oreochromis niloticus*), and dagaa or omena (*Rastrineobola argentea*) comprise most of the catch; additional species include other tilapias (*O. esculentus*, *O. variabilis*, *Tilapia rendalli*, and *T. zilli*), catfish (*Clarias gariepinus* and *C. mossambicus*), and small haplochromids. Catches have declined since 2000 (Figure 1) and it is widely rumoured that the Nile perch fishery has collapsed or will soon collapse. Overcapacity, use of illegal gear, e.g. monofilament net and small mesh-size, and fishing in breeding grounds appear to be the main reasons for the decline. Many species, especially haplochromid cichlids, suffered as a





Fish breeding grounds are being protected by local fishers and catches are increasing

result of the introduction of Nile perch in the late 1950s; pollution and sedimentation from land-based activities also have played a role in decreasing the fish stocks.

Fish provide substantial economic opportunity and over 50 percent of the animal protein for people in the district. Therefore, urgent action is needed to prevent additional hunger and hardship on the population and to save the fishery resources of the Lake. Fisheries is one sector that the Government of Kenya has targeted in its current poverty reduction strategy².

FSFS approach

Food security field schools (FSFS) build on the successful farmer field school (FFS) model introduced in Kenya in 1996. The FFSs were developed in SE Asia during the 1980s to help small-scale rice farmers investigate and learn for themselves the benefits of integrated pest management (IPM) in their rice fields. The FSFS are conceived to induce self-reliant approaches in the community by addressing multidisciplinary issues necessary to improve livelihoods and raise food security (see Box 1).

Bondo District presents numerous challenges to agriculture and fishery development. Numerous projects involving fisheries and fish farming have been implemented in the Lake Basin. However, unfamiliarity with fish

farming, inappropriate extension and lack of understanding of the complicated cultural, economic and social system in the area have often worked together to reduce the effectiveness of these past activities. Along Lake Victoria, fishers, processors and traders are often migrants or short-term residents that do not invest or have interest in long-term local development. Additionally, much of the population has limited business experience or competence; money is made and spent quickly with no concern for investments or savings. The motto appears to be that "there will always be fish, so spend the money today and simply get more fish tomorrow". It is now apparent that there may not be fish tomorrow.

The FSFS approach has proven to be an effective mechanism to address many of the above problems by adopting a more participatory bottom-up approach to learning about the entire production and social system by incorporating a broad range of development topics. In Bondo District the approach was designed to be multidisciplinary and broad in scope (see Box 1).

The unique aspect in Bondo District is that, for the first time, the FSFS approach has been applied to BMUs and groups of people involved in capture fisheries.

What is a Farmer Field School?

A Farmer Field School can be described as a community-based practically-oriented field study programme, involving a group of farmers, facilitated by extension staff or – increasingly – by other farmers. The Farmer Field School provides an opportunity for farmers to learn together and test and adapt farming practices, using practical, hands-on methods of discovery learning that emphasise observation, discussion, analysis, and collective decision-making. Discussion and analysis are important ways to combine local indigenous knowledge with new concepts and bring both into decision-making. The process builds self-confidence (particularly for women), encourages group control of the process, and improves group and community skills. Facilitators are used rather than instructors, in order to help stimulate discussion and learning by discovery.

What is a Food Security Field School?

Food Security Field Schools were designed to broaden existing Farmer Field School methodologies. Through Food Security Field School, farmers would move a step further from an agricultural model into a community study and support group that addresses the multi-faceted aspects of food security, including measures to raise production, reduce risks, mitigate the effects of HIV/AIDS and put in place safety nets. The Food Security Field School also provided the main forum to build the capacity of technical staff at various levels, as well as of community members to become skilled facilitators of multisectoral approaches to improving food security.

Capture fisheries and FSFS

Two BMUs, Kogonga and Akoka, have undertaken fishery-based food security field schools (FBFSFS), while a third BMU, Luanda Disi, is making preparations to start the process. Kogonga is a temporary community of approximately 200 people (>50 percent women) from many different areas around the Lake Basin. Local fishing grounds had become unproductive through overfishing and use of illegal fishing gears. A beach management unit was started in 2000 under the direction of Kenyan Fisheries Department (KFD). In 2003,

35 members of the community formed a FSFS to try to protect the valuable fishery habitat in the area and to develop additional land-based activities for income generation and overall improvement in standard of living.

The Akoka FBFSFS is composed of local residents from three beaches, Aram Beach, Kokech Beach, and Kadede Beach. Fishing is similar to Kogonga, and also in a similar manner, fish catches had decreased in the area due to over-fishing and use of illegal fishing gear. On 3 May 2003, ten people within the BMU began mobilizing the community to help protect critical spawning habitat in the area. By 30 July, 2003 the group had 30 members, each paying 100Ksh to join. The group had learned of the experience from Kogonga FBFSFS and contacted KFD to establish a FBFSFS with similar objectives.

The "trials" in both areas involved the protection of fish breeding grounds for Nile tilapia and perhaps Nile perch along the coastline through the establishment of a protected area where fishing was restricted and illegal fishing gear was banned. The idea was that fish from the protected area would move from the protected area into areas where fishing was allowed in order to increase production in the surrounding areas. Prior to

Devin Bartley, FAO



Tilapia are sorted and sold according to size – habitat protection has led to larger and more tilapia and Nile perch

Box 1. Key elements of Food Security Field Schools	
Participatory/ Interactive/ Bottom-up	Group members decide what is important for the school. Discussion among members and facilitators are important
Facilitators not teachers	Facilitators encourage discussion and exchange of ideas; provide additional information that the group may need to make decisions; help group decide what to do rather than lecture group or simply transfer technology
Learn from common experiences	Practical experiences are shared among resource users
Agro-ecosystem analysis	The entire production system and how its parts are linked is extremely important
Multi-disciplinary	Since most people undertake a variety of tasks in their daily lives, the approach should address many components of the production and social system
Experimentation/trials	Learning by doing is most effective
Analysis/adoption	Participants assess the results of their trials and then adopt appropriate techniques to their own production/social system

Table 1. Tilapia production from Kogonga Fishery Based Farmer Field School

a) Indicative tilapia catch of a 3 man crew fishing 4 hours with 5.5" gill net

Size category (approximate weight)	Number of fish	Value/category (ksh)	Value subtotal (ksh)
1 (0.91 - 1.00kg)	2	70	140
2 (0.81 - 0.90kg)	2	60	120
3 (0.71- 0.80kg)	3	50	150
4 (0.61 - 0.70kg)	4	40	160
5 (0.50 - 0.60g)	3	30	90
TOTAL VALUE			660

establishment of the protected area, there were practically no tilapia caught in the area and no Nile perch greater than 1 kg. Additionally, each FBFSFS started raising tomatoes as a means to generate additional income.

Results of establishing the protected area were dramatic. In Kogonga tilapia started reappearing after 3 months of intensive protection of habitat. As of 3 January 2004, 40 weeks after initiation of the programme, catches of tilapia increased from approximately 50 kg/d to between 400 – 500 kg/d; now tilapia of about 1 kg are part of the catches in the surrounding protected area (Table 1). Traders like the larger fish as they are easier to transport and spoil less quickly.

Tilapia of a range of sizes are now regular components of the fish harvest. Tilapia prices are based on size and



Women learning to raise tilapia in ponds

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no record is kept of the weight of the catch, nor of the time spent fishing (Table 1). A general rule is that a fish crew of three people spend six to eight hours/day fishing. Only Nile perch are weighed and sold for approximately 75Ksh/ kg at the time of this report.

In Akoka catches of tilapia increased to approximately 50 kg/beach/day. Nile perch also started appearing in the catch with a maximum size of 5 kg.

However, in both areas the increase in catch brought increased fishing pressure from fishers from other areas into the protected area. These "pirates" usually had motorized boats, did not respect the closed area, often used illegal gear, cut floats away, and physically attacked group members trying to patrol the area.

The FSFS approach in the project is multi-disciplinary. Therefore the fishers also attempted to raise tomatoes as an income generating activity. However, members were not farmers and needed help in producing the crops. Many fishers' families or ancestors had been involved with farming in the past, however. The FSFS brought in facilitators on a variety of agriculture related topics, such as seed variety, plant diseases, health, and HIV/AIDS, and new plots have been planted with tomatoes. Savings accounts and loan schemes have been established and small grants received from the project were used in part to develop horticulture, i.e. fishers chose to spend money on horticulture rather than on fishing gear. At the time of the mission, no fishers had quit fishing to take up farming full-time.

Another BMU at Luanda Disi, one of the first BMU's to protect habitat and regulate fishing gear, has also received funding from the project. This money was used for horticulture development, and the group wants to establish a FBFSFS to study further the benefits of responsible fishing and improve crop production.

Fish farming and FSFS

There is tremendous interest in developing fish farms in the Lake Basin. This was expressed by many of the groups interviewed and also by fishery officers in KDF. Aquaculture development here has not had a very successful track record due to lack of experience, lack of appropriate extension, economic competition from wild fisheries, lack of understanding the social/cultural context of the Basin, shortage of water and other inputs, and shortage of human

resources and capacity³. None-the-less, this interest combined with precarious state of wild fish stocks presents an opportunity for FSFS to learn from past mistakes and determine how and when fish farming may be appropriate.

One FBFSFS in Odundo was organized around tilapia farming and horticulture. The FBFSFS in Odundo sought to teach women alternative activities in order to increase income and food security. Participants were primarily women and senior citizens who did not know anything about fish farming. They chose to examine the differences between tilapia ponds stocked with only male tilapia (all-male treatment) and those stocked with male and female fish (mixed-sex treatment). The group also undertook horticulture of kale and some traditional vegetables using different levels of fertilizer as treatments.

Although production appears to have been low for both tilapia and vegetables, the participants learned basic fundamentals of tilapia farming and were extremely enthusiastic about continuing with fish farming. The group now wants to dig bigger ponds to stock with catfish fingerlings to sell as bait to the Nile perch long-line fishery. However, simple economic analyses of the potential for tilapia and catfish fingerling culture have not been done. These analyses are necessary and should be part of the curriculum of the FBFSFS. For example, 3 fishers working 4 hours captured about 660 Ksh worth of tilapia – can tilapia farmers compete with this source of wild caught fish? Furthermore, long-line fishers currently harvest small haplochromids for bait. This practice is actually illegal as the nets used have mesh size smaller than the legal minimum size. These fish are essentially free costing only labor; each fisher uses about 1200 fish per long-line. Would the fishers be willing to pay for bait that previously was free? How much would farmers need to sell the catfish fingerlings for to be profitable? Would the KFD enforce the ban on small mesh nets, thus forcing fishers to purchase farm-raised bait? What input and transportation costs would be involved?

Opportunities for FBFSFS

The precarious status of the Lake's fish stocks, most of which have declined substantially in recent years, may have created a situation where fishers are motivated to learn about responsible fishing and investing in land-based activities, such as fish farming and horticulture. These new activities will reduce reliance and

pressure on wild fish stocks. Most of landing areas have an established administrative structure, i.e. the BMU, that provide a ready-made entry point for FSFS. Additionally, the excellent results achieved by the Akoka, Kogonga, and Luanda Disi BMU's have shown group members that their aquatic environment is a valuable asset that should be protected. The success of the protected areas has been noticed by other BMU's and fishers in the Lake, thus facilitating establishment of additional field schools.

Although the BMU's were a critical first step in community mobilization, the FBFSFS introduced agriculture to a primarily fishing group of people. One of the problems identified with long-term reduction in poverty and hunger in Bondo District was that many fishers have little business capacity, are transient and do not invest in land or local development. Now fishers are at least considering such investments, and some have created savings accounts and a system of credit.

However, changing established customs and practices will not be quick or easy. It is said that "a man from the sea leaves the sea only when he dies". This should be borne in mind when trying to wean fishers into agriculture. However, it should be stressed that it is still early in the process, there appears to be a viable crop of tomatoes awaiting future harvest, and signs are that there is interest in agriculture development by fishing community.

Lessons learnt

The food security field school approach can and should be extended to the fishery sector (Box 2). The current project has demonstrated that there is interest from group members, good facilitators available on a variety of topics, and although the schools have only been in operation a short time, initial results are encouraging from the BMUs. The development of fish farming in the area will require further economic study, and the FSFS approach in a multi-disciplinary setting would be appropriate in helping farmers decide on where and what kind of fish farming to undertake.

The FBFSFS provide an excellent contact point for interaction with Kenya Fisheries Department, FAO and other potential partners. The Kogonga and

Akoka FBFSFS's working with Kenya Fisheries Department were able to achieve results that neither group could achieve individually. KFD fishery officers have come to understand that many BMUs are serious in their attempts to fish responsibly, whereas many fishers understand better the governments rationale behind fishing regulations. Signs of increased cooperation between resource managers and users are that the District Fishery Officer has agreed to assist with patrolling the protected areas around Kogonga and Akoka BMUs, KDF provided a small foot-pump has been provided to help with irrigation of crops, and local fishers have been diligent at reducing illegal fishing gear and patrolling their fishing area.

Some development projects have been criticized for not reaching the truly vulnerable sectors of society. Strengthening the BMU's through FSFS may help reach some of the vulnerable in Bondo District. Many of the BMU's had set up cooperatives and membership fees in order to support widows and orphans and to provide schools. The holistic approach adopted by FSFS and the increased confidence members have in government resource officers and facilitators may help disseminate information on HIV/AIDS and promote necessary change in social attitudes and practices. Several of the BMU's visited had awareness posters and were trying to inform members on how to prevent the disease.

It will be important to build quickly on the current success and enthusiasm generated by the project. The approach to conserving fishery habitat should be promoted throughout Kenya's shores of Lake Victoria immediately



Devin Bartley, FAO

BMU's and FSFS provide a forum for discussion on related issues such as HIV AIDS



The Lake contains valuable fishery resources, but rural communities are still poor

to protect fisheries, to reduce motivation for poaching, and to improve the effectiveness of the Kenya Fisheries Department. A necessary change in attitude around the Lake Basin may be underway. Sparked by the declining stocks of Nile perch, people are looking for alternative activities to provide food and economic growth. This may involve investment in land based activities, interest in developing long-term residence around farms or productive fishery habitat, and reduced migration out of fishing communities. Accompanying improvements in infra-structure such as roads and processing, as well as improvements in savings and availability of credit, may also be expected.

Bondo District of Lake Victoria has abundant natural resources, but the inhabitants still remain poor for a variety of reasons, some of which are well known, while others are less clear. A multi-disciplinary FSFS approach that incorporates fishery issues and facilitates interventions by government and donor organizations, provides excellent possibilities to address underlying causes of poverty and food insecurity, and help the people improve their lives through better understanding of their environment.

¹ TCP/KEN/2901 Horn of Africa (Kenya): Reducing Chronic Hunger in Bondo District: Evaluation of Fisheries-Based Food Security Field Schools; ² Samaki News, page 33. Vol II (No.1), July 2003. ³ Harris, E. 1993. Fish Farming in the Lake Basin, Kenya. University of Sussex, Brighton, UK.

Box 2. Advantages and challenges of the Fishery Based Food Security Field Schools in Bondo District

Advantages	Challenges
BMUs provide entry point for FSFS	Aquaculture lacks comparable structure
Competent Fisheries Department and User Group	New activities and user skills may be required.
Necessary change in attitude underway facilitated by FBFSFS	Changing attitude difficult
Government support for sector	Infra-structure needed
Mechanism to build trust	New activities should not put users at risk
Trust allows additional topics to be discussed, e.g. HIV/AIDS, education, general health, environment	Other political interests may feel challenged and resist change
Multi-disciplinary approach helps to decide what activities are appropriate	Some activities desired by group may not be appropriate; requires numerous well trained facilitators
FSFS provide contact point for government and donors	
Good user communication helps spread the word	

Letters to Editor

Regarding the article entitled "Trends in National Aquaculture Legislation - Part 1- published in FAN-30, December 2003, we received the following two messages. We appreciate their inputs and clarifications.

Dr M. Sakthivel, President, Aquaculture Foundation of India wrote:

Kindly refer to your article on "Trends in National Aquaculture" Part (1) published in FAN No. 30, Dec. 2003. I congratulate you for preparing this article which is informative. You have referred India in Page 12 wherein you have mentioned "Local fishers started protesting, but in 1996 the Indian Supreme Court issued a final judgment that confirmed the Notification, thereby banning all non-traditional aquaculture within 500m of the high water mark or within 1000m of lakes Chilka and Pulicat". It is not a total ban of non-traditional aquaculture. It is worked like this "The farmers who are operating traditional and improved traditional systems of aquaculture may adopt improved technology for increased production, productivity and return with prior approval of the "authority" constituted by this order". Therefore all farms, developed within 500m (Coastal Regulation Zone) are to follow improved traditional farming technology for higher production and productivity. Aquaculture Authority was established to regulate this development through a licensing system and about 6000 licences have been issued so far. To issue licence, Aquaculture Authority has set up two committees at District and State levels with representatives from Forest and Wild Life, Pollution Control Board, Fisheries, Revenue and Irrigation Departments. Of course, the litigation is still going on in the Supreme Court. Aquaculture Bill is yet to be passed in the Parliament.

Dr Yugraj Yadava, Member Secretary, Aquaculture Authority of India wrote:

Many thanks for your mail and for pointing out the anomaly in the said paragraph of the article. In fact the paragraph does not bring out the issue in its correct perspective and leads to erroneous information- e.g. The Coastal Regulation Zone (CRZ) Notification of 1991 has no direct reference to "aquaculture" at all. If one carefully peruses the Notification, it may be seen that all relevant references in the said Notification lead to aquaculture as a permitted activity (example - hatcheries as permitted activity within CRZ, etc.). However, the Supreme Court judgement of December 1996 interpreted shrimp farming as an industry, which does not require a water front and therefore placed restrictions on certain types of shrimp farming practices within the CRZ. Further, the 1995 Aquaculture (Regulation) Act of Tamil Nadu no longer exists, as this Act and also the Act of the West Coast State of Goa on Brackishwater Aquaculture have been superseded by the 1996 judgement of the Apex Court. I feel such articles should be fully factual (if possible reviewed) so as to disseminate the correct picture. It is all the more important in matters, which are in the process of judicial review.

REVIEW OF FISH PRODUCERS' ASSOCIATIONS IN EASTERN EUROPE

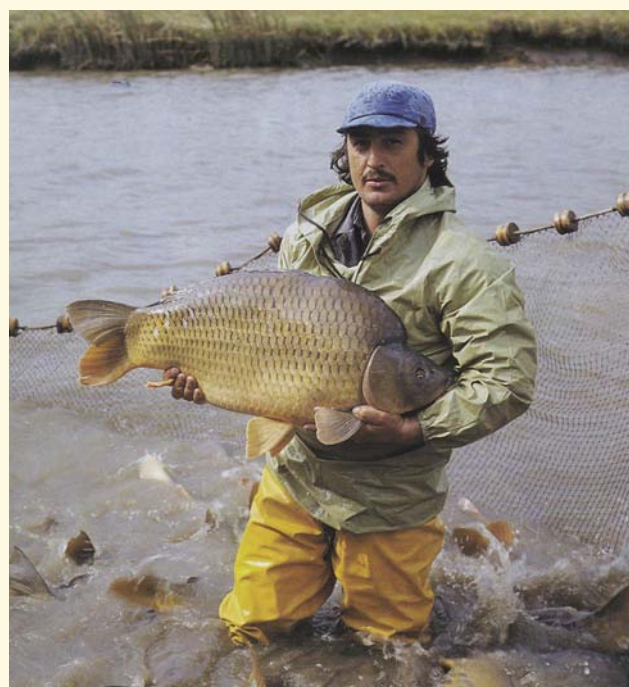
Emese Békefi, bekefie@haki.hu
Péter Lengyel, lengyelp@haki.hu
László Váradi, varadil@haki.hu
Research Institute for Fisheries, Aquaculture and Irrigation
PO Box 47, H-5541 Szarvas, Hungary

Background

The last ten years have brought substantial changes in Eastern Europe on political and economic levels, resulting in radical changes in many sectors as well as in aquaculture. Fish farms had to overcome the difficult process of transition to market economy, during which their characteristics and the market of their products have drastically changed. The process of the transformation was slowed by the fact that most farms had first to solve their liquidity problems arising from the economic difficulties associated with the political changes. In addition, the farms had to operate in continuously worsening market conditions. Compared to the decades of centrally planned economy when they based their production on secure state orders, now they had to face conditions of increasing competition. Privatisation eliminated most of the previously existing large state-owned fish farms, and led to the appearance of new, privately owned and family enterprises. The assets of the existing farms were often acquired at low prices by companies or private owners who were subsequently unable to utilize their capacities or warrant profitable operation due to lack of competence, financial and other reasons. In spite of that, they increased competition to other farms.

At the same time, policy-makers of some Eastern European countries, especially the landlocked ones, still regard fisheries and aquaculture as a low-priority sector of the national economy.

As a result of these factors, aquaculture producers in these countries gradually realized that they needed a new type of cooperation, which would allow them to act jointly to achieve their common objectives. Obviously, this process did not happen simultaneously in the different countries of the region. In the Czech Republic, Hungary or Poland, producers' associations are well-organized, strong and active on both national and international



HAKI

Carp breeding



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Pond fish farming and carp breeding (see photo previous page) are dominant in the Eastern European Region

levels. In contrast, in most Eastern European countries, the level of development of these associations is still low or their formation is only beginning now.

The purpose of this paper is to give a brief overview on the state of development of producers' associations in Eastern European countries, and to invite response by readers, in particular, on additional information they may have on producers associations in Eastern Europe or in other regions.

Development of producers' associations in Eastern Europe

As mentioned above, producers' associations in Eastern European countries are at very different stages of development. They can be broadly classified into the following developmental stages:

- In some countries, there are no producers' organizations and even the structural reorganization of the fisheries sector, which would create the basic conditions for their development, is starting only now. Such is the case of the Republic of Belarus, where the 20 major fish farms are owned by the state and operate under the authority of the Ministry of Agriculture. Although their transformation into stock companies is under process since 2003, the state remains the majority owner of the shares.
- In other countries, the existing producer associations are organised in a top-down direction and are run by the state. A typical example is the Association of Fish Farms of Inland Waters of Ukraine, which is an affiliation of the State Department of Fisheries. Another example is the State Cooperative Association for Fisheries ("Rosrybkhoz") in Russia, which serves as an umbrella organization for over 700 state-owned or private aquaculture enterprises. Currently, the organizations united by the Rosrybkhoz produce over 90 percent of the total production of intensive and pond farms. Recently, steps have been taken in Russia toward forming producer associations of a new type, like the Association of Inland Water Fish Culture Enterprises and Aquaculture ("Rybkhozassotsiatsiya") established in 1993. Its membership currently consists of 32 fish production enterprises and 8 research institutions, and it aims mainly at organization of training courses for fishery professionals and development of collaboration among the members and on an international level.
- In Bulgaria three aquaculture producer associations were founded in the last seven years and the formation of a fourth one is in progress. The oldest of these organizations is the National Association of Fishery and Aquaculture in Bulgaria ("Aquafish-BG") that was established in 1998 and has now 36 members including 25 leading Bulgarian aquaculture producers, fish processing and trading companies and 11 independent experts of the sector. The main objectives of the existing associations, i.e. the Aquafish-BG, the Fish Producers' Association (BG-Fish) and the Bulgarian Fish Association, are mostly similar:

- Protecting the rights of their members and the fisheries and aquaculture sector as a whole;

- Improving the national fishery and aquaculture legislation and adapting it to the EU Common Fisheries Policy;

- Strengthening the position of Bulgarian producers on the domestic and international market;

- Improving the international relationships of the sector by closely cooperating with international organizations and participating in international fishery-related events.

- The most advanced fish producers' associations can be found in the Czech Republic, Hungary and Poland. The oldest organization, the Polish Fishery Association, was established in 1918, but its activity was suspended in 1939 and reactivated during the early 1990's. The most active one is the Polish Trout Breeders' Association, which is a member of FEAP¹ since 1996, is involved in the organization of annual salmonid farmer meetings and the monitoring of Polish trout production. The Czech Fish Farmers' Association, consisting of 60 members, is a

strong national association which is mainly involved in pond fish production. It is active both nationally and internationally, similarly to the Hungarian Fish Producers' Association. Both associations are member organizations of FEAP. In these countries, previous organizations (e.g. associations of state farms or cooperative farms) served as a basis for the development of new-type producers' associations.

Table 1 provides a list of presently known producers' associations and their contact information.

The Hungarian fish producers' association: a case study

The Hungarian Fish Producers' Association is the organization representing the professional interests of the Hungarian fish production sector. It was established in 1990 as the successor of the Organization of Fisheries Cooperatives, founded in 1957. Since 1990, all natural persons, legal entities, or their affiliated organizations not having legal personality can be the members of the Association. The Association has currently 109 members, who operate about 13,800 ha of fish ponds (65 percent of the total fish pond area), representing more than 75 percent of

Table 1. Fish Producers' Associations in Eastern Europe

Country	Name of Association	Address
Belarus	None	
Bulgaria	1. National Association of Fishery and Aquaculture in Bulgaria 2. The Fish Producer Association 3. Bulgarian Fish Association	1. 3 Luna Str. 4003 Plovdiv, Bulgaria (aquafish_bgass@abv.bg), (nkissov@spnet.net) 2. 1756 Sofia, Technical University, bl. 7, vh. 6 (NTM), Bulgaria (reyafish@mail.com) 3. 3 Industrialna Str. 8000 Burgas, Bulgaria
Croatia	Croatian Chamber of Commerce, Section Aquaculture	Mari Mirna, Giordana Palliage 4, 52210 Rovinj, Croatia (marimirna@pu.tel.hr)
Czech Republic	Czech Fish Farmers' Association	495/58 Pražska, 371 38 České Budějovice, Czech Rep. www.rybsdr.fish-net.cz; (RYBSDR@pvtnet.cz)
Estonia	Estonian Fish Farmers' Association	5 Kaluri tee, 11712 Harju county, Viimsi, Estonia www.ngonet.ee
Hungary	Hungarian Fish Producers' Association	4/b Vöröskő u. 1126 Budapest, Hungary www.haltermosz.hu; (iroda@haltermosz.hu)
Latvia	Latvian Crayfish and Fish Farmers' Association	7-6 Alberta Str. 1010 Riga, Latvia (earens@latnet.lv)
Lithuania	No information	No information
Romania	None	
Russian Federation	State Co-operative Association for Fisheries "Rosrybkhoz"	18a Ermolaevskiy pereulok 123001 Moscow, Russia
Russian Federation	Association of Inland Water Fish Culture Enterprises and Aquaculture "Rybkhozassotsiatsiya"	18a Ermolaevskiy pereulok 123001 Moscow, Russia
Ukraine	Association of Fish Farms of Inland Waters of Ukraine	45a, Artema str., 04053 Kyiv, Ukraine



Utilization of geothermal energy in intensive systems is one of the possibilities of aquaculture development

the total volume (quantity) of fish supplied by the Hungarian fish production sector.

The main governing organs of the Association are the General Assembly, the Board of Directors, and the Control Commission. Two important organizations affiliated to the Association are the Fish Product Council and the Carp Breeding Branch. They are involved in organising the biological and economic bases of the national fish culture. The Fish Product Council suggests limit prices, coordinates marketing activities between producers, processors and traders, and provides information to members. The Carp Breeding Branch, in close collaboration with the Institute for Agricultural Quality Control, the Ministry of Agriculture and Rural Development, and the Research Institute for Fisheries, Aquaculture and Irrigation, is an important player in the planning and implementation of carp breeding programs and standardised carp performance tests. It also assists the members by providing them with technological advice.

The Association owns a fish breeding farm that cooperates closely with several universities and state research institutes and actively participates in putting the results of fisheries and aquaculture science into practice. The farm provides stocking material of good quality to Hungarian producers and plays an important role in the organization of live fish exports.

The main objective of the Association is safeguarding and emphasizing the interests of fish producers. Therefore, the basis of its work is the communication with state

organizations for fisheries, governmental and non-governmental bodies of environmental protection, international fisheries organizations, media and people.

The Association regularly organises professional forum discussions on strategies and actual problems of the sector. It provides advisory assistance to its members in legal, environmental and marketing issues, but also in the preparation of various applications for subsidies and funds. The Association has recently launched a Marketing Communication Program aiming at the increase of fish consumption, with special regard to locally produced fish products.

The Association is also responsible for the maintenance of international contacts for the benefit of its members. It organises study tours abroad, which not only contribute to the professional development of the members but also strengthen their international relationships.

The Hungarian Fish Producers' Association joined the FEAP in 1999.

Perspectives of development

The need for coordinated actions and joint representation of fish farmers is increasing and the positive examples from the activities of existing farmers' associations encourage the establishment of new organizations. However, there is still much to be done in this field. Several countries have only just begun the



HAKI

organization of their producer associations and the experiences of their already existing foreign counterparts can help them avoiding the mistakes that the latter might have made.

The situation of the existing associations is often also far from ideal. They frequently struggle with institutional and personal problems, and suffer from lack of recognition and appreciation by policy-makers in their respective countries, and from economic difficulties. The international cooperation and exchange of information and experiences are hampered by the inadequate supply of modern communication means (internet, etc.) and by language barriers which are especially characteristic and particularly problematic for the former Soviet republics.

The improvement of the situation needs, first of all, stabilization of the economic situation and creation of the fundamental infrastructural and institutional background for the operation of producers' associations. But another extremely important task is the improvement of cooperation and information exchange between the producers' associations of the Eastern European region. Better communication is needed to draw the attention of new associations to the possibilities to make use of, the ways to follow and the mistakes and traps to avoid.

NACEE: Possible assistance in improving communication

Recognising the need for better communication and information exchange between Eastern European countries, the Research Institute for Fisheries, Aquaculture and Irrigation (HAKI) in Szarvas initiated the creation of a network that would promote cooperation and information exchange between fisheries-related institutions and organizations of the region. The Network of Aquaculture Centres in Central-Eastern Europe (NACEE) was established in 2003 and already counts 19 members from 13 countries. Although NACEE is an inter-institutional network of aquaculture R&D and training institutions, one of its main objectives is to enhance partnership between science and producers. It provides a good framework for solving the common problems and promotes the development of fisheries and aquaculture in the entire region. To facilitate communication and recognizing the linguistic specificity of the region, NACEE has two official languages: English and Russian. It undertakes the mission of bridging the communication gap and acting as a mediator between the aquaculture-related institutions of the Eastern European countries and international organizations like EAS, FAO, FEAP and NACA.

For further information on NACEE, please contact Mr Peter Lengyel at HAKI (lengyelp@haki.hu). The authors will also appreciate receiving any additional information on Eastern European producer associations.

¹ FEAP Federation of European Aquaculture Producers. www.feap.info and www.aquamedia.org

Aquaculture Development: Partnership between Science and Producer Associations

Highlights of the EIFAC Symposium held in May 2004 in Wierzba, Poland

*Courtney Hough, Federation of European Aquaculture Producers (FEAP¹), courtney@feap.info
László Váradi, Research Institute for Fisheries, Aquaculture and Irrigation (HAKI²), varadil@haki.hu
Michael New, European Aquaculture Society (EAS³), Michael_New@compuserve.com
Uwe Barg, Inland Water Resources and Aquaculture Service, (FAO), uwe.barg@fao.org*

A Symposium on Aquaculture Development "Partnership between Science and Producer Associations" was held during 26–29 May 2004 in Wierzba, Poland, in conjunction with the Twenty-third Session of EIFAC⁴, the European Inland Fisheries Advisory Commission. More than 70 experts from 23 countries attended the Symposium which benefited from the participation and experience of the Federation of European Aquaculture Producers (FEAP) and the European Aquaculture Society (EAS).

Background and scope

There is an increasing trend within the European aquaculture sector towards creating partnerships and collaboration between aquaculture producers and scientists, government officials and other stakeholders. Producers are recognized as key players for establishing sustainable aquaculture development, being direct users of resources during the production of food. However, more interaction and better communication and coordination between producers and natural and social scientists, as well as other stakeholders interested in aquaculture, is required. The Symposium goals were to discuss roles, opportunities and needs of aquaculture producer associations in the EIFAC region, to identify possible contributions by science, governments and other stakeholders, in support of such associations, and to propose measures to strengthen participation, activities and positions of aquaculture associations in

the management and development of the aquaculture sector. The Symposium sessions further focused on partnership experiences between science and production, on scientific results for practical applications, and on aquaculture and fisheries interactions.

Experiences

A significant range of activities within this scope were presented by the European Commission (CEC), the Federation of European Aquaculture Producers (FEAP), the European Aquaculture Society (EAS), and AquaTT⁵. A variety of programmes and projects, including AquaFlow⁶ (an important thematic network) as well as Asian experiences demonstrated the wide range of issues associated with interactions between the scientific and production sectors.

The European Community adopted a strategy for the sustainable development of the European aquaculture industry in September 2002 that is now being implemented. The strategy aims to maintain the competitiveness, productivity and sustainability of the European aquaculture sector. It also aims to enlarge the knowledge base of the industry, so appropriate partnerships should be promoted at all levels, particularly between science and industry.

In recent years, the European Commission has contributed to strengthening the links between the aquaculture industry and scientists by promoting participation of the industry in



... fish for people and the market

research projects and concerted development actions; examples include 'AquaFlow', for the networked dissemination of RTD project results, and the PROFET⁷ programme for the identification of the research needs of the aquaculture sector. The EU's 6th Framework Research Programme offers new possibilities to scientists and producer associations to improve their partnerships under the specific measures for small and medium-size enterprises (SMEs). In addition, the FIGG (Financial Instrument for Fisheries Guidance) regulation has been modified to allow the financing of small-scale applied research initiatives. The European Commission strongly recommends producers and scientists to make use of the instruments that exist at community level.

The symposium recognized that the level of organization, representativeness and effectiveness of producer associations varies throughout Europe, where there are strong national associations and regional federations as well as associations which are still growing in membership and influence. The small-scale

producers, the highest number of enterprises active in the European fish farming sector, are often isolated and in need of information, in addition to scientific and structural support. These represent the part of the sector that needs the greatest assistance in terms of support from strong professional associations that, in turn, also have the most difficulty in being established and supported financially by their members.

Surveys of aquaculture producer associations in Asia, conducted by the Network of Aquaculture Centres in Asia-Pacific (NACA⁸), showed the wide range of approaches and purposes, and organizational and working patterns adopted by such associations. These also displayed different levels and modes of representativeness, independence, participation and consultation, empowerment and policy influence. Key issues include communication and cooperation with governments, scientific institutions and other parties, as well as supportive legislation and enabling environments facilitating and promoting such associations.

Participants presented numerous and wide-ranging examples of partnerships between producer associations and science, which included:

- Provision of information to farmers; identification of producers' research needs; formulation of national and pan-European research agendas; training of producers,
- Provision of the quality of inputs used in aquaculture (e.g. feeds, seed, water, skills) and culture-based fisheries; identification of scientifically-sound criteria and para-meters;
- Environmental management and monitoring of shellfish production; genetic strain improvement, organic carp production; restocking of lakes and integrated management of lagoon fisheries and aquaculture;
- Identification of bottlenecks in policy and regulation and diversification of production; Development of national aquaculture sector development strategies; market chain cooperation;

Examples of multi-stakeholder partnerships were: the management of lagoon fisheries in France and Italy, which involve producers, scientists, processors, sellers, and government authorities, as well as a carp production consortium and a multi-functional carp farm in Hungary. Professional aquaculture has to show that it can provide added-value, in many different ways, to the area or the region in which it is developing. This added-value, aside from the products themselves, can be demonstrated in terms of the development of opportunities for jobs, conservation, (eco) tourism and other economic opportunities related to the production activity.

Partnerships between associations and science can assist aquaculture producers in: production (stocking density, feeding regimes), technologies (water efficient and environmentally friendly systems), management (to enhance skills in farm and business management), economics (e.g. cost-benefit analyses and economic feasibility studies) and marketing (such as related to low market prices, accessing market information). Attention was drawn to Aquainnovation⁹, an example of a partnership between science and producer associations and other stakeholders at pan-European level. This new partnership was set up in a project format,



Measuring ... for production and science

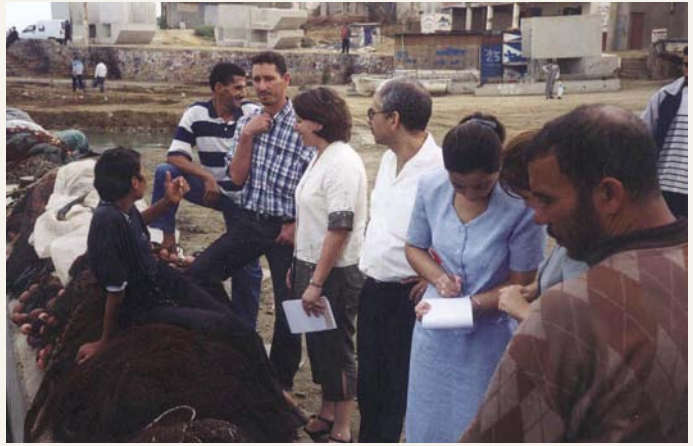
aiming to establish a network of stakeholders that should address the gaps in international transfer of technical information that is essential for SMEs.

Experiences of partnerships between science and the production sector were generally good, although awareness and communication of issues, problems and solutions can be enhanced further. This can be achieved through regular communication between partners, by formalizing consultations and participative coordination processes. Equally, efforts should be made to create conditions for the successful implementation of the outcomes of the partnerships and stakeholder consultations. Positive results could be obtained, as examples, by adapting legislation, establishing research projects, identification of funding possibilities (research, training, investment). For the purposes of sectoral management, it can be important that consultation fora are institutionalized in order to facilitate partnerships and enhance involvement of stakeholders in information collection, knowledge building, policy development and decision-making.

Aquaculture research

Aquaculture research increasingly addresses social and economic issues, including financial management, product marketing, food safety, consumer preferences, integration with local area and regional management, and institutional, legal, and governance aspects. Social science assessment methodologies are being increasingly applied. They examine interactions between stakeholders, analyze fishery product chains, identify development potentials in local and regional contexts, and facilitate stakeholder participation, consensus building, and policy formulation and implementation.

Many aquaculture scientists and individual producers are still production-oriented and do not pay enough attention to the financial, marketing and quality aspects of the production processes. Market-driven production is still not common in some countries, but efforts are under way to increase experience and to apply effective farm management for the production of competitive aquaculture products. Partnerships to establish marketing chains for fishery products can enable producers to respond more effectively to consumer demands. Successful chains require cooperation between producers, their associations, scientists, wholesalers, the processing industry and retailers.



Communicatingfor production and science

New production projects - including diversification efforts - should be based on a realistic cost-benefit analysis (investment/operational costs included) that accounts for market situations. Too often, mistakes have been repeated by investors or authorities, at different times and in different countries, which could have been avoided through improved communication with experts and availability of information.

It was recognised that there are significant linkages between research and development programmes for aquaculture and fisheries, as illustrated by the involvement of both sectors in enhancement and rehabilitation schemes aimed at monitoring and improving fish stocks in inland waters. Recreational fisheries are important for the development of aquaculture, the rehabilitation of fish stocks and for the economy in general.

Participants discussed the differences between theoretical and applied research and the use of research outputs in practice. There is a need for the terminology of scientific research results to be communicated in terms that can be easily understood by producers. Ideally, every aquaculture research paper should include a summary, in simple language, of its main findings and practical applications.

More focus is needed on the dissemination of technical information to aquaculture producers. Most scientific publications are not easily accessible to aquaculture producers and the main research findings require translation for communication in popular magazines. Another way of disseminating essential information is through workshops, meetings and conferences where private sector aquaculture producers

can discuss and exchange experiences with scientists. However, the mobility of professional producers is limited and the use of Association or Professional meetings provides the potential for larger audiences.

Funding constraints for applied research are common, as some consider that the sector should contribute to its own applied research programmes and activities. Nevertheless, government funding for aquaculture research is still needed. The support of government agencies was highlighted, particularly since national research programmes are the most important source of funding for European aquaculture research, and it was suggested that these should be more directly involved in supporting the work of the producer associations.

Stronger producer associations

Stronger national associations are needed to respond to increasing legislative, market and consumer demands and to be able to respond to the requests for better self-regulation. Achieving this requires partnerships with science and efficient communication and networking. While such circumstances exist and are quite strong at the European level, efforts are needed to improve dissemination and cooperation at the most basic of levels.

There is a trend towards broader cooperation and consultation involving multiple stakeholders, including potential investors. There is need to access professional management and communication skills within the producer associations, a requirement that accompanies sectoral development and new market and consumer demands. Support is also needed to develop and consolidate the producer associations in those countries where

aquaculture is developing or undergoing significant structural changes.

The Symposium participants reiterated the importance of partnerships in the overall context of promotion of sustainable aquaculture development, in particular in the implementation of the provisions of the FAO Code of Conduct for Responsible Fisheries¹⁰ and the FEAP's Code of Conduct for European Aquaculture¹¹.

Recommendations by EIFAC

The main recommendations of the symposium were discussed by the 23rd Session of EIFAC, which was held immediately after the Symposium. EIFAC's main conclusions and recommendations are as follows.

Cooperatives, trade associations and producer organizations/associations are essential mechanisms, not only to improve marketing but also to cover R&D costs that many small farms cannot afford. Targeted research and development programmes have significant benefits for aquaculture producers. Successful partnerships are characterized by good understanding and communication between partners, clear comprehension of their needs and pro-active positions, as well as coherent national and European RTD policies.

Producers should be assisted in the organization of representative associations. They should also participate in priority-setting and decision-making processes, and be provided with access to information and education.

Partnerships are important in the overall context of promotion of sustainable aquaculture development. Strong professional associations

are required to establish and maintain successful partnerships with scientists. Multidisciplinary approaches should encompass consumer, social and economic issues, and should facilitate cooperation and consultation involving multiple stakeholders.

EIFAC agreed on the following recommendations to its Members:

- Durable partnerships should be promoted at all levels, highlighting the requirement for skill development and securing financial resources for the operation of producer associations,
- RTD programmes applicable to SMEs and associative groupings should be promoted,
- International organizations, such as EIFAC, FEAP and EAS should continue working together to demonstrate the benefits of partnerships in the promotion of sustainable aquaculture,
- Core funding should be sought to promote networking, effective dissemination of research results and communication among inland fisheries and aquaculture stakeholders,
- Organizations such as EIFAC should address the social and economic influences on the sustainability of inland fisheries and aquaculture.

EIFAC welcomed the symposium recommendation to continue the approach of promoting partnership consultations between science and production at future symposia, and to widen the scope by including other relevant stakeholders.

¹ FEAP: www.feap.info; www.aquamedia.org

² HAKI: Research Institute for Fisheries, Aquaculture and Irrigation: <http://www.haki.hu/english/default.htm>

³ EAS: www.easonline.org

⁴ EIFAC: www.fao.org/fi/body/eifac/eifac.asp

⁵ AquaTT: www.aquatt.ie

⁶ AquaFlow: www.aquaflow.org

⁷ PROFET transnational workshops on research needs of the European fish farming sector: www.feap.info/news/RTD/profet_en.asp;

⁸ NACA: www.enaca.org

⁹ Aquainnovation: www.aquainnovation.net

¹⁰ FAO Code of Conduct for Responsible Fisheries: www.fao.org/fi/agreem/codecond/codecon.asp

¹¹ FEAP Code of Conduct for for European Aquaculture: www.feap.info/feap/code/default_en.asp

TRENDS IN NATIONAL AQUACULTURE LEGISLATION – PART II

Melvin Spreij
Legal Consultant
FAO Development Law Service
melvin.spreij@fao.org

This two-part article highlights the most significant trends and initiatives in national aquaculture legislation over the last decade. The previous issue of FAN addressed the tendency to draft comprehensive regulatory frameworks, integrated coastal management and the tendency to coordinate the various governmental authorizations related to aquaculture. This issue of FAN addresses the growing environmental concerns, food safety and other health issues, the concept of sea ranching, law enforcement and the tendency of the aquaculture sector toward self-regulation. It concludes with a comprehensive list of references and selected reading material. FAO continues to assist countries to develop and adopt appropriate legal frameworks and legislature through its technical assistance programme. For further information and advice on national aquaculture legislation, please contact Ms Annick van Houtte, Legal Officer of the FAO Development Law Service (annick.vanhoutte@fao.org)

Increasing environmental restrictions

There is a growing concern noticeable about the environmental impacts of aquaculture activities. Environmental concerns increasingly form a major part of licensing procedures, from the initial environmental impacts of establishing an aquaculture activity to the impacts that may arise through the actual operation of an aquaculture farm. The environmental legislation related to aquaculture has become more direct and stringent over the years given the degree of ecological hazard that can be involved in aquaculture farming. This tendency can be demonstrated by developments in the following areas:

Environmental Impact Assessment (EIA). In order to prevent developments from being undertaken in an environmentally unsustainable manner it is nowadays required to perform an EIA before establishing and/or operating an aquaculture farm. The instrument as such is usually regulated in basic environmental laws, but in some cases reference to the requirement of EIA is made in a specific fisheries and/or aquaculture text. Submission to an EIA is usually determined by various factors such as the proposed size of the aquaculture farm or the sensibility of the area involved. In developed countries it is most common to make use of an EIA and the procedures are usually laid down in impressive and exhaustive detail. Increasingly, also developing countries require aquaculture activities to be subject to an EIA. Recent examples can be found in the *Aquaculture Management Regulations 1996* of Sri Lanka and the *Fisheries and*

Marine Resources Act 1998 of Mauritius. Other countries have developed special guidelines relating to EIA for aquaculture operations, such as Egypt, Tanzania and – with particular attention to shrimp farms – Vietnam.

Chemicals. Over-use and misuse of chemicals, including veterinary drugs, in the aquaculture industry, causing pollution and contamination of the aquatic environment, is another area of growing concern. In addition, the improper use of chemicals raises serious concerns about the quality of the aquaculture product and subsequently human health (see below). While the overriding consideration should be minimizing the use of chemicals in aquaculture, it is recognized that the use of some chemicals is essential. A particular problem is that the expanding aquaculture industry has adopted chemicals that were originally developed for use in other industrial sectors, most notably the agricultural sector. Since many chemicals have not been evaluated yet with respect to their effects on the aquatic environment, a precautionary approach should therefore be applied.

Chemical contamination can be controlled in two ways. The first technique concerns a direct prohibition or restriction upon the use of specific chemicals that are harmful to the environment. The use, import, distribution or sale of particular hazardous chemicals can be made a criminal offence, while such activities in relation to less dangerous chemicals can be made subject to authorization schemes and licensing requirements. Generally, this type of control legislation is found in basic environmental laws or more specific acts related to the use of specific chemicals. Some countries have simply adopted lists of chemicals that are allowed to be used in aquaculture, including rules on how they have to be used. Examples can be found in Vietnam, Malaysia, Thailand, Sri Lanka and China. The second tool to regulate the presence of various chemicals in the environment consists of a system of wastewater discharge licensing. Again, such licenses are in most instances likely to be regulated under the same general system of environmental legislation that applies to the normal industry. A specific example related to aquaculture is the Australian *Great Barrier Reef Marine Park (Aquaculture) Regulations 2000*, whose purpose it is to regulate the discharge of waste from aquaculture operations, which may affect animals and plants in the Great Barrier Reef Marine Park.

Introduction and movement of species. One of the most potentially serious effects of aquaculture on the environment is the introduction of exotic species into environments where they may compete with, or replace, native species. Such introductions are generally unintended, though some can also be the result of deliberate actions. Increasingly, countries have introduced legislation that prohibits the introduction of non-indigenous species and/or limits the movement of fish and other aquatic organisms. In addition, such restrictions are often justified in order to prevent the spread of diseases (see below). Recent attempts to increasingly control the introduction and movement of species can be found in the EU and Japan. In 2001, Peru adopted a specific provision on disease control and the introduction of new species in order to protect the ecosystem and the environment.

Special attention must be given to the relatively new phenomenon of genetically modified aquatic organisms (GMOs). They are usually defined as being essentially transgenic organisms, i.e. organisms that have had foreign genes inserted into their cells. Although currently the majority of farm-raised products are still similar to their wild forms, globally more than a dozen transgenic fish are being developed for aquaculture in developed countries, and it seems likely that aquatic GMOs will soon be available for consumers. Generally, it is accepted that the genetic modification of aquatic species has the potential to increase both quantity and quality of aquaculture products. Biotechnology can be used to increase production, to manage disease outbreaks or can even result in the culture of new species. However, it is the question what the exact impact of GMOs on the local genetic biodiversity will be if GMOs breed with local stocks. They might compete with native species, but interbreeding could also damage the genetic integrity of the wild stock. Although much research has already been done, definite answers are not available yet.

A precautionary approach toward the introduction and release of GMOs should therefore be applied for the prevention of environmental harm. This can be illustrated by the extensive provisions on the use of aquatic genetic resources in FAOs *Code of Conduct for Responsible Fisheries*. In most developed countries, stringent legislation on the introduction and use of GMOs has been adopted over the years. Although there is a widespread feeling in developing countries to regulate the issue as well, only few specific measures have

been taken so far. In some countries the issue is considered to be sufficiently addressed by existing legislation on the introduction and movement of species. During the negotiations leading to the Cartagena Protocol on Biosafety, which entered into force on 11 September 2003, the developing countries have pressed for strict regulation of GMOs since they generally lack an adequate regulatory system and believe that all kinds of unsafe experiments will be carried out in their countries. Nevertheless, in some developing countries strict regulations to the use of GMOs in aquaculture do exist. In the Philippines, a National Committee of Biosafety that identifies and evaluates potential hazards from genetic experiments or introductions addresses the issue. Another example is Mozambique, where the recent *Aquaculture Regulation 2001* contains a special provision on genetic manipulation.

Food safety and other health issues

At the end of the 1980s, developed countries arrived at the conclusion that classic inspection procedures, usually based on the analysis of samples and tests, were not sufficient to provide the necessary level of protection to consumers. In order to address all the relevant hazards in food production, a new control system was developed and incorporated into the harvesting, processing and distribution of - amongst other - fish products. This system is called Hazard Analysis and Critical Control Point (HACCP) and has currently been incorporated in the legislation of many importing countries of fish products, particularly the United States and in the European Union. The issue is often regulated in general food safety legislation, since food safety is not a concern that is unique to aquaculture products.

Increasingly, the legislation of aquaculture exporting countries is influenced by the legislative developments in importing countries. In particular, exporting countries have been forced to meet the strict HACCP regulations of the USA and the EU by means of implementing similar regulations in their own national legislation. While nowadays the implementation of safety assurance systems may be well advanced in the fish-processing sector, the application and enforcement of such systems at aquaculture farm level is a relatively new approach. Nevertheless, in 1998 Sri Lanka implemented the applicable EU Directive in its aquaculture legislation. Recently, also Jamaica adopted a special law, which provides for the inspection and certification of various categories

of aquaculture, inland and marine products intended for export. The law also contains provisions for the licensing of persons and facilities engaged in the production, harvesting, processing, handling, storage and transport for export of such products and includes the development of a HACCP plan.

Whereas food safety regulations primarily aim at preventing human diseases, it is as important to protect the health of fish and other aquatic organisms. Increasingly, disease outbreaks are being recognized as a major problem for the aquaculture industry, affecting trade, production and economic and socio-economic development. Particularly in the shrimp sector disease is now considered to be the most limiting factor. Many circumstances have contributed to the health problems currently faced by the aquaculture industry, such as the uncontrolled expansion and the inadequate management of aquaculture farms. Also the increasing use of chemicals and the introduction and movement of fish and other aquatic organisms have contributed to the spread of diseases upon wild and/or farmed populations.

There appears to be a tendency to adopt stringent legislation in order to control the outbreak of diseases. Examples relating to the introduction and movement of fish and other aquatic products have been discussed above. Also noted for their detailed legislation on disease matters are the Governments of Norway and Japan. Increasing attention to the control of disease matters is also given in the basic fisheries laws of some developing countries. The *Fisheries Proclamation 1998* of Eritrea, for instance, states that the prevention from the spread of disease and the protection of the quality of aquatic organisms is one of the main reasons to suspend the operation or close an aquaculture facility. Other similar legislative attempts can be found in Mauritius and Honduras. Noteworthy for its comprehensive strategy is the Australian National Strategic Plan for Aquatic Animal Health 1998-2003. The Plan outlines the objectives and projects in order to develop a national approach to emergency preparedness and response and to the over-all management of aquatic animal health in Australia. Key programmes of the Plan consist of quarantine, surveillance, monitoring and reporting, research and development as well as legislation, policies and jurisdiction.

Enforcement and self-regulation

Until the 1990s aquaculture was hardly considered in any law enforcement sanction. Where aquaculture was dealt with under a basic fisheries law the enforcement sections had often been drafted with only capture fisheries in mind. Progress has certainly been made under the more recently adopted fisheries and aquaculture laws and frameworks. In many countries the practising of aquaculture without authorisation, the discharge of wastewater without a permit or the illegal import of fish or aquatic organisms all result in some sort of defined penalty. In particular, there is a trend toward the imposition of administrative sanctions, i.e. sanctions imposed by an administrative agency or an independent institution for breach of a regulation or rule established by that agency or institution or enacted by parliament without intervention by a court. As a consequence, the regulator is not required to prove a matter to the criminal standard and is not constrained by criminal court procedures. It thus provides for an alternative enforcement mechanism that can be more cost-effective, timely and practical. Administrative sanctions may take different forms. They can be a warning, a suspension or revocation of an authorization, a temporary ineligibility to apply for an authorization, the confiscation equipment, a monetary penalty, the closure of aquaculture facilities or the exercise of summary powers.

However, due to the overlap of laws, regulations, government institutions and agencies involved, the implementation of enforcement mechanisms remains difficult and may even lead to an attitude of limited responsibility by the farmer. A major problem, particularly in developing countries, is the availability of a sufficient number of trained staff with a sufficient expertise. Limited budgets practically mean that aquaculture rules often cannot be properly and adequately enforced. Other options are therefore being explored in order to encourage farmers to make more efficient use of resources and to take full responsibility for mitigating or minimising environmental changes caused by their aquaculture operations. In particular, there appears to be a growing interest in the use of economic (market-based) instruments, such as various forms of subsidy for environmental friendly locations, technologies and management or tradable permits for resource use and harvesting rights.

Where the introduction of new legislation is difficult, or will cause excessive delay, other - voluntary - options such as guidelines or codes of conduct may be introduced prior or in addition to specific legislation. These instruments are also considered to have great value in promoting the sustainability of the aquaculture sector over the long-term, for example through the implementation of self-monitor and control systems or by tying them to eco-labelling schemes (on the assumption that some consumers will pay a premium for environmentally friendly goods). Although voluntary in nature, the effectiveness of guidelines and codes can be enhanced by creating incentives to encourage compliance. For instance, the authorisation to engage in aquaculture activities or the membership of an aquaculture organization can be made dependent on compliance with the applicable guideline or code.

At the global level, the introduction of the *FAO Code of Responsible Fisheries*, which contains special provisions on aquaculture development, has been important. More detailed guidelines on specific issues and topics that are covered by the *Code* have been developed afterwards or are still in preparation. At the regional level, the Federation of European Aquaculture Producers (FEAP) drafted an influential *Code of Conduct for European Aquaculture*, which establishes and recommends the guiding principles for the European aquaculture industry. At the national level, the self-regulatory approach has received increasing attention particularly in farmed shrimp producing countries. Codes of conduct have been adopted over the years in India, Malaysia, Sri Lanka, Philippines and Thailand. In Japan, the development of aquaculture management has even led to a complete self-imposed and self-controlled system via Fisheries Co-operative Associations (FCAs). The members of FCAs engage in aquaculture according to FCA-management plans, while the FCAs also develop and implement Aquaculture Ground Improvement Programs.

Special attention deserves sophisticated agreements between government and industry to protect the environment, such as "eco-contracts" in Denmark or "covenants" in The Netherlands. This type of agreement could also be applied to the aquaculture environment. The basic idea of these agreements is that pollution control cannot be achieved without close and active co-operation of the industry. Therefore, binding objectives and targets for the reduction of pollution are laid down on a

sector by sector basis. Then members of the group work out plans and mechanisms and set time frames for the shared reduction of pollution. The construction limits the constant issuance of all kinds of licenses and permits and helps to reduce the bureaucracy and input from governments. However, these mechanisms can only be applied in legal systems with a tradition of consensus seeking and a joint problem approach and where the sectors of industry have organized themselves in production organizations.

Concluding remarks

As we have seen in both Part I and Part II of this article, aquaculture is slowly developing itself into a maturing sector. Modern aquaculture legislation should meet the overall needs of the farmer, the consumers as well as other water and land users, while specific attention should be given to the environmental impacts of and on aquaculture. Under pressure of the growing industry many countries are in the process of reviewing their existing legislation or even adopting a new comprehensive regulatory framework in order to encourage a sustainable and commercial aquaculture industry. However, such efforts are often complicated and time-consuming due to the many issues and interests involved.

Ideally, control is established by a license or permit system, which allows the authorities to examine the suitability of a location and the potential environmental effects of the operation. Increasingly a single window approach is adopted for the numerous licenses that are usually required. All activities with an adverse environmental impact, such as wastewater discharge or the use of chemicals, should be continuously monitored and evaluated after the legal establishment of the aquaculture farm. Stricter regulation is also noticeable with respect to food safety and health issues. Strongly influenced by the importing countries quality and safety standards are becoming more requisite than optional nowadays.

Although the development of aquaculture legal frameworks is progressing slowly, law enforcement often remains the weak link in the legal regimes. Special attention should also be given to the transitional state of aquaculture farms that have been lawfully established for a number of years, but become unlawful due to subsequent legal requirements. For these farms it would be unrealistic to expect immediate compliance with new rules unless

sufficient time has been allowed for changes to accommodate in practice. An effective and powerful option for the future will be the application of administrative sanctions and of economic incentives and disincentives. Likewise, voluntary instruments, such as Codes and Guidelines, will serve as an alternative prior or in addition to legal frameworks and will undoubtedly require a greater involvement and participation of the aquaculture community.

With many of the world's capture fisheries being over-fished, aquaculture is often viewed as the industry that could meet the increasing shortfall in supply of fish. However, due to its environmental and technical limitations it is becoming clear that the conventional aquaculture industry will not be able to fulfil these expectations to the fullest extent. Stock enhancement and sea ranching should therefore be considered as valuable long-term alternatives, but in order to be cost effective the crucial hurdle of property rights needs to be taken first.

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A fallow rice field in Hai Thuong village

A participatory case study on Nutrition and Aquatic Resources in Quang Tri Province, Central Viet Nam

reported by

Isabel J. Fleischer
Inland Water Resources and
Aquaculture Service
FAO Fisheries Department
isabel.fleischer@fao.org

Wild aquatic resources play an important role in the food security of rural poor people living in rice-based ecosystems. It is the wet rice cultivation area that provides the habitat for a variety of living aquatic resources such as fish, molluscs, crustaceans, reptiles, insects and plants. Rice farmers catch and collect aquatic animals in rice fields and surrounding water bodies and use them for their own consumption as well as for livestock feed, spices, green fertilizer and medicine.

This article contributes to the activities initiated by the FAO Inter-Departmental Working Group on Biodiversity, analyzing the existing agricultural biodiversity resource base and developing recommendations for the sustainable utilization of the given resources¹.

The first results of studies conducted in Cambodia and China showed an impressive variety of aquatic plants and animals and gave evidence to concentrate attention towards the often unrecognized importance of this aquatic biodiversity for the livelihoods of the rural poor². One of the main findings indicated the nutritional role in terms of quantity and quality of the wild inland aquatic resources and raised the objective to get more detailed information on the consumption patterns.

The nutritional value of aquatic resources

Farmer families in rice-based production systems rely in their daily diet on rice as their main food. This may lead to an unbalanced

diet, lacking sufficient animal proteins and fats. Therefore fish and other aquatic animals are an important source not only of protein but also of essential fatty acids, which deliver a high amount of energy, allow the solution of important vitamins and provide the components that are particularly important for neurological growth and development of skin functions (Oller do Nascimento/ Oyama 2003).

In the daily nutrition a minimum supply of fat as it can be given due to the consumption of aquatic resources is necessary for healthy infant growth and is especially important for pregnant and lactating women.

Analyzing the diets of rice farmers should therefore consider the positive potential of wild aquatic resources providing cheaply a diversity of nutrients to poor rural farmer households.

Nutrition and aquatic resources in Quang Tri Province, Central Viet Nam

In collaboration with a poverty alleviation programme financed by the Finish Ministry for Foreign Affairs and the Vietnamese Ministry of Planning and Investment, the FAO Inland Water Resources and Aquaculture Service (FIRI) conducted its latest study on this issue in December 2003 combining health and nutrition considerations with the consumption and culture of aquatic biodiversity in the rice producing agro-ecosystem of Quang Tri Province, one of the poorest provinces in Central Viet Nam.

The Quang Tri Rural Development Programme (QTRDP) aims at the poverty alleviation and the sustainable improvement of rural people's livelihoods. In order to achieve this goal a study was initiated to analyse the food and nutrition situation in the villages situated in Quang Tri Province, with special attention to signs of malnutrition within the group of children under 5 years.

QTRDP, in collaboration with FIRI, designed the study with particular focus on the utilization of wild aquatic resources including environmental aspects influencing the availability of this living resource base.

The study was conducted following a participatory approach assessing the rural

people's nutrition and health status and their use of the available aquatic resources. Specific attention was given to their self-perception related to poverty and malnutrition and discussions within groups offered the possibility to reflect on causes and possible problem solutions.

The study included three elements: a household questionnaire, anthropometric measurements of mothers and children under five, and focus group discussions. The communes were randomly selected, giving 5 communes in the remote, by ethnic groups inhabited and particularly poor Dakrong district, 2 communes in the lowland Hai Lang district and 1 commune in Cam Lo district. Per selected commune a sample of 15-30 percent of the total number of households was randomly chosen.

Poverty and food insecurity in Viet Nam

Viet Nam has the highest malnutrition rate among adults and children of the countries in South East Asia (FAO 1999). Malnutrition and food insecurity are signs of absolute poverty. Thereby the definition of poverty has been enlarged from income determinants to the question whether people have the opportunities and capabilities to satisfy their basic needs such as food security and hygiene. The detection of children being the most vulnerable group to malnutrition has led to use the status of child nutrition as one of the 5 Human Poverty Indices (UNDP 1997). Malnutrition of children is usually measured by three anthropometric indices: underweight (weight for age), stunting (height for age) and wasting (weight for height). These three indices show the existence



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Arrival of the project team at Hai Le Health Center

of chronic (stunting) and acute malnutrition (wasting) and prove that the basic nutritional needs of a children are not satisfied (Reinhard/Wijayaratne 2002).

In Viet Nam the prevalence of underweight among children under 5 years of age is 31,8 percent, that of stunting is 34,8 percent and that of wasting is 9 percent (Figure 1). According to WHO criteria these rates indicate important public health problems.

Adults are also strongly affected by malnutrition as indicated by the average Body Mass Index (BMI) value which is with 19.1 very low. 40 percent of the population, both men and women, do not meet the BMI of 18.5, which is the threshold value for underweight. Only a negligible proportion of the population is overweight or obese (NIN/UNICEF 1998).

Food insecurity and malnutrition are caused by various factors such as poor health, inadequate food supply and lack of access to food. It would be misleading to consider the access to food only by people's power of purchase i.e. the annual per capita income. As the aquatic biodiversity studies prove, the use of natural resources caught or collected from the wildlife are an important food source and should especially not be underestimated in remote areas where often due to bad infrastructure a lack of food supply prevails. Wild aquatic resources are particularly important in the food security of the very poor people who don't have

the necessary income to satisfy their nutritional needs by purchase.

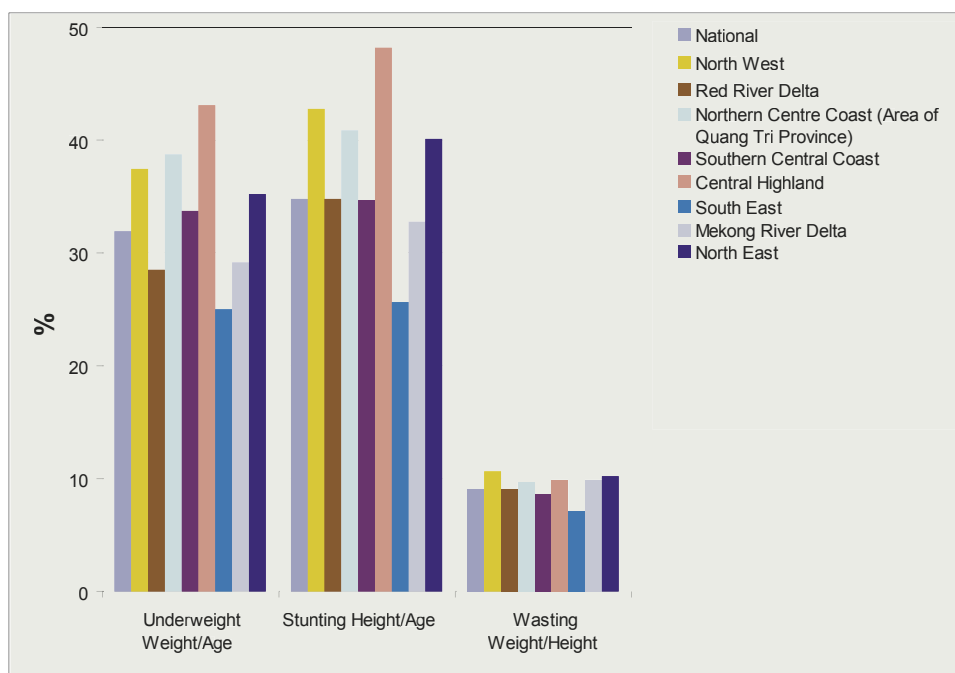
Results

Nutritional status: malnutrition and food shortage

The study results show a high level of malnutrition in all districts but especially in the remote mountainous Dakrong area (Table 1). In comparison with the regional data in Figure 1 (Northern Centre Coast) the study results show in Hai Lang and Cam Lo a *lower* or *equal* percentage of children suffering from acute and chronic malnutrition. The percentage of wasting is even only a third of the data indicated in Figure 1. In contrary to this Dakrong district shows compared to the national and regional data a *very high* rate of acute and chronic malnutrition. Only in some Dakrong communes the share for wasting is lower than the regional and national average. It is also in these remote communes that the importance of wild aquatic resources is estimated much higher than in the richer lowland areas. The malnutrition data did not show any significant difference of prevalence between female and male children.

Most of the households in the various districts suffer from rice shortage up to 5 months per year with the remote Dakrong area having even higher numbers of households who experience up to 8 months of rice shortage. In Dakrong

Figure 1. Anthropometric status of children (in %) under five years of age in different regions of Viet Nam



Source: NIN 2002

Table 1. Nutritional status of children under 5 years of age in the 3 study districts by severity and commune (in %)

Districts (number of children measured)	Hai Lang (241)		Cam Lo (50)	Dakrong district (282)					Regional average (data 2002)
Communes/ Indicators of malnutrition	Hai Thuan	Hai Le	Cam Lieu	Trieu Nguyen	A Ngo	A Bung	Huc Nghì	Ta Long	
Underweight Weight/age	11.9	30.2	28	45.8	46.2	64.6	50.0	39.3	38.7
Severity (low-very high)	medium	very high	high	very high	very high	very high	very high	very high	very high
Stunting Height/Age	20.1	29.5	42	44.7	53.8	68.8	61.5	50.0	40.9
Severity (low-very high)	medium	medium	very high	very high	very high	very high	very high	very high	very high
Wasting Weight/Height	3.0	3.8	2	6.3	7.7	14.6	6.4	10.7	9.7
Severity (low-very high)	low	low	low	medium	medium	very high	medium	medium	medium

Table 2a. Consumption frequency (%) of fish and other aquatic organisms among the surveyed households in **Hai Lang district**

Hai Lang (n=70)	Never	1x /month	2-3x /month	1x /week	2-5 x /week	Every day 6-7x/week	No answer
Fish	2.9	-	1.4	5.7	61.4	18.3	10.3
Snakes	84.3	8.6	4.3	-	-	-	2.8
Snails	45.7	21.4	8.6	10.0	1.4	1.4	11.5
Field crabs	54.3	15.7	7.1	5.7	4.3	-	12.9
Shrimps	5.7	1.4	4.3	4.3	67.1	4.3	12.9
Insects	92.9	1.4	1.4	-	2.9	0.1	1.3
Frogs	60.0	7.1	4.3	5.7	1.4	-	21.5

Table 2b. Consumption frequency (%) of fish and other aquatic organisms among the surveyed households in **Cam Lo district**

Cam Lo (n=35)	Never	1x /month	2-3x /month	1x /week	2-5 x /week	Every day 6-7x/week	No answer
Fish	-	2.9	-	8.6	71.4	17.1	-
Snakes	94.3	-	5.7	-	-	-	-
Snails	68.6	8.6	8.6	-	2.9	-	11.3
Field crabs	51.4	2.9	8.6	11.4	11.4	-	14.3
Shrimps	20.0	8.6	5.7	25.7	37.1	-	2.9
Insects	88.6	-	-	5.7	2.9	-	2.8
Frogs	62.9	2.9	5.7	8.6	8.6	-	11.3

Table 2c. Consumption frequency (%) of fish and other aquatic organisms among the surveyed households in **Dakrong district**

Dakrong (n=158)	Never	1x /month	2-3x /month	1x /week	2-5 x /week	Every day 6-7x/week	No answer
Fish	1.3	21.5	27.8	10.1	33.5	5.1	0.7
Snakes	87.3	5.1	3.2	-	0.6	-	3.8
Snails	26.6	27.8	16.4	5.1	9.5	-	14.6
Field crabs	46.2	20.9	10.8	4.4	1.3	-	12.4
Shrimps	21.5	23.4	19.6	8.9	11.4	-	13.2
Insects	58.2	11.4	12.0	4.4	4.4	0.6	9
Frogs	48.1	21.5	9.5	5.7	1.3	-	13.9



Isabel J. Fleischer

Interview on household food consumption



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Farmers draw the availability of aquatic resources in a village map

reported coping strategies include the use of other staple foods (cassava), gathering wild biodiversity and the reduction of the number of meals. Unlike households in Hai Lang and Cam Lo district, who mostly reduce the food amount and try to get loans in periods of rice shortage.

Consumption preferences and quantities

Fish is a very common food and proves to be the most consumed aquatic animal, with 79 percent of the households in Hai Lang (Table 2a), 88,5 percent in Cam Lo (Table 2b) and 38 percent in Dakrong district (Table 2c), eating fish twice or more times per week.

Fish is among the various aquatic animals the most preferred food, indicated for its good

taste, easy availability and healthy qualities. The study shows that taste is in general the main reason for consuming aquatic animals, and most of the households say that they eat snakes for their healthy qualities and frogs, insects and field crabs because of their easy availability.

Frogs are part of the villagers' diet with 38 percent in Dakrong, 18.5 percent in Hai Lang and 24.8 percent of the households in Cam Lo.

Field crabs are mentioned to be consumed by 37.4 percent of the households in Dakrong, 32.8 percent of the households in Hai Lang, and 34.3 percent in Cam Lo.

Snakes are in all districts rarely eaten whereas insects are a basic food of almost the half of the households in the mountainous Dakrong district

Analysing the average consumption of aquatic animals per household and day in terms of weight, the study results show that households in Hai Lang and Cam Lo district consume more fish, crabs and shrimps than the households in Dakrong district. Insects, snails and frogs though are consumed in higher quantities in Dakrong than in Cam Lo or Hai Lang district (Table 3).

Compared to the amount of other eaten aquatic organisms, fish is the most consumed animal with an average of 370 gram per day in Hai Lang (with an average household size of 5 persons) district, and 260 gram in Cam Lo (with an average household size of 5 persons) and 260 gram in Dakrong district (with an average household size of 6 persons).

Child nutrition and aquatic resources

A high percentage of women report to feed their children between 4 and 12 months of age, with fish, small shrimps and field crabs.

Table 3. Consumption of aquatic organisms (in kg) per day per household (average household size: 5 persons)

District	Aquatic resources amount (kg)						
	Fish	Snakes	Snails	Field crabs	Shrimps	Insects	Frogs
Hai Lang (n=70)	0.39	0.08	0.05	0.05	0.2	0.03	0.03
Cam Lo (n=35)	0.26	0.03	0.04	0.15	0.21	-	0.06
Dakrong (n=158)	0.26	0.02	0.24	0.10	0.17	0.06	0.08

In Hai Lang district up to 80 percent of the households stated to prepare 2-5 times per week the children's food with fish and 64 percent with small shrimps. A difference can be noted between the richer and poorer districts, with only 30 percent of the households in the poorer Dakrong district feeding their children with fish twice or more times per week.

Compared to other studies there was no particular evidence that pregnant women were avoiding the consumption of aquatic food (Meusch *et al.* 2003). In some cases it was stated that the consumption of animals that were already dead when purchased, and the consumption of sour food (lemon etc.) was believed to harm during pregnancy.

Purchase versus wild aquatic resources availability

More than half of all households catch and collect various aquatic animals such as fish, frogs, snails, mussels, snakes and insects.

Fish caught in the wildlife plays not only a role for the own consumption but also for the generation of income with 9 percent of the households in Cam Lo and Hai Lang districts selling fish from the wildlife on the market, and more than 75 percent of the households in the remote Dakrong district selling fish and other aquatic resources from the wildlife directly among each other in the villages.

Most of the households get their fish and shrimps from the market, except from the households in the remote Dakrong district where many of the households collect fish and shrimps from the wildlife for their own consumption. Other aquatic animals such as snakes, snails and frogs are in all districts mainly collected from the wildlife, especially by the households in Dakrong.

Focus group discussions revealed that the importance of purchasing fish and other aquatic animals have become more important during the last years as, although being surrounded by rivers and ponds, the availability of the wild aquatic animals has decreased impressively over the last ten years.

Traditional knowledge and division of labour

With regard to the activities involved in the utilization of wild aquatic animals the study shows that fishing is mainly done by men and

children, whereas women and children collect the various aquatic organisms during their work on the fields.

It is mostly the women who sell the aquatic animals at the market and prepare the daily meals. They own the traditional knowledge of food preparation such as the typical fermentation to fish paste. Most households in the lowland areas boil the fish and other aquatic animals whereas the mountainous ethnic groups use to grill or ferment their catch. Fish proves to have an important traditional role at the celebration of festivities and is a main component of the menu at special events in the survey area.

Decline of wild aquatic resources

The participants of the discussion groups indicated an average of 40 different fish species known to them from the wildlife and partly used for aquaculture activities. Nevertheless they feel that the availability of aquatic resources in the wildlife is declining and that they have more difficulties to catch or collect wild aquatic animals compared to ten years ago. The villagers state that possible reasons are the more intensive use of pesticides and herbicides in the agricultural production and confirm growing demand because of an increase of the population over the years. Furthermore the output of the group discussions shows that in most of the districts unsustainable fishing methods such as electro-fishing, poisoning



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Low body height as an indicator for chronic malnutrition



A day's catch

and the use of mosquito nets for fishing are practiced, endangering the stocks and reproduction capacities of the aquatic animals.

Conclusion

The study shows that the given aquatic biodiversity in rice-based production systems contributes to an important extent to the food security of the rural population in Quang Tri Province. The anthropometric data reveal that the negative nutritional status, caused by malnutrition and poor hygiene, is particularly dominant in the remote mountainous areas. People in these communes are more exposed to staple food shortage and rely to a big extent on wild resources with low purchase power and bad connection to market infrastructure.

The richer lowland areas Hai Lang and Cam Lo are less exposed to rice shortage, and have better infrastructure and better access to extension and micro-credit schemes. These communes are therefore less vulnerable to periods of household food shortage and can afford to purchase aquatic resources and to

rely on a much lesser extent than people in Dakrong district on what is available in the wildlife.

The study reveals a drastic decline of the aquatic resources over the last years in the survey area, a result which confirms the observation of similarly conducted studies in other SE Asian countries with rice-based ecosystems (Halwart M. 2003b). Consequently development activities that focus on the alleviation of malnutrition and poverty should include the consideration of these resources in agricultural management decisions and aim at their conservation and sustainable use. Further studies are needed to better understand the nutritional value of aquatic biodiversity for rural people and to assess how this value can be better used for increased food security in various ecosystems without compromising the natural resource base³. The pressure on wild aquatic resources could be reduced *inter alia* through the further development of aquaculture activities and their integration into agriculture. This offers an important potential to improve the household's income and food security, for which property rights and women's work load have to be carefully considered and incorporated in an equitable plan of agri- and aquaculture management. On the community level management activities may have to address the improvement of irrigation facilities and the better use of already existing aquaculture infrastructure.

¹ The aquatic biodiversity activities have been co-sponsored by the FAO Netherlands Partnership Programme (FNPP).

² A compilation of the study results can be found in: M. Halwart 2003a, M. Halwart 2003b and T. Balzer and P.&S. Pon 2002.

³ Further studies on nutrition and aquatic resources have been recommended by the International Rice Commission at its 20th Session (FAO 2002), and by FAO/NACA 2003.



Ca Thu a traditional way of fish preservation

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Ms Isabel Fleischer, a national of Germany, completed her Master Studies in Social Sciences with focus on International Politics and Marketing/Communication at the University of Mannheim, Germany and worked as Communication Consultant on various rural development issues, including the World Summit on Sustainable Development.

Ms Fleischer joined the FAO Inland Water Resources and Aquaculture Service (FIRI) in February 2003 as a consultant to assist in the implementation of the Service's programme on aquatic biodiversity, especially through the FAO Interdepartmental Working Group on Biodiversity. Her consultancy is supported through the FAO/Netherlands Partnership Programme on Biodiversity. In FIRI Ms Fleischer contributes to an awareness-raising campaign on the importance of aquatic biodiversity in rice-based ecosystems, nutritional aspects of aquatic biodiversity and the responsible use and control of alien species in fisheries. Currently she is focusing on updating the FAO Database on Introductions of Aquatic Species (DIAS).

Highlights from the FAO database on Aquaculture Statistics

Alan Lowther
Fisheries Information, Data and Statistics Unit
alan.lowther@fao.org

The FAO Fisheries database of statistics on aquaculture production and values has been updated to include data for 2002. Total aquaculture production of fish, crustaceans and molluscs for 2002 was reported to be 39.8 million tonnes with a farm-gate value of US\$ 53.8 billion. With the inclusion of aquatic plants, the production increases to 51.4 million tonnes with a value of US\$ 60.0 billion. This represents an average annual increase in production of 6.1 percent from the total aquaculture production reported for 2000. Considering the ten-year period from 1992-2002, the production shows an average annual increase of 9.3 percent.

For fish, crustaceans and molluscs, China is reported to produce nearly 70 percent of the global total. The top ten producing countries are listed in Table 1. These countries account for 88.6 percent of the total global production. By continent, in 2002, the countries of Asia were responsible for 88.9 percent of production, followed by Europe (5.1 percent), North America (2.4 percent), South America (2.1 percent), Africa (1.1 percent) and Oceania (0.3 percent). See Figure 1.

The species with the highest production volume was the Pacific cupped oyster (*Crassostrea gigas*) with 4.2 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) 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 one million tonnes in 2002. The top ten ISSCAAP species groups in terms of production

Table 1. Top ten countries in production of fish, crustaceans and molluscs for 2002

Country	2000	2002	APR
China	24,580,671	27,767,251	6.3%
India	1,942,204	2,191,704	6.2%
Indonesia	788,500	914,066	7.7%
Japan	762,824	828,433	4.2%
Bangladesh	657,120	786,604	9.4%
Thailand	738,156	644,890	-6.5%
Norway	491,175	553,933	6.2%
Chile	391,587	545,655	18.0%
Viet Nam	510,555	518,500	0.8%
USA	456,045	497,346	4.4 %

Note: APR refers to the average annual percentage growth rate for 2000-2002

Table 2. Top ten ISSCAAP species groups in production of fish, crustaceans and molluscs for 2002

Species group	2000	2002	% 2002 total	APR
Carps and other cyprinids	15,451,646	16,692,147	41.9%	3.9%
Oysters	3,997,394	4,317,380	10.8%	3.9%
Misc. freshwater fishes	2,864,199	3,739,702	9.4%	14.3%
Clams, cockles, arshells	2,633,441	3,430,820	8.6%	14.1%
Salmons, trouts, smelts	1,545,149	1,799,383	4.5%	7.9%
Tilapias and other cichlids	1,274,389	1,505,804	3.8%	8.7%
Mussels	1,370,953	1,444,734	3.6%	2.7%
Misc. marine molluscs	1,591,813	1,348,327	3.4%	-8.0%
Shrimps, prawns	1,143,774	1,292,476	3.2%	6.3%
Scallops, pectens	1,154,470	1,226,568	3.1%	3.1%

Note: APR refers to the average annual percentage growth rate for 2000-2002

Figure 1. Growth in aquaculture production of fish, crustaceans and molluscs by continent, 1980-2002

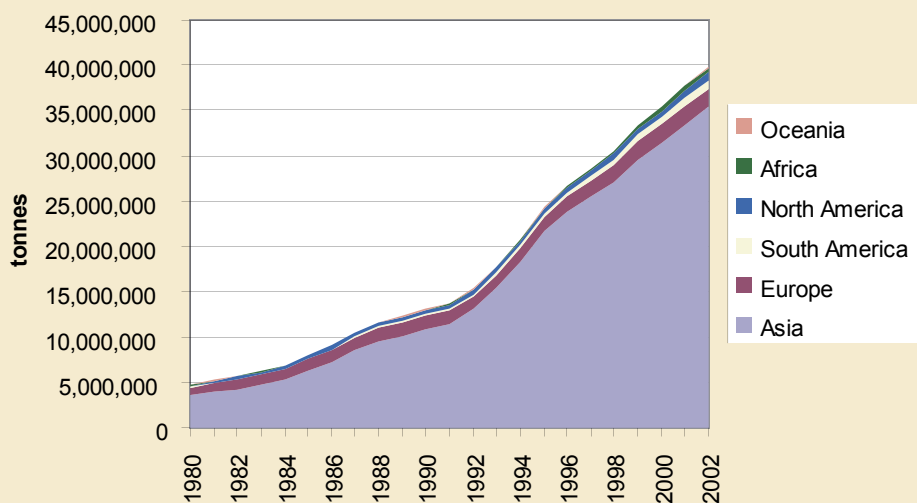
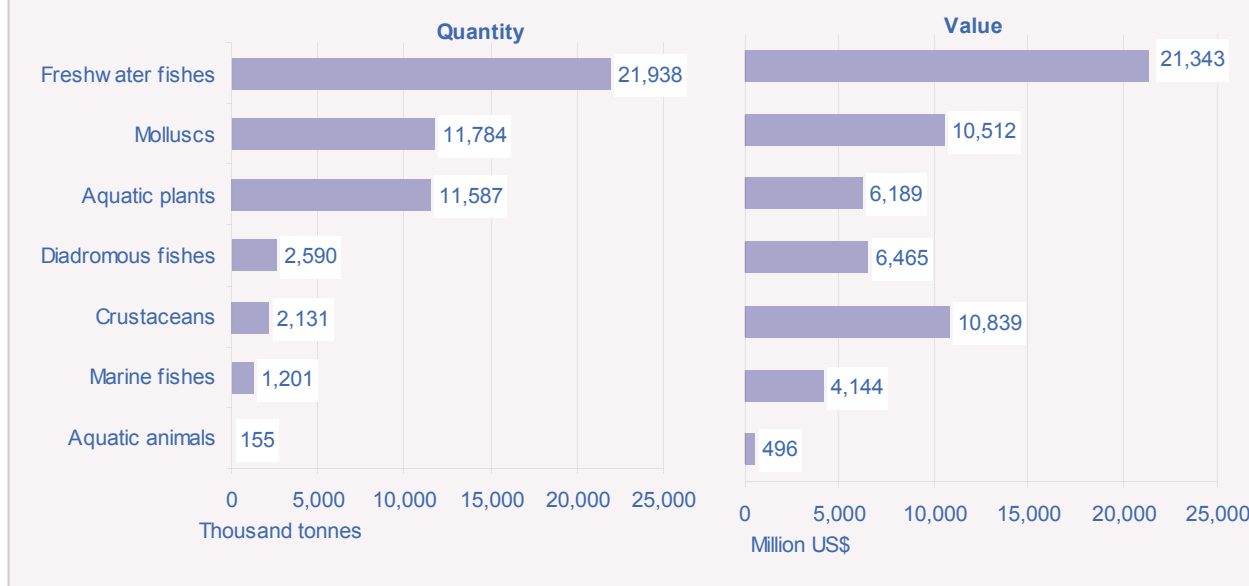


Figure 2. Global aquaculture production: major species groups by quantity and value in 2002



are listed in Table 2. If we include aquaculture of aquatic plants, the species with the highest production is Japanese kelp (*Laminaria japonica*) with a production of 4.7 million tonnes. Figure 2 shows production and value for the more general ISSCAAP divisions.

For 2002, carps were the species group with the highest reported value – US\$ 14.7 billion. They were followed by shrimp and prawns (US\$ 7.3 billion), salmon and trout (US\$ 4.9 billion), clams and cockles (US\$ 3.8 billion) and oysters (US\$ 3.6 billion). The highest reported value for a single species was US\$ 3.5 billion for the Pacific cupped oyster, followed by silver carp, giant tiger prawn (*Penaeus monodon*),

common carp, grass carp, Atlantic salmon (*Salmo salar*), Japanese kelp and Japanese carpet clam (*Ruditapes philippinarum*).

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 for global capture fishery data, fishery commodities statistics, 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/.

FAO hosts Meetings for Improving Information on Aquaculture Status and Trends

Alan Lowther
Fisheries Information, Data and Statistics Unit,
alan.lowther@fao.org

The rapid growth of the aquaculture sector has increased the need for accurate and reliable information with which to enact rational and sustainable management policies. To work towards improving information on global status and trends for aquaculture, in January of this year 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.

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 Expert Consultation

To support the continued sustainable development of aquaculture, the Expert Consultation identified six key themes that status and trends reporting should address:

- Aquaculture production quantities, species and values
- Aquaculture resource use and environmental management
- Contributions of aquaculture to poverty alleviation and improving livelihoods
- Contributions of aquaculture to food security and food demand
- Contribution of aquaculture to national economies and trade
- Development of institutions to support responsible development of aquaculture

The group further identified measurable indicators for each theme and made suggestions on how the information would be collected. All six themes were recognized as important for decision-making, but at the same time it was realized that there would be difficulties collecting information for some themes, and that this may influence data and information collection priorities, especially in the context of limited resources.

Outcomes, conclusions and recommendations of the Expert Consultation

In addition to outlining the above themes, the Expert Consultation made some general recommendations for methods to improve status and trends reporting. A high priority was given to improving and expanding socio-economic data collection efforts. Employment data, in particular, was noted as an area where better information was needed.

Increased collaboration among FAO, national fishery and aquaculture ministries, and regional aquaculture organizations (for example, NACA, the Network of Aquaculture Centres in Asia-Pacific) was cited as a way to improve and

share information and reduce duplication of efforts in data collections.

FAO was called upon to provide guidance to countries in the appropriate data collection methodologies. FAO has developed standard software tools based on survey sampling methodology to collect and estimate fishery statistics. The system has been implemented in several countries and the expansion of the system to include aquaculture is now ready to be tested.

The Expert Consultation endorsed the creation of a standing group, with representative from international organizations, to deal with issues related to aquaculture data, statistics and trends analysis – much like the role of the Coordinated Working Party in capture fisheries. Such a group would work to establish standardized and internationally-accepted definitions, and could review further improvements to FAO aquaculture data collection methodology.

Finally, the consultation discussed and produced a draft "Strategy for Improving Information on Status and Trends for Aquaculture." The Strategy is a broad document that outlines the basic needs and goals of data collections for aquaculture. Guiding principles are outlined including those of sustainability, inclusiveness, objectivity, transparency, timeliness and flexibility. Required actions and standards are laid out including tools and methods to build the capacity of developing countries to collect and analyze the necessary information. Once finalized, it is envisioned that this document will be submitted for approval to the next session of the COFI Subcommittee on Aquaculture, to be held in 2006 in India.

The Working Group

At the conclusion of the Expert Consultation, the Working Group of Experts on the FAO Aquaculture Questionnaire "FISHSTAT AQ" was convened to suggest improvements to the data collection form used by FAO. Each year, FAO asks its member countries to complete the FISHSTAT AQ questionnaire. This form requests national data on aquaculture production and value by species, production method and environment. In addition, data are requested concerning hatchery production.

Concerns have been raised because responses to the inquiry have been inconsistent, particularly regarding production by method and the value of aquaculture products. Many

countries provide production statistics but do not have the other requested information available. Because of this, often countries feel discouraged from completing the form at all. The ease-of-use of the form has been another general complaint. On the other hand, those responsible for developing and implementing aquaculture policies are requesting even more, and different, types of information (for example, the recommendation of the Expert Consultation for improved data on employment in the aquaculture sector). The Working Group tried to keep in mind the balance between competing needs and capabilities.

To obtain additional information concerning the FISHSTAT AQ form, two survey research professionals conducted cognitive interviews with several of the participants before the start of the meeting. These interviews consisted of one or both researchers sitting together with a data provider and asking specific questions concerning their reaction to the form. For example, "Which parts of the form are difficult?" "What do you think when you read this question?" "Do you have this information available in your country?" Based on these interviews, the researchers redesigned a simplified version of the form. Then, based on their own deliberations and the recommendations of the Expert Consultation, the Working Group analyzed the redesigned form and made some minor modifications – for example, including the request for information concerning employment. A new form, based on the work done, should be ready for testing with national correspondents in the near future and hopefully will be implemented for the 2005 data collection cycle (for 2004 data reporting).

The reports of the two meetings as well as the Strategy document will soon be available at the FAO Fisheries website, www.fao.org/fi. The background documents for the Expert Consultation are currently available at: http://www.fao.org/fi/NEMS/events/detail_event.asp?event_id=14402. The documents for the Working Group are available at http://www.fao.org/fi/NEMS/events/detail_event.asp?event_id=14403. It is hoped that the outcomes of these two meetings will help improve the available information on aquaculture status and trends, and that this will contribute to the sustainable and responsible development of the sector.

Aquatic biodiversity in rice-based ecosystems Activities in the framework of the FAO Interdepartmental Working Group on Biodiversity

2001

- Aquatic Biodiversity case studies in Cambodia and P.R. China – “making the invisible visible” - focussing on the availability and use of aquatic biodiversity for livelihoods

2002

- Aquatic Biodiversity case studies in Lao PDR and Viet Nam focussing on the availability and use of aquatic biodiversity for livelihoods
- First output: CD-ROM with results from Cambodia published. Available at <ftp://ftp.fao.org/fi/CDrom/AwarnessAgrBiodiv/default.htm>
- Presentation of the results of the Cambodia and P.R. China case studies at the 20th Session of the International Rice Commission, Bangkok, July 2002
- The Commission not only acknowledges the importance of aquatic biodiversity but recommends to its member countries the enhancement of this resource base and to give stronger attention to the nutritional contribution of aquatic organisms in the diet of rural people
- <http://www.fao.org/ag/AGP/AGPC/doc/field/commrice/pages/sessions.html#01>
- FAO/NACA Regional Workshop on Traditional use and availability of aquatic biodiversity in rice-based ecosystems in Xishuangbanna, Yunnan, P.R. China
- Recommendations include:
 - Analyze available aquatic species and their importance for a balanced diet (e.g. regarding Vitamin A, essential fatty acids)
 - Conduct follow-up research on the more important consumed species in terms of nutritional value
 - Investigate possibilities to increase the availability of these speciesRead the report: <ftp://ftp.fao.org/fi/document/xishuangbanna/xishuangbanna.pdf>

2003

- Contribution to 29th Session of the Committee on World Food Security in the preparation of The role of aquaculture in improving food security and nutrition incorporating considerations on the role of integrated rice-fish systems
- Recommendation to the CFS is inter alia to encourage and promote the production of aquaculture products as a source of nutrition for human consumption with the help of targeted nutrition education programmes
- Presentation at the Convention of Biodiversity's (CBD) Eighth SBSTTA meeting, Montreal: FAO Fisheries Department Programme on Inland Aquatic Biodiversity
- Presentation of UTILIZATION OF AQUATIC BIODIVERSITY IN MOUNTAINOUS RICE-BASED ECOSYSTEMS OF CHINA AND VIET NAM; Main theme: Mountain biological diversity
- Read the abstract: <http://www.biodiv.org/doc/publications/cbd-ts-08.pdf>
- View the poster: <ftp://ftp.fao.org/fi/CDrom/AwarnessAgrBiodiv/poster.pdf>
- A study organized by FAORAP with collaboration of IUCN in LAO PDR further develops the analysis of The role and nutritional value of aquatic resources in the livelihoods of rural people.
- Read at www.fao.org/DOCREP/004/AD454E/ad454e00.htm
- National workshop on aquatic biodiversity in Lao PDR linked to the FAO/UNDP proposal workshop on a planned national Agro-Biodiversity Programme.

2004

- Participation in the preparation of the International Year of Rice (IYR) 2004 raising awareness on the role of aquatic biodiversity in rice production systems in the IYR Concept Paper and IYR fact sheet on Aquatic Biodiversity
- Browse the website: <http://www.fao.org/rice2004/en/factsheets.htm>
- View Aquatic Biodiversity fact sheet at <http://www.fao.org/rice2004/en/f-sheet/factsheet7.pdf>
- Participation in the preparation of World Food Day 2004 with theme “Biodiversity for Food Security”

Upcoming events:

- FAO Regional Technical Expert Meeting on Aquatic biodiversity, its nutritional composition, and human consumption in rice-based systems, FAO Bangkok, 8-10 December 2004
- FAO & Partner Organizations (MRC, IUCN, NACA, others) Regional Workshop on The utilization of aquatic resources and their nutritional role for rice-based livelihoods, Vientiane, Laos, TBD in 2005

For further information visit the FAO corporate Biological Diversity website: <http://www.fao.org/biodiversity/index.asp> or contact: matthias.halwart@fao.org

¹Supported by FAO-Netherlands Partnership Programme and Regular Programme funds.

Aquatic Biodiversity

From research evidence to national policy

Towards a National Agricultural Biodiversity Programme for Lao PDR

Inland aquatic resources are extremely important for the population of LAO PDR. Particularly for those people living in rural rice production areas, fish and other aquatic animals such as frogs, shrimps, snails and snakes are an easy accessible and inexpensive source of food.

In order to make this aquatic biodiversity and its utilization visible, the FAO Inland Water Resources and Aquaculture Service initiated a **case study** in 2002, in which more than 50 aquatic organisms were identified that are being utilized every day and traditional catching and collection methods documented.

Following similar activities in other SE Asian countries, FAO in collaboration with the Network of Aquaculture Centres in Asia-Pacific (NACA) organized a **Regional Workshop on the Traditional use and availability of aquatic biodiversity in rice-based ecosystems** in Xishuangbanna, P.R. China, in October 2002. Decision makers and researchers from the various SE Asian countries had the opportunity to compare their situation and realized that they all face a decrease in their natural aquatic resource base.

A study organized by FAORAP with collaboration of IUCN in December 2002 provided a participatory assessment of the **role and nutritional value of aquatic resources in the livelihoods of rural people** in Attapeu Province, Lao PDR.

To review and discuss the results of various projects on the contribution of aquatic resources and fish production to rural poor people's livelihood, the Living Aquatic Resources Research Center (LARReC) of Lao PDR's Ministry of Agriculture and Forestry organized in collaboration with FAO a **Workshop on Aquatic Biodiversity in December 2003** in Vientiane. This conference prepared the way for the formulation of national priority activities to conserve the existing aquatic biodiversity and to enhance its sustainable use within the **National Agricultural Biodiversity Programme**.

FAO is joining the programme on Agricultural Biodiversity with the Lao PDR Ministry of Agriculture and Forestry (MAF) and the National Agriculture and Forestry Research Institute (NAFRI). The main objective is to develop a long-term national Agricultural Biodiversity strategy, which will support, implement and co-ordinate various activities addressing the sustainable use of the existing biodiversity in Lao PDR. FAO and NAFRI have taken the technical lead on the formulation of the Agricultural Biodiversity Programme, including priority activities on aquatic biodiversity.

The aquatic components of the National Agricultural Programme include:

- *Improved understanding of the status of aquatic resources for food security and sustainable livelihoods*
- *Strengthened management capacity at the national, provincial and regional levels to support sustainable aquatic resource development for food security and sustainable livelihood*
- *Strengthened institutional and human capacity at the community level to promote the sustainable use of aquatic resources for food security and sustainable livelihoods*
- *Increased understanding of importance of aquatic resources among policymakers, rural inhabitants, and other stakeholders*

Beyond the legislation process, FAO continues to assist its member country Lao PDR in the implementation of the formulated policy and provides a platform for knowledge sharing such as at the upcoming FAO Regional Technical Expert Meeting on *Aquatic biodiversity, its nutritional composition, and human consumption in rice-based systems* to be held in FAO/RAP Bangkok from 8-10 December 2004. This will be an occasion also for other countries to learn from Lao's experience and assess good practices and policies for transfer into their own national activities.

Health management and biosecurity maintenance in white shrimp (*Penaeus vannamei*) hatcheries in Latin America. *FAO Fisheries Technical Paper*. No. 450. Rome, FAO. 2003. 64p.



This document, Health management and biosecurity maintenance in white shrimp (*Penaeus vannamei*) hatcheries in Latin America, presents technical guidance for the effective and responsible operation of shrimp hatcheries in Latin America. This document was compiled through an extensive

consultative process undertaken from 2001 to 2003 that involved inputs from government-designated National Coordinators, regional and international experts, representatives from several intergovernmental organizations, private sector representatives and the Food and Agriculture Organization of the United Nations. This process was made possible through the FAO Regional Technical Cooperation Programme project - Assistance to health management of shrimp culture in Latin America: TCP/RLA/0071 (A), which involved the participation of 14 countries of the region, several intergovernmental organizations, shrimp hatchery operators and farmers, and individual experts. It is envisaged that this document will provide a firm basis for the improvement of the health and quality of hatchery-produced *Penaeus vannamei* postlarvae in Latin America.

Contact Mr Rohana Subasinghe at FAO/HQ (rohana.subasinghe@fao.org) for further information.

Subasinghe, R.P.; McGladdery, S.E.; Hill, B.J. (eds.). *Surveillance and zoning for aquatic animal diseases*. *FAO Fisheries Technical Paper*. No. 451. Rome, FAO. 2004. 73p.

In an effort to determine what surveillance options can best support scientifically valid zonation frameworks for aquatic animal diseases, an Expert Consultation was organized by FAO, the Federal Department of Fisheries and Oceans Canada (DFO Canada) and the World Organisation for Animal Health (OIE) in October 2002. The objective of the Consultation was to provide recommendations for surveillance and zoning that will be useful for designing national

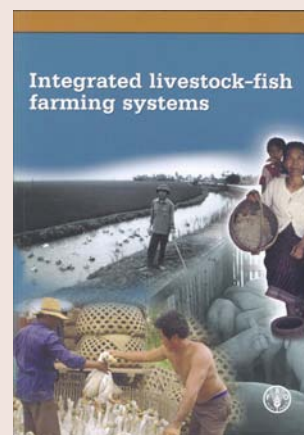
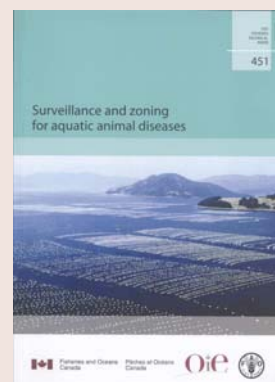
programmes aimed at reducing the risks of diseases resulting from transfers of live aquatic animals.

This document contains the collective expert opinion and recommendations made during the Consultation, aimed at providing scientific advice to member countries building national or regional aquatic animal health management infrastructures. It provides technical information and recommendations to the Competent Authorities of countries wishing to implement zonation to demonstrate that they have a "reliable system of disease control and surveillance" in place.

Further details could be obtained by writing to Mr Rohana Subasinghe at FAO/HQ – rohana.subasinghe@fao.org

Integrated livestock-fish farming systems by D.C. Little and P. Edwards. *FAO* 2003. 177p.

Small farmers in developing countries are poorer than the rest of the population, often not getting enough food to lead normal, healthy and active lives. Dealing with poverty and hunger in much of the world therefore means confronting the problems that small farmers and their families face in their daily struggle for survival. One option for economically and ecologically sustainable development of farming systems is the integration of agriculture and aquaculture.



The objective of the publication is to provide an analysis of the evolution and current status of integrated livestock-fish systems in Asia (integrated agriculture-aquaculture systems), particularly East and Southeast Asia, as well as to provide a sound technical basis for considering their relevance for the planning of livestock-fish systems in Africa and Latin America.

It is hoped that the conclusions and recommendations presented here will be interesting and thought-provoking for a wide audience generally interested in the subject of integrated agriculture-aquaculture, and particularly policy makers, planners, NGOs and senior research and extension staff. It is hoped that the book will stimulate these people at all levels to ensure that agricultural development provides for reasonable rural livelihoods, a clean environment, and adequate food products.

For further details, contact Mr Matthias Halwart at FAO/HQ – matthias.halwart@fao.org

Lovatelli, A. (comp./ed.); Conand, C.; Purcell, S.; Uthicke, S.; Hamel, J.-F.; Mercier, A. (eds.). *Advances in sea cucumber aquaculture and management. FAO Fisheries Technical Paper. No. 463. Rome, FAO. 2004. 425p.*



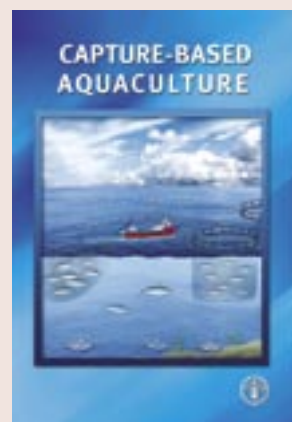
This document is a collection of the technical papers presented at the international Workshop on Advances in Sea Cucumber Aquaculture and Management (ASCAM) held in October 2003 in Dalian, People's Republic of China, and organized by the FAO Fisheries Department. The first part of the publication includes

the recommendations concerning sea cucumber resource management and aquaculture deliberated by the participants during discussion sessions. These were formulated and designed to help international and regional development organizations and national governments prioritize their activities concerning sea cucumber conservation and exploitation. The next sections reproduce the technical papers as presented at the workshop sessions, namely (i) on the status of resources and utilization, (ii) on resource management, and (iii) on aquaculture advances. Thirty-five presentations were delivered by international experts from 20 countries including Australia, Canada, China PR, Cuba, Egypt, France, Malaysia, New Caledonia, Papua New Guinea, Seychelles, Tanzania and Viet Nam.

Further details can be obtained by writing to Mr Alessandro Lovatelli at FAO/HQ - alessandro.lovatelli@fao.org

Ottolenghi, F.; Silvestri, C.; Giordano, P.; Lovatelli, A.; New, M.B. *Capture-based aquaculture. The fattening of eels, groupers, tunas and yellowtails. Rome, FAO. 2004. 308p.*

Capture-Based Aquaculture defines and reviews certain practices that are shared between aquaculture and capture fisheries. It specifically considers the on-growing or fattening of four species groups – eels, groupers, tunas and yellowtails – which is based on the use of wild-caught “seed”. The report begins with



an introduction on the overlap between aquaculture and fisheries and their global trends. Chapters on the four species groups follow and include information on species identification, fishery trends, the supply and transfer of “seed” for stocking purposes, aquaculture trends, culture systems, feeds and feeding regimes, fish health, harvesting and marketing. Further chapters examine the environmental and socio-economic impacts of capture-based aquaculture, together with the relevant fisheries and aquaculture management issues. Finally, the report looks at food safety issues, as well as identifies topics for future consideration. The principal targeted audience includes policy-makers, administrators and trainers in the fields of aquaculture, fisheries and the environment.

For further information please write to Mr Alessandro Lovatelli at FAO/HQ - alessandro.lovatelli@fao.org

Aquaculture development. 1. Good aquaculture feed manufacturing practice. FAO Technical Guidelines for Responsible Fisheries. No. 5, Suppl. 1. Rome, FAO. 2001. 47p.

This publication is available in all FAO languages; Arabic, Chinese, English, French and Spanish. Further details could be obtained from Mr Matthias Halwart at FAO/HQ – matthias.halwart@fao.org.