

**SPECIAL ISSUE**



## Aquaculture and Africa's development

FAN 35, the June 2006 issue of the FAO Aquaculture Newsletter (FAN), is dedicated to the Third Session of the FAO Committee on Fisheries Sub-Committee on Aquaculture.

Aquaculture has an important role to play in global efforts to eliminate hunger and malnutrition through supplying fish and other aquatic products rich in protein, essential fatty acids, vitamins and minerals. Aquaculture can also make significant contributions to development by improving incomes, providing employment opportunities and increasing returns on resource use. With appropriate management, the sector appears ready to meet the demand gap for aquatic food (fish) for the coming decades, a consequence to the increasing global population and stagnant capture fishery production. The main challenge for policy makers and development agents is to create an "enabling environment" to support the expansion needed to meet this potential. This enabling environment is multi-faceted and requires significant political will, policy support and investment. If we fall short in this endeavour, we may not be able to provide the supply of aquatic food required to even maintain current levels of consumption.

In Sub-Saharan Africa, per capita consumption has already dropped and we can little afford to see this trend continue or worsen. Thus, for the coming years and decades, Africa should be a high priority region for aquaculture development. We should join hands with all development agents and institutions to ensure that aquaculture and fish production in Africa becomes part of the overall development process for the continent. There are some new developments, such as the New Partnership for Africa's Development (NEPAD), which, through its Fish for All Summit in 2005, raised awareness regarding the potential of aquaculture. We should capitalise on these. Most countries in Sub-Saharan Africa have limited resources to deliver quality public goods and services without donor support and an under-developed private sector which could operate in its stead. There is thus a need for renewed and long-term assistance to Africa's aquaculture sector. This approach should favour private investment; it is imperative that we all learn from mistakes of the past.

During a recent review by FAO, two essential overarching conditions identified for making this happen were political stability and good governance. However, we also believe that there should be more emphasis put on private sector investment in aquaculture. Private sector efficiency will be facilitated by the establishment of an enabling public sector environment combined with a strategy to undertake development within the limits of available resources. Positive impacts of growing aquaculture development will be further complemented by aggressive implementation of Poverty Reduction Strategy Papers (PRSPs), development of national aquaculture strategies and good legislation. Providing incentives and risk reduction measures for Foreign Direct Investment are also necessary and can have trickle-down effects to boost development of small- and medium-scale commercial aquaculture.

The availability of quality inputs such as seed and feed in sufficient quantities, good quality information and available capital as well as access to land and water resources will contribute to reducing risks and enhancing sustainability. During the process of increasing the benefits of aquaculture to Africa, including direct and indirect advantages to the most needy, it will be imperative that the good image of aquaculture be maintained. Adoption of appropriate environmental management practices for protection and sustainable use of aquatic resources will be vital in this regard. It is also important that we maintain high standards for food safety. Finally, development of skills and the efficient use of communication and knowledge transfer through modern information technology will not only improve overall global knowledge but also link the continents.

As the only global inter-governmental forum with an aquaculture mandate, the Sub-Committee will undoubtedly play a strong advocacy role for raising and discussing timely global issues in the coming years. It will endeavour to review, discuss, harmonize and agree on regional and/or global standards and guidelines required for sustainable aquaculture development. The Sub-Committee, while playing the role of global watchdog for aquaculture, will also help in unlocking the potential for aquaculture development in Africa, particularly, by creating an effective South-South and North-South dialogue. It is important that Africa can both learn from its own past as well as from the successes and failures in aquaculture development worldwide.

Rohana P. Subasinghe  
Chief Editor of FAN and  
Technical Secretary of the Sub-Committee on Aquaculture

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**Cover Photos:** Top photos (left to right): Farmers participating in Farmer Field School in Suriname; Catfish farmer in Suriname (M. Halwart, FAO)

Middle photos (left to right); Seaweed farming family in the Philippines; LAO PDR women collecting fish in a reservoir (MB Reantaso, FAO)

Bottom photos (left to right): Fish market in Riga, Latvia; Tilapia processing plant in Belize; Fish meal in a Tuscan pizzeria in Monterchi, Arezzo, Italy (MB Reantaso, FAO)

## The Committee on Fisheries Sub-Committee on Aquaculture

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### Why?

In FAO, for many years, aquaculture issues have been discussed under the Committee on Fisheries (COFI), the highest governmental meeting on fisheries which meets biennially. During the past decade, as aquaculture gained serious momentum and developed as a strong food producing sector, FAO Members realised that the time allocated for discussing global issues of aquaculture during COFI is inadequate and a separate sub-committee should be created to exclusively discuss aquaculture issues, as it does for aquatic products trading issues by the Sub-Committee on Fish Trade. The FAO Members in 1999, during the 23rd Session of COFI requested FAO to look at the feasibility of a sub-committee on aquaculture and report to COFI.

### How?

In response to this request, thirty three participants from 14 countries, two regional inter-governmental organizations and two international non-governmental organizations attended an expert consultation from 28-29 February 2000, in Bangkok, Thailand to discuss the setting up of a sub-committee on aquaculture for COFI.

The consultation confirmed the growing importance of aquaculture, including culture-based fisheries, and its interactions justified a focused global intergovernmental mechanism to provide the opportunity for information exchange, discussion and consensus-building among various parties interested in aquaculture development and to establish an efficient means to advice and guide COFI and FAO. The consultation concluded that the establishment of such a sub-committee would be in line with the FAO Conference Resolution 13/97 and the expenditure of funds on the sub-committee would be justified. The consultation identified major issues and prioritized six key areas that need to be addressed and stated that the role of aquaculture for enhancing food security and economic development in FAO member countries was a primary priority.

### When?

The [Sub-Committee on Aquaculture](#) was established by FAO's Committee on Fisheries (COFI) at its Twenty-fourth Session in 2001 in accordance with Rule XXX-10 of the General Rules of the Organization and Rule VII of the COFI Rules of Procedures.

### Who?

Sub-Committee membership is open to all Member Nations of the Organization. Non-Member states of the Organization that are member of the United Nations, or any of its Specialized Agencies or the International Atomic Energy Agency, may be admitted by the Council of the Organization to membership in the Sub-Committee.

### What?

Terms of Reference of the Sub-Committee on Aquaculture

The Sub-Committee shall provide a forum for consultation and discussion on aquaculture and advice COFI on technical and policy matters related to aquaculture and on the work to be performed by the Organization in the subject

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*Pearl oyster farming in China*



*Seaweed farming in the Philippines*

matter field of aquaculture. In particular the Sub-Committee shall:

- ⊙ identify and discuss major issues and trends in global aquaculture development;
- ⊙ determine those issues and trends of international importance requiring action to increase the sustainable contribution of aquaculture to food security, economic development and poverty alleviation;
- ⊙ recommend international action to address aquaculture development needs and, in this regard:
  - ⊙ to advise on mechanisms to prepare, facilitate and implement action programmes identified, as well as on the expected contribution of partners;
  - ⊙ to advise on the liaison with other relevant groups and organizations with a view to promoting harmonization and endorsing policies and actions, as appropriate;
  - ⊙ to advise on the strengthening of international collaboration to assist developing countries in the implementation of the Code of Conduct for Responsible Fisheries.
- ⊙ advise on the preparation of technical reviews and of issues and trends of international significance;
- ⊙ address any specific matters relating to aquaculture referred to it by its Members, the Committee on Fisheries or the Director-General of FAO".

## Sessions of the Sub-Committee on Aquaculture:

### Where?

#### FIRST SESSION: 18-22 APRIL 2002, BEIJING, CHINA PR

The First Session was attended by 49 Members of FAO, by an observer from one non-Member Nation of FAO, by a representative from one specialized agency of the UN and by observers from 8 intergovernmental and international non-governmental organizations. The First Session, the Sub-Committee recognized the important role that aquaculture could play in improving livelihoods, generating income and stimulating national and regional development and identified the following key areas for future work:

- ⊙ creating an enabling environment for the promotion of sustainable aquaculture development and management
- ⊙ establishing a framework for sustainable rural aquaculture development
- ⊙ education, information sharing and capacity-building
- ⊙ data collection and reporting to improve knowledge and management of the sector.

#### SECOND SESSION: 7-11 AUGUST 2003, TRONDHEIM, NORWAY

The Second Session of the Sub-Committee was attended by 64 Members of FAO, by an observer from one Non-Member nation of FAO, by a representative from one specialized



*Reservoir fishing in Lao PDR*

agency of the UN and by observers from 6 inter-governmental and international non-governmental organizations. The Second Session of the Sub-Committee identified and discussed a number of issues such as:

- ⦿ Implementation of the recommendations of the First Session;
- ⦿ Efforts by regional fishery bodies in responsible aquaculture and culture-based fisheries;
- ⦿ Progress in implementing the provisions of FAO's CCRF relevant to aquaculture and culture-based fisheries;
- ⦿ Improving status and trends reporting on aquaculture;
- ⦿ Strategies to improve safety and quality of aquaculture products; and
- ⦿ Responsible practices in culture-based fisheries.

In addition, the Sub-Committee discussed and made recommendations on emerging issues concerning: (a) exotic aquatic species, their introductions, transfers and movement; the risks and benefits, including introduction of pathogens and management of health; and (b) shrimp aquaculture sustainability, including follow-up activities recommended at the Expert Consultation on Good Management Practices and Good Legal and Institutional Arrangements for Sustainable Shrimp Culture held in Brisbane, Australia in December 2000. The Sub-Committee also requested FAO to

review and analyse the various certification systems in place with a view to ensure harmonized approaches and procedures for the development and implementation of shrimp aquaculture products certification systems. The Sub-Committee requested the Secretariat to provide a prospective analysis of future challenges in global aquaculture as a basis for a discussion of the longer term direction of the Sub-Committee's work.

### THIRD SESSION: 4-8 SEPTEMBER 2006, NEW DELHI, INDIA

The Third Session of the Sub-Committee will discuss the FAO Fisheries Department's efforts in implementing the recommendations of the first and second sessions of the COFI Sub-Committee on Aquaculture and the progress made on the implementation of the aquaculture related provisions of the Code of Conduct for Responsible Fisheries during the intrasessional period. It will also discuss, debate and decide on several other timely issues on

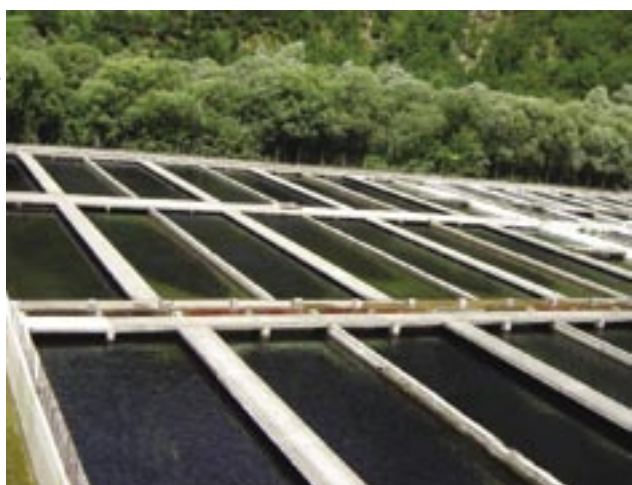
- ⦿ improving information on the status and trends in aquaculture development,
- ⦿ increasing the socio-economic impacts of aquaculture,
- ⦿ improving planning and policy development in aquaculture: opportunities and challenges,
- ⦿ better management of aquaculture: the future; and
- ⦿ prospective analysis of the future aquaculture development and the role of COFI Sub-Committee on Aquaculture.

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- ⦿ Report of the First Session of the Sub-Committee on Aquaculture, Beijing, People's Republic of China, 18-22 April 2002. FAO Fisheries Report No. 647. Rome, FAO. 2002. 66p.
- ⦿ Report of the Second Session of the Sub-Committee on Aquaculture, Trondheim, Norway, 7-11 August 2003. FAO Fisheries Report No. 716. Rome, FAO. 2003. 91p.

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*Trout farming in Bosnia and Herzegovina*

# Is aquaculture at its turning point?

Rohana P. Subasinghe<sup>1</sup>

The FAO study conducted in 2001 (SOFIA, 2002) reports that the world demand for fish and fishery products is projected to expand by almost 50 million tonnes, from 133 million tonnes in 1999/2001 to 183 million tonnes by 2015. On the supply side, total world fish production would increase from 129 million tonnes in 1999/2001 to 172 million tonnes by the year 2015. Of the total production, capture fisheries is projected to stagnate, while aquaculture production is projected to increase substantially, but at a slower rate than in the past. Of the expected increase of 43 million tonnes in global fish production from 1999/2001 to 2015, 73 percent would come from aquaculture, which will account for 39 percent of global fish production in 2015 (up from 27.5 percent in 1999/2001).

Global production from aquaculture has grown substantially, both in terms of quantity and its relative contribution to the world's supply of fish for human consumption. During the last 50 years, (Figure 1) from less than a million tonnes in the early 1950s, production reached 59.4 million tonnes, including 13.9 million tonnes of aquatic plants, by 2004, with a value of US\$ 70.3 billion. This increasing trend is projected to continue in forthcoming decades. The sector aims to contribute more effectively to

food security, poverty reduction and economic development by producing 83 million tonnes of aquatic food by 2030, an increase of 37.5 million tonnes over the 2004 level.

An article in the Economist (1995) - The World in 1996 - predicted that, "Farmed fish will become a major source of protein and will meet 40 percent of the world demand for fish by 2010". More than half a decade ahead of the projections aquaculture already provides more than 40 percent of the global food fish supply.

Population growth, rising per capita incomes and growing consumer preference for fish products have led the world fish consumption to increase from 40.5 to 106 million tonnes over the period 1970 to 2004, a trend that is expected to continue onwards. With stagnant capture fisheries production, aquaculture expansion, as in the recent past, is expected to contribute significantly to meet this growing global demand for fish consumption.

## AQUACULTURE AT ITS CROSSROAD

While taking giant strides in productivity, intensification, integration, industrialization, and diversification, the sector presents significant concerns on reducing environmental

**Figure 1.** Trend in total world aquaculture production and value (including plants), 1950-2004



degradation and competition for environmental goods and services. This calls for the sector to better serve the poor, and to be more sustainable, more responsible, more equitable, and more economical in its development.

The FAO study (SOFIA, 2002) also reported that the 10.9 million tonnes of deficit, arising from excess demand for fish and fishery products, will not materialize as the market will be re-equilibrated through two factors: relative price increases and shifts in demand among different types of fish and fish products, and change in demand towards alternative protein foods. According to the projections, prices for all types of fish would increase in real terms by 3.2 percent by the year 2015; this will have relatively severe effects on low-income consumers. As a consequence of the increase in price, world consumption of all types of fish would be 179 million tonnes, which is 3.8 million tonnes lower than the projected demand. On the other hand, the study pointed out that, world supply of all types of fish, stimulated by higher prices, would increase by 7.1 million tonnes by the year 2015. And in terms of world trade, developing countries as a whole would increase their net exports of fish and fishery products.

A recent global aquaculture review (FAO, 2006a) reported six general development trends:

- ⇒ continuing intensification of aquaculture production in which the main driving forces are the availability of sites that is becoming increasingly limited and the ability to exploit non-agricultural land that is becoming restricted;
- ⇒ continuing diversification of species use, particularly high value marine species in regions and countries where aquaculture is well established;
- ⇒ continuing diversification of production systems and practices, including integration of aquaculture into existing farming systems and diversification of other sectors, particularly agriculture, into aquaculture;
- ⇒ increasing influence of markets, trade and consumers, which is prompting producers and processors to pay more attention to food quality and safety and moving toward greater value adding and development of processed products for exports;
- ⇒ enhancing regulation and improving governance of the sector, with strong emphasis being placed on increasing self-regulation by farmer associations and the sector in general; and

- ⇒ increasing attention on better management of the aquaculture sector through production efficiency, economic sustainability and overall competitiveness.

The global review noted that the trends do not necessarily apply equally to all the regions due to intra- and inter-regional differences in the development stage of aquaculture.

A Prospective Analysis of Future Aquaculture Development, recently conducted by FAO (FAO, 2006b), endorses those trends, and provides a roadmap for the sector to achieve its vision by 2030, based on an analysis of factors which contributed to aquaculture growth, factors which hindered growth, and factors that could constrain growth in the future. The three factors were analysed based on three related themes: (a) policy, institutional, legal and management; (b) markets, trade and finance; and (c) research and development.

The Prospective Analysis also noted that, due to the marked intra- and inter-regional and country variations in the history, practice and potential of aquaculture, it is not logical to consider the analyses and conclusions of the factors to apply equally to all countries and regions engaged in aquaculture activities.

The results of the analysis mainly reflect the behaviour of the sector in the countries where aquaculture is well established, notably China and other Asian countries. In 2004, China accounted for 69.6 percent of the total global production, with the rest of Asia accounting for 21.9 percent. In contrast, Sub-Saharan Africa warrants special consideration due to the vast disparity in production, consumption and other related factors.

In 2004, Sub-Saharan Africa contributed less than 1 percent to global production. Fish consumption is the lowest in all regions and is the only part of the world where it is declining. However, the potential for growth is extremely high and Africa is now receiving greater attention by both national and international development agencies.

From an activity that has primarily Asian origin (e.g., culture of common carp as early as 1100 BC in China; oyster farming recorded as early as the Han Dynasty in 206 BC to 220 AD), aquaculture has now spread to all the continents. From an activity that was focused on freshwater fish, particularly the cyprinids, it now encompasses all the aquatic environments and many aquatic species. From an activity

that was primarily small-scale or non-commercial and family-based, it now includes large-scale commercial or industrial production of high value species that are traded at the national, regional and international levels. Asia's dominance, the cyprinid-focused culture practices and the persistent small-scale based aquaculture operations are still evident in the present structure of the sector.

Many governments have now clearly recognized that aquaculture programs need to be implemented based on sound policies in order to explore the following opportunities for further developing the sector such as:

- ⇒ growing population and increasing purchasing power of people;
- ⇒ opening of new markets facilitated by trade liberalization; and
- ⇒ advances in biotechnology and marine engineering

Major challenges include:

- ⇒ strengthening capacities of institutions and other stakeholders;
- ⇒ supplying the increasing consumer demand for diversified, safe and quality products;

- ⇒ the efficient use of scarce land and water resources; and
- ⇒ the need to support small-scale farmers.

The sector's performance, based on past trends, indicate that it stands ready to meet new challenges, but will need sustained commitment and support by government policy makers and international development partners involved in aquaculture development from "drivers", those who initiate and lead the process, "champions", those who supports the process and "change agents", those who take the risks and accepts the challenges, within the sector to promote its cause more effectively.

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*Photo left: Large-scale shrimp farming in Belize with hatchery, grow-out and processing facilities*

*Right: Small scale tilapia farming in Belize*

*Bottom: State-operated salmon hatchery in Latvia*

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# Aquaculture Stock Insurance: a short summary of the current status

Raymon van Anrooy<sup>1</sup>

## INTRODUCTION

Over the last decades, due to the rapidly changing production processes in aquaculture worldwide (e.g., submergible cages, sea ranching, intensification, aquaponics and recirculation systems), which sometimes increase vulnerability to disease outbreaks and which generally require large investments from aquaculturists, the demand for insurance to share and cover the risks involved has increased significantly within the aquaculture sector. Besides, disasters (e.g., oil spills, white spot disease in shrimp culture, tsunamis, storms, red tides) that have hit the aquaculture sector and affected the livelihoods of aquaculture producers, their families and their communes, have been many in recent years. Farmers went bankrupt and societies encountered social disruption from one day to another due to loss of employment, food and income. Apart from this, the consequences for the environment (like escapes from cages as a result of storm damage) are difficult to assess.

Aquaculture insurance is one of the tools used in aquaculture risk management (see related articles on page 20), but there is considerable lack of knowledge within the aquaculture industry about its availability, the process of obtaining insurance cover, especially on aquaculture stock mortality, and the constraints to insurers providing its services. Farmers, generally, are not aware that insurance services for aquaculture stock exist. Most aquaculturists still think that insurance is limited to life, health, car and property insurance. On the other hand, insurance companies are not widely promoting aquaculture insurance services as the risks involved in these services are often considered higher than other insurance services; thus premiums are higher and therefore, less attractive to aquaculturists). In addition, personnel with knowledge and experience in aquaculture issues is often lacking within insurance companies and the experiences with aquaculture insurance in the eighties and nineties were less than satisfactory.



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*FI Officers, R Van Anrooy (left) and MB Reantaso (right) with P. Secretan (Managing Director of AUMS, Ltd.) during the 10th Aquaculture Insurance and Risk Management Conference in Vigo, Spain on 6-7 April 2006*

It should be recognized that the benefits of aquaculture insurance are many. First of all aquaculture stock insurance provides some level of financial security against the causes of natural and man-made disasters that can hit aquaculture stock. Moreover, aquaculture insurance can provide for more stable incomes, compensation for lost harvests, increase lending and investment opportunities by guaranteeing repayment of loans, increase access to risk management information, and decrease the daily stress about everything that can go wrong on an aquaculture farm.

In 2005, FAO carried out a review aimed to increase awareness of aquaculture producers worldwide, particularly those in developing countries, on the opportunities that aquaculture insurance can offer. This study was also intended to inform decision-makers at national government levels as well as in international agencies about the role of aquaculture insurance in the sustainable development of the aquaculture sector and to provide aquaculture sector stakeholders with insights as to what is all-too-frequently considered a complicated type of activity.

The review covered the main aquaculture producing countries worldwide. Seven

syntheses papers (China, Asia, Europe, North America, South America, sub-Saharan Africa and Oceania) were prepared, discussing the specificities of the situation with regard to aquaculture insurance in China and the above regions. Moreover, a summary of the regional syntheses was made, together with conclusions and clear recommendations at various levels to increase the contribution of aquaculture insurance to the sustainable management and development of the aquaculture sector.

## SOME FINDINGS OF THE REVIEW<sup>2</sup>

The aquaculture insurance market consists of large numbers of farmers on the demand side and only few suppliers of the service. This means that the opportunities to shop around for farmers are limited, particularly as most suppliers are only active in a few countries and limit their services to only a few species and culture systems. Most suppliers have their headquarters in Europe. Lloyd's of London, which is an insurance market in itself, already dealt with aquaculture insurance in the 1970s. At present the demand for aquaculture insurance has never been as high as it is now and it seems that there is a widening gap between the demand for and supply of aquaculture insurance in the world. While some countries in Europe, Oceania and North America are currently served by the insurance industry, many countries in Asia, Latin America and Africa lack the service so far.

The number of aquaculture insurance policies in force is estimated at only around 8 000 worldwide, while the number of people employed in aquaculture almost reaches 10 million. Many of these policies can be found in Japan, one of the few countries with a well-established system of aquaculture insurance. In countries like China and India, with hundreds of thousands of aquaculturists, the number of aquaculture insurance policies in force is insignificant.

Of the aquaculture insurance policies in force in Asia, most are of the "named perils" type, while in other regions, the aquaculture policies are often of the "all risks" type. The following "named perils" are commonly included in standard policies:

### For onshore systems:

- ◇ pollution from external sources;
- ◇ aircraft and other aerial devices or articles dropped from the sky;
- ◇ malicious acts;

- ◇ predation;
- ◇ floods, inundations and tidal waves;
- ◇ storm damage (including hurricanes, cyclones and typhoons);
- ◇ landslides, earthquakes and volcanic eruptions;
- ◇ structural failures (e.g., of dykes), breakage or blockage of any part of the water supply system;
- ◇ drought, fire, lightning, explosion;
- ◇ freezing, frost damage, frazil ice;
- ◇ mechanical breakdown or accidental damage to machinery and other installations;
- ◇ electrical breakdown, failure or interruption of the electricity supply, and electrocution; and
- ◇ de-oxygenation and other changes in the concentration of the normal chemical constituents of the water that cause damage.

### For offshore systems:

- ◇ pollution from external sources;
- ◇ aircraft and other aerial devices or articles dropped from the sky;
- ◇ malicious acts;
- ◇ predation or physical damage by predators or other aquatic organisms (excluding by sea lice or other ectoparasites);
- ◇ storm, lightning, tidal waves and collision;
- ◇ sudden and unforeseen structural failure of equipment;
- ◇ freezing, super-cooling, ice damage;
- ◇ de-oxygenation due to competing biological activity or to changes in the physical or chemical conditions of the water, including upwelling and high water temperatures; and
- ◇ other changes in the concentration of the normal chemical constituents of the water, including pH or salinity.

Insurance policies with additional cover for diseases, such as shell disease, vibriosis, and parasitic diseases, and for damage caused by red tides can often be arranged for as well. Theft, riots, strike, war and similar disturbances are generally not covered, nor is damage caused by negligence of the policy-holder.

The Review showed that the underwriting experiences of aquaculture insurance companies largely differ among companies and regions and from year to year. Since the start of the new millennium, it seems that aquaculture stock insurance experiences are improving and that the aquaculture insurance activity is becoming profitable.

Mutual insurance schemes, while common in some countries for agriculture and capture fisheries, are still insignificant in aquaculture. So far, the only successful mutual insurance-like scheme for aquaculture that did not remain at the pilot stage is the Japanese aquaculture insurance scheme.

Asymmetric information, moral hazard and adverse selection are among the major constraints to undertaking aquaculture insurance activities for international and national insurance companies. The fact that farmers know much better than insurers what is happening in their cage or pond and what are the risks involved in the production process gives them an advantage over insurers with regards to assessing the risks involved for the establishment of the premium rates. There are some risk factors that negatively influence new entrants to the aquaculture insurance sector. These are: (a) insurance protection which create a condition for some unscrupulous individuals to cause the insured event; (b) behaviour that increases the likelihood that the event will occur (i.e., moral hazard); and (c) tendency of persons who present a worse than average risk to apply for, or continue, insurance (i.e., adverse selection).

#### **FOLLOW-UP ACTIVITIES**

The insurance industry and a number of governments recently began to recognize that aquaculture insurance is an important tool for risk management for sustainable aquaculture. It is somehow understood that the lack of enabling policies and regulatory frameworks for aquaculture and fisheries insurance is negatively affecting the development of insurance services. It also seems difficult in many cases to bring the various stakeholders around the table to discuss what should be

done exactly to decrease the constraints to the development of aquaculture insurance. FAO is supportive of initiatives that aim to bring together the stakeholders to exchange information, increase awareness and build capacity on this subject.

The "Review of the current state of world aquaculture insurance", the presentations at the 10th Aquaculture Insurance and Risk Management Conference, held in Vigo, Spain on 6-7 April 2006, and a number of other publications such as the FAO Report entitled "Livestock and aquaculture insurance in developing countries: a brief overview"<sup>3</sup> all showed that aquaculture insurance services don't reach the small-scale aquaculturists world-wide. In Asia, in particular, the percentage of all aquaculture enterprises (large- and small scale) covered by insurance is extremely low. The participants at the "Regional workshop on guidance for credit and microfinance programmes in support of the sustainable use of inland fisheries resources and poverty alleviation." held in Beijing on 14-17 February 2006, recognized this and recommended, among others, that a " regional workshop should be organized on the promotion of aquaculture insurance in Asia". Currently FAO is planning the organization of such a regional workshop, which is scheduled to take place in February 2007.

If you are interested in attending this workshop, please contact the author of this article about the details.

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<sup>2</sup>Van Anrooy, R.; Secretan, P.A.D.; Lou, Y.; Roberts, R.; & Upare, M. 2006. Review of the current state of world aquaculture insurance. FAO Fisheries Technical Paper. No. 493. Rome, FAO. 2006. 92p.

<sup>3</sup>This publication can be found on-line at: <http://www.ruralfinance.org/id/31730>.

MB REANTASO, FAO



*Aquafarming family in Hue, Viet Nam*

# Use of Geographic Information Systems (GIS) for Responsible Aquatic Resource Management

José Aguilar-Manjarrez<sup>1</sup>, Alexis Bensch<sup>2</sup>, Fabio Carocci<sup>3</sup>, Gertjan de Graaf<sup>4</sup> and Marc Taconet<sup>5</sup>

## INTRODUCTION

Aquaculture and fisheries play important roles in the global economy, in poverty alleviation, in fostering food security and in recreation. As recognized in the FAO Code of Conduct for Responsible Fisheries (CCRF), sustainability is a fundamental management and development requirement for both sectors. Sustainability has many important spatial elements.

A principal way through which the FAO Fisheries Department (FI) facilitates implementation of the CCRF is through its FishCode Programme of Global Partnerships for Responsible Fisheries (<http://www.fao.org/fi/fishcode.htm>). Amongst other activities FishCode promotes the use of manuals and applications like Geographic Information Systems (GIS) for fisheries monitoring and analyses, in line with the CCRF principles ([http://www.fao.org/figis/servlet/static?xml=STF\\_proj.xml&dom=org&xp\\_nav=5](http://www.fao.org/figis/servlet/static?xml=STF_proj.xml&dom=org&xp_nav=5)).

**Aquaculture** spatial issues addressed most frequently include: development (siting and zoning, strategic planning), practice and management (inventory and monitoring of aquaculture and the environment, environmental impacts), and integration of aquaculture into other uses of lands and waters (management of aquaculture together with fisheries, multisectoral planning including aquaculture).

**Inland fisheries** spatial issues addressed most frequently include: status of fishery resources (habitat quality and quantity linked to fish abundance and distribution), fisheries (planning and potential), environment (impacts on fishes and habitats), and multisectoral planning and management including fisheries.

**Marine fisheries** spatial issues include: activities in support of management options (analysis of conflict areas, catch and effort spatial analysis), inventory and location of fishery

resources (maps of distribution, bio-diversity analysis), modelling of fishing activities (through Vessel Monitoring Systems-[http://www.fao.org/figis/servlet/static?dom=topic&xml=VMS\\_Home.xml](http://www.fao.org/figis/servlet/static?dom=topic&xml=VMS_Home.xml)), activities in support of ecosystem approach to fisheries, and location and impact assessment of marine protected areas (MPAs).

## CURRENT IMPLEMENTATION AND ALLOCATION OF GIS ACTIVITIES AT THE FISHERIES DEPARTMENT

Six main GIS related activities are currently being carried out by different technical services of the FI, namely: (a) Methodologies, technical guidelines and technical papers, (b) Geo-referenced information systems, (c) Field projects and training, (d) New technologies, (e) Seminars, and (f) Standards and guidelines. The present article provides a brief on these activities with a specific focus on aquaculture. It is intended for administrators and technical staff of fishery departments of FAO member countries.

## Inland Water Resources and Aquaculture Service (FIRI)

### *Programme Activities*

The following activities will be completed in 2006 or will continue in 2007 and onwards like GISFish.

🌐 "GISFish" The Global Gateway to Geographic Information Systems (GIS), Remote Sensing and Mapping for aquaculture and inland fisheries to be released in late 2006. (By Aguilar-Manjarrez, J. and Kapetsky, J.M.).

GISFish is a "one stop" site from which to obtain the depth and breadth of the global experience on GIS, remote sensing and mapping as applied to aquaculture and inland fisheries. GISFish was created to: (a) promote the use of GIS, remote sensing and mapping; and (b) facilitate the use of these tools through easy access to comprehensive information on applications and training opportunities. Accordingly, GISFish targets a broad range of users.


GISFish sets out key issues in aquaculture and inland fisheries, and demonstrates the benefits of using GIS, remote sensing and mapping to resolve them. The global experience provided by GISFish is captured in databases of literature references, ongoing projects, training opportunities, activities, news and links.

GISFish provides access to case studies in order to: (a) call attention to a wide variety of applications that have contributed to solving important issues that affect the sustainability of aquaculture and inland fisheries and (b) provide information that is usually lacking from scientific papers and reports, particularly with regards to ways in which work has been completed and the commitment of time and specialized personnel involved.

**Figure 1.** Example of GISFish Web page illustrating case studies (GISFish is still under construction)



GISFish is powered by FAO's Community Directory Service (CDS) engine, which is compatible and has links to FAO's Fisheries Global Information System (FIGIS). A "marine fisheries" section will be developed for GISFish by FAO's Marine Resources service (FIRM) as soon as funds are made available.

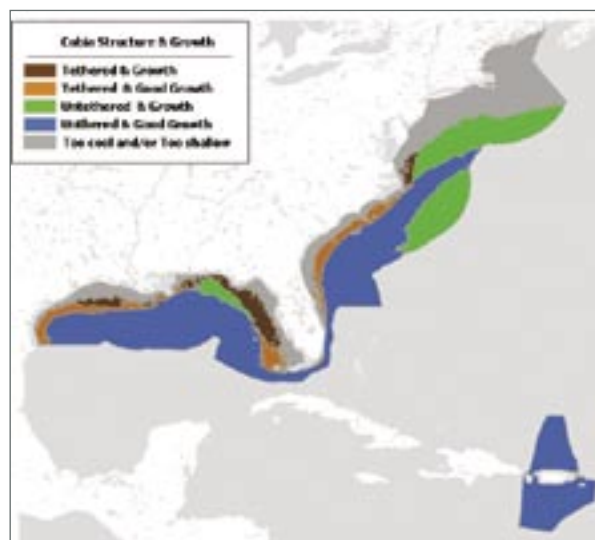
 GIS and Remote Sensing for the Development and Management of Offshore Aquaculture: A Reconnaissance - to be published in 2006. (By Kapetsky, J.M and Aguilar-Manjarrez, J.).


Open ocean aquaculture is in its very early stages. Currently available technologies are limited to operations in exposed offshore

sites. Exploiting open ocean sites will require new designs for tethered and free-floating structures. Nevertheless, a number of factors provide incentives for such developments. Among them are an increasing demand for fish products, escalating competition for space along with problems of pollution in inland and coastal areas, and the perception that the world's oceans offer an almost unlimited capacity for growth. Meanwhile, nearshore aquaculture is well developed in many countries but there are important issues regarding sustainability. Whether offshore or nearshore, GIS, remote sensing and mapping have important roles to play in resolving the issues that are entirely spatial or that have spatial components. The purpose of this reconnaissance study is to document the role of available tools to support the development and management of marine applications in places where good potential exists. The study, to be published as an FAO Fisheries Technical Paper includes a global in-depth review of the issues, concepts, data needs and availability, techniques, and capacity.

At first glance assessing open ocean aquaculture potential appears simple and straightforward compared to land-based and inshore aquaculture. In reality, it is complex. Two case studies use GIS and remote sensing to assess the open ocean aquaculture potential of two species - Cobia, a warm water finfish, and the blue mussel, a cold water mollusc - within the Exclusive Economic Zones (EEZ) of the east coast of the USA and Puerto Rico/Virgin Islands. The criteria broadly include suitability for the organism and the culture system, and access (Figure 2). Guidance for the identification of relevant data sources is provided by FIRM.

**Figure 2.** An example of Cobia culture suitability map for nearshore and offshore aquaculture



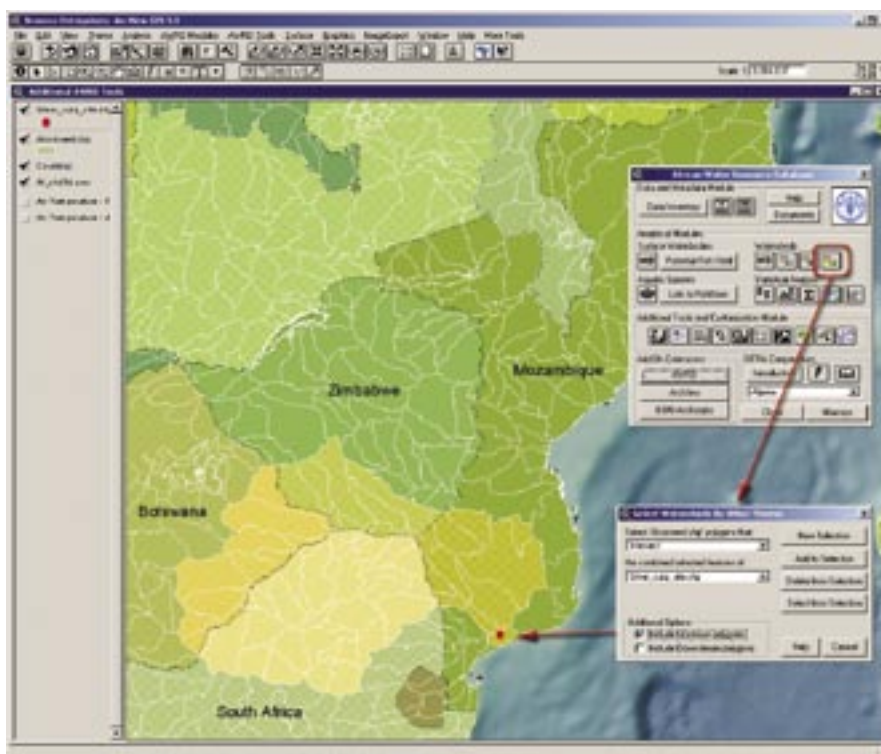
 African Water Resource Database (AWRD) – to be published in 2006 (By *Jenness, J.; Dooley, J.; Aguilar-Manjarrez, J., and Riva, C.*).

The African Water Resource Database (AWRD) represents the follow-up activities based on the recommendations of the Committee on Inland Fisheries for Africa (CIFA). AWRD is a GIS analytical framework supporting inland aquatic resource management with a specific focus on inland fisheries and aquaculture. AWRD database includes: surface water bodies, watersheds, aquatic species, rivers, political boundaries, population density, soils, satellite imagery and many other physiographic and climatological data types. AWRD contains an assortment of new custom-designed applications and tools to display and analyze these data. The Database allows integration of different types of information (e.g., fishery statistics) into a cohesive programme that, because of its visual nature, is easy to understand and interpret. Systems such as AWRD are excellent means to attract and direct investments in aquaculture and fisheries development. Further explorations and applications of AWRD data could deepen our understanding of inland aquatic resource management and be of immediate value in addressing a wide variety

of issues raised at recent CIFA sessions. These include, for instance: improving status and trends reporting in inland fisheries and aquaculture, co-management of shared inland fisheries resources, transboundary movements of aquatic species, and increased participation of stakeholders in watershed use decision making processes.

AWRD offers an effective way of dealing with transboundary issues, such as assessing the risks and benefits from the use of alien species (i.e. introduced or exotic species) in fisheries and aquaculture. Use of alien species may impact areas very far removed from the target locality. **Figure 3** shows the area that the introduced Silver carp species could potentially access once introduced into the Limpopo drainage in southern Africa. A local introduction into coastal Mozambique or Zimbabwe highlands would provide access to four countries. International codes of practice on alien species, such as the ICES codes of practice (ICES 1995) and the FAO Code of Conduct for Responsible Fisheries, call on users of alien species to notify States that may be impacted by their introduction. AWRD would provide clear indication of which countries should be notified and which waterbodies may be impacted.

**Figure 3.** Use of AWRD data and tools to assess the distribution of Silver carp through four countries



🌐 Distribution and characteristics of the main aquaculture production sites by administrative units for the National Aquaculture Sector Overviews - to be published in NASO in 2006. (By Crespi, V.; Dessi, A.; Franceschini, G.; and Aguilar-Manjarrez, J.).

The National Aquaculture Sector Overview (or NASO) collection, a concise and comprehensive cross-domain product, provides synthesis of aquaculture and culture-based fisheries at the national level (Figure 4).

**Figure. 4** Example of NASO GIS produced map for Brazil\*



\*[http://www.fao.org/figis/servlet/static?dom=coun trysector&xml=naso\\_brazil.xml](http://www.fao.org/figis/servlet/static?dom=coun trysector&xml=naso_brazil.xml)

NASO maps, supported by line drawings, illustrations and charts, provide a quick overview of aquaculture site locations and offer links to summary tables on aquaculture production. These maps are being produced for globe coverage and when finalized could represent what is likely to be the most comprehensive geo-referenced database on aquaculture site locations ever compiled.

🌐 Inventory and monitoring of coastal aquaculture and fisheries structures by Satellite Aperture Radar (SAR) (By Travaglia, C.; Kapetsky, J.M.; Profeti, G., and Aguilar-Manjarrez, J.).

Satellite Aperture Radar (SAR) data can be used for inventory and monitoring of coastal aquaculture and fisheries structures which are important baseline data for decision-making in planning and development, including regulatory laws, environmental protection and revenue

collection. Publications produced by FIRI in 1999 and 2004 using SAR data include studies for Sri Lanka (Environment and Natural Resources Working Paper No.1) and the Lingayen Gulf, the Philippines (FAO Fisheries Technical Paper. No. 459). Provided funds are available in the future, SAR analysis could be applied in similar environments around the globe and could help create a comprehensive inventory of aquaculture structures, thus enhancing NASOs and the statistics compiled by FIDI.

#### Project-based activities

In terms of Technical Cooperation, the following projects have a GIS component:

- ≡ TCP/RAF/3101 (F) "Project formulation for fisheries-related technical assistance components of the Regional Programme for Integrated Management of Lake Tanganyika.
- ≡ "UTF/BRA/066/BRA on Coastal Communities Development" (Aguilar-Manjarrez, J. Lead Technical Unit Officer). Using the GIS analytical framework developed by the previous TCP on seaweed farming TCP/ BRA/0065, the UTF project will collect and enter the required information to pre-select 15 new sites per state for further analysis. The establishment of GIS for integrated mariculture and artisanal fisheries would include the training of the operators and the programming of the system which should also be used for monitoring of project impact (Figure 5).

**Figure 5.** An example of potential areas for seaweed culture in Paraíba as indicated by the GIS analysis (green areas indicate high potential whilst orange areas indicate medium potential)



## Marine Resources Service (FIRM)

GIS activities at FIRM contribute to different areas of analysis and management of fishery resources. In the last biennium 2004-05, FIRM has played an important role in:

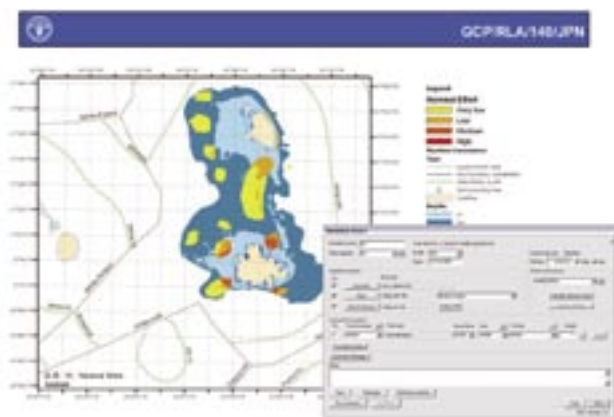
- ⇒ production, maintenance and updating of distribution maps of marine species of commercial importance;
- ⇒ preparation of electronic fact sheets of selected fishery resources as inputs to FIGIS and other regional and global databases;
- ⇒ ecosystem analyses and monitoring in support of Ecosystem Approach to Fisheries (EAF);
- ⇒ updating of the "Review of the state of world marine fishery resources" (available at <ftp://ftp.fao.org/docrep/fao/007/y5852e/y5852e00.pdf>); and
- ⇒ global and regional reviews of tuna and tuna-like fisheries and fishery resources.

### Programme activities

FIRM is involved in the development of methodologies and applications for the analysis of fishery information:

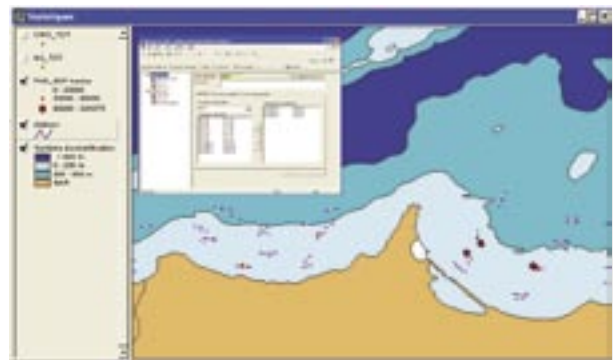
- ⇒ Simulation and modelling of spatial distribution of small-scale fishing activity through a dedicated GIS application called FAST (Fishing Activity Simulation Tool). The application and documentation is available through the FAO COPEMED Project at [http://www.faocopemed.org/en/activ/research/gis/eff\\_network.htm](http://www.faocopemed.org/en/activ/research/gis/eff_network.htm) (Figure 6).

**Figure 6.** An example of application of FAST in the Caribbean region: preliminary analysis of the distribution of local fishing activities modelled according to "scoring" functions applied to distance from landing sites and depth zones



- ⇒ Application "Resources" for the management and spatial analysis of data collected by scientific fishing surveys. The application includes a data-entry interface and assists the user for mapping catch statistics. A GIS project is automatically built by the application for each selected set of fishing operations, including one layer for each computed statistics (Figure 7). Further documentation is available through the FAO COPEMED Project at [http://www.faocopemed.org/en/activ/research/gis/app\\_trawl.htm](http://www.faocopemed.org/en/activ/research/gis/app_trawl.htm).

**Figure 7.** An example of the "Resources" application: map of catch statistics extracted from the module for spatial analysis and compared to depth zones



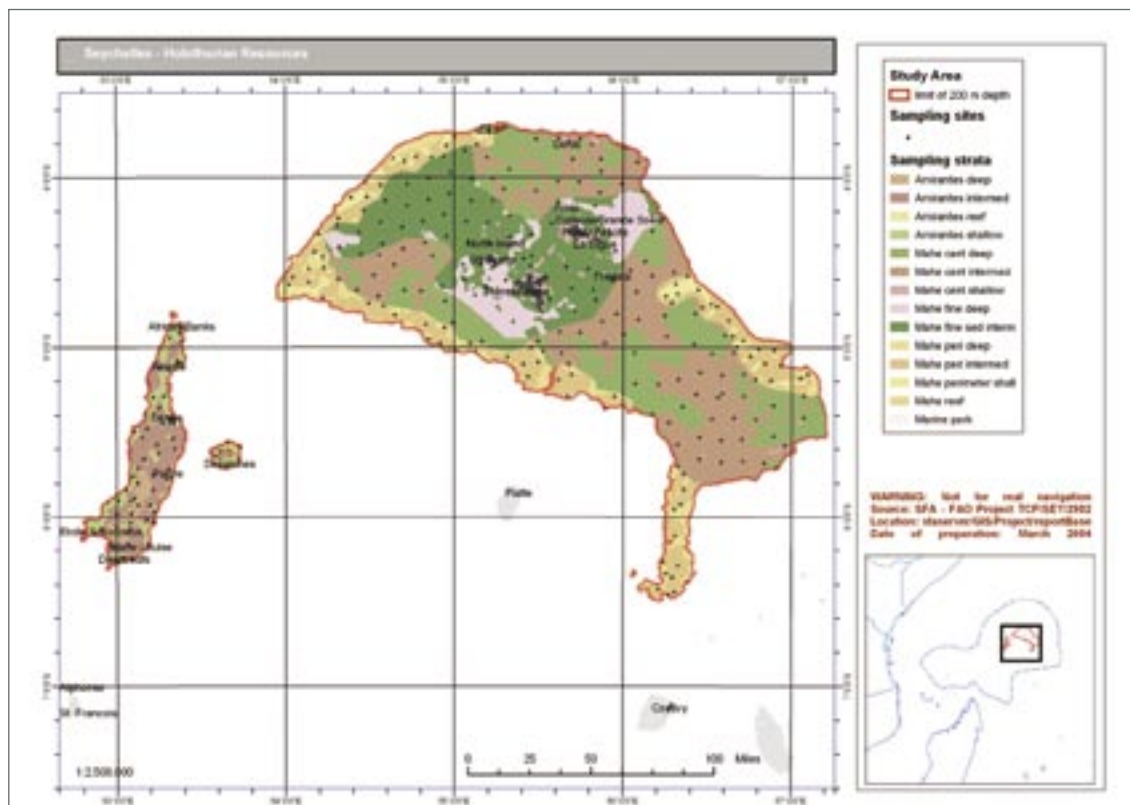
- ⇒ In addition, GIS is pursued by FIRM as a valuable tool in the development and use of indicators and reference points for assessing and monitoring the status of marine fishery resources in the context of their ecosystem.

### Project-based activities

In terms of Technical Cooperation the following Projects have included a GIS component:

- ⇒ GCP /RLA/140/JPN on Scientific Basis for Ecosystem-Based Management in the Lesser Antilles including interaction with Marine Mammals and Other Top Predators.
- ⇒ TCP/GAB/3001 on Support for the formulation of a development plan for the industrial fishery in Gabon.
- ⇒ TCP/SEY/2902 on Capacity Building in the Resource Assessment and Management of the Seychelles Holothuria Fishery (Figure 8).

**Figure 8.** GIS analysis for the optimal allocation of sampling sites using multi-criteria and randomly allocated stratified sampling scheme



### Fishery Information, Data and Statistics Unit (FIDI)

Thanks to a mixed support of extra budgetary and Regular Programme inputs, FIGIS has supported the integration of geo-referenced data and applications through implementation of standards and integration of web-based applications. To date, six dynamic mapping applications built on KIDS (Key Indicator Data System developed by FAO) core GIS software are disseminated through the FIGIS platform:

- ⇒ Species distribution maps (Species Identification Data Programme - SIDP) in collaboration with Marine Resources Service;
- ⇒ Tuna Atlas catch statistics by 5 degree square (in collaboration with Marine Resources Service);
- ⇒ Aquatic Sciences Fisheries Abstract (ASFA) geographic query tool;
- ⇒ Fishery Resources Monitoring System (FIRMS) geographic query tool;
- ⇒ Dynamic mapping of Stocks and Fishery resources (FIRMS); and
- ⇒ Dynamic mapping of RFB competence areas (FIRMS).

The standard GIS framework is currently being extended with the national sub-administrative levels boundaries (Global Administrative Unit Layers or GAUL), a FAO GIS corporate product.

Considering the experience gained by the FIGIS framework, FIDI intends to continue to provide the know-how and infrastructure to develop new mapping applications. The FIGIS framework should continue to play an important role to:

- ⇒ expand dynamic mapping web interfaces through application of data standards and customization of existing tools, e.g. integrate the African Water Resource Database with relevant information, dynamically power NASO maps, etc. ;
- ⇒ implement inter-operability with statistical mapping tools and trade flow maps developed by FAOSTAT2;
- ⇒ integrate mapping applications of stocks and species distribution;
- ⇒ develop other geo-referenced fisheries data and applications; and
- ⇒ contribute to the development of methodologies for elaboration of new global/regional geo-based fishery indicators.

## CROSS-CUTTING ISSUES/APPLICATIONS AND PLAN OF ACTION FOR THE GIS USAGE IN FI

As part of FI's medium term plan of action, three main activities are currently underway:

🌐 Training course on GIS for FI staff. The objective of the course is to train interested FI Staff in the use GIS and applications of GIS in fisheries and aquaculture management. A one week training course is proposed, up to 36 hours in September or October 2006 for about 10-15 staff members. The training course will be based on FAO Fisheries Technical Paper No 449. The trainers will be from FI/FishCode (de Graaf/Bensch), FIRI (Aguilar-Manjarrez) and FIRM (Carocci). The programme of the course is being prepared and interested staff of FI will be requested to apply.

🌐 Seminars on applications of GIS in fisheries and aquaculture. A series of seminars, to be held during 2006-2007 with the support of FishCode, will set out some of the key issues in fisheries and aquaculture and demonstrate the benefits of using GIS, remote sensing and mapping to resolve them. Three seminars are planned for 2006 whilst seven are proposed for 2007. Each seminar will focus on one or two key issues and will be targeted at different FI divisions/services. The seminars are grouped into six main categories: (a) GIS work at FI; (b) GIS applied to fisheries management; (c) GIS applied to the ecosystem approach; (d) GIS as a mapping and dissemination tool for fishery statistics; (e) GIS applied to aquaculture; and (f) Case studies.

🌐 Project proposals. Proposals for projects under the FishCode umbrella are being developed in order to complement and strengthen core GIS activities under FI's Regular Programme. Project topics and issues areas under consideration include the following:

- ⇒ Ecosystem approach to aquaculture and fisheries
- ⇒ Statistical representations of world and regional resources and fisheries and related monitoring through geo-based indicators
- ⇒ High seas resources and fisheries mapping and management
- ⇒ Marine protected areas
- ⇒ Analysis of shared stocks management
- ⇒ Area-based fisheries management
- ⇒ Climate change scenarios – including risk and productivity
- ⇒ Explorations of decision-rule approaches for aquaculture development and management

- ⇒ Applications of risk analysis
- ⇒ Environmental safety
- ⇒ Disease - epidemiology, risk mapping, disease surveillance and control
- ⇒ Estimates of aquaculture carrying capacity
- ⇒ Spatial modelling of aquaculture related to development poverty and needs issues.
- ⇒ Integrated watershed or coastal area management
- ⇒ Poverty/livelihoods targeting using market chain data
- ⇒ Marketing – global trade fluxes

## GIS TO ASSIST WITH YOUR FUTURE MANAGEMENT TASKS

GIS is aimed at a broad range of users. Potential beneficiaries include researchers, planners and managers in national, regional and international organizations, scientific institutes and universities. Other beneficiaries are in the commercial sectors of aquaculture and fisheries.

GIS is most frequently applied as a decision-making tool for development, but increasingly it will be used for the tasks of administration and regulation. Potential applications include allocation of sites in a context of administrative jurisdictions, and environmental carrying capacity. Also, GIS can be used administratively and operationally to relate locations of individual culture sites or clusters to optimize extension efforts.

The authors continuously seek opportunities to cooperate with other organizations in the realm of GIS, remote sensing and mapping, training to improve the sustainability of aquaculture and fisheries is of particular interest. To explore cooperative activities, please contact:

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# Application of risk analysis in aquaculture

Melba B. Reantaso<sup>1</sup>, Rohana P. Subasinghe<sup>2</sup>  
and Raymon Van Anrooy<sup>3</sup>

## RISK AND HAZARD

As a food-producing sector, aquaculture has surpassed both capture fisheries and the terrestrial farmed meat production systems in terms of average annual growth rate. However, like other farming sectors, aquaculture is associated with environmental concerns that pose a number of risks and hazards to both its development and management, and to the aquatic environment and society.

In general terms, 'risk' is defined as 'a combination of the *likelihood* of occurrence of undesired outcomes and the *severity* of consequences'; while a 'hazard' is 'the presence of a material or condition that has the potential to cause loss or harm<sup>1</sup>'. No matter how well managed a system is, there will always be associated risks and hazards.

Aquaculture faces risks similar to those of the agriculture sector. However, as aquaculture is very diverse (in terms of species, environments, systems and practices), the range of hazards and the perceived risks are much greater. These are coupled with the intensified transboundary movement of aquatic species as part of increasing trade and globalization, the sector's vulnerability to natural disasters and on-going climate changes, and other management and operational issues.

During the last few years, we have seen a number of significant biological and environmental hazards, causing considerable damage and affecting thousands of households depending on aquaculture for livelihood. These include oil spill pollution in Ireland (2003); super chill in the east coast of Canada (2003); *Chatonella* bloom in the west coast of Canada (2002); tsunami in Indonesia, Thailand, Sri Lanka and India (2004); disease outbreaks affecting finfish, molluscs and crustaceans in many regions; storms (including hurricanes); red tides and algal blooms.

## DRIVERS OF THE RISK ANALYSIS PROCESS AND THE BENEFITS

Multiple objectives are driving the application of risk analysis to aquaculture. Foremost is for **resource protection** (human, animal and plant health; aquaculture; wild fisheries and the general environment) as embodied in international agreements and responsibilities (e.g., the World Trade Organization's (WTO) Sanitary and Phytosanitary Agreement, United Nations Environmental Programme's (UNEP) Convention on Biological Diversity and the supplementary agreement Cartagena Protocol on Biosafety, the Codex Alimentarius).

Of equal importance, the other drivers of risk analysis are:

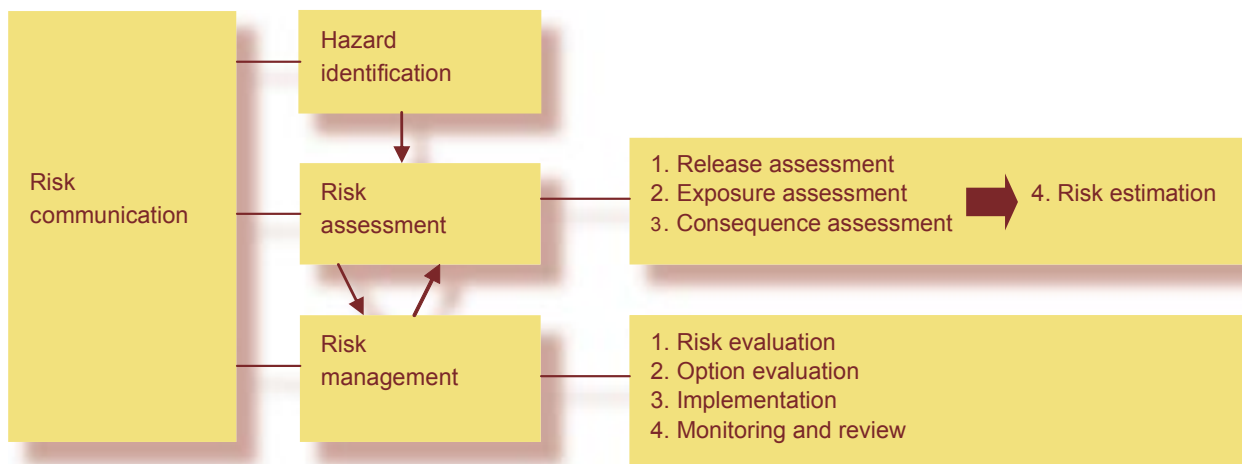
- o food security
- o trade
- o consumer preference for high quality and safe products
- o production profitability, and
- o other investment and development objectives.

The benefits of applying risk analysis in aquaculture are now slowly better understood and recently recognized as important to improve the sector's sustainability, profitability and efficiency.

## WHAT IS RISK ANALYSIS?

MacDiarmid (1977)<sup>2</sup> defined risk analysis as a tool that provides decision-makers with an objective, repeatable and documented method for assessing the risks posed by a particular action or event; it is intended to answer the following questions:

- What can go wrong?*
- How likely it is to go wrong?*
- What would be the consequence of its going wrong?*
- What can be done to reduce either the likelihood or the consequences of its going wrong?*



Risk analysis makes use of sound scientific and technical data; the process is transparent, iterative and uses a defensible methodology upon which to base policy development and decisions.

### THE PROCESS

The principal components of the risk analysis process, as illustrated above<sup>3,4</sup>, are:

- o hazard identification
- o risk assessment
- o risk management and
- o risk communication (a continuous activity that takes place throughout the entire process).

This framework is commonly used for pathogen risk analysis; a similar process is used for assessing food safety and public health hazards.

Regardless of the type of risk analysis, the **pathway analysis approach** provides a risk assessment framework that facilitates detailed and transparent examination of the key factors that contribute to the overall risk.

On a global scale and across all aquaculture production systems, some of the major areas of environmental concern are:

- o **eutrophication of water:** accumulation of nutrients from the release of uneaten food, feces and metabolites that damage the water column and generate unwanted algae;

- o **biological pollution:** introduction of exotic species, biodiversity loss, escape of genetically modified organisms (GMOs) from production facilities, interbreeding causing loss of genepool, transmission of diseases to native stocks from cage and pen facilities, increased abundance of pathogens in the water due to their reproduction in farmed stocks;

- o **chemical pollution:** release of drugs and other substances used for treatment of disease and parasitic infections into the environment; and

- o **habitat degradation:** destruction of productive coastal marshes and other physical impacts (chance or loss) on habitat.

Although these problems are well recognized, the elements of risk in many of these areas of concern are vaguely understood. For example, the risks associated with introductions and transfers of live aquatic animals due to their potential ecological or genetic impacts need long term evaluation, yet the methods for their assessment are not yet clearly defined.

Other areas of risk in aquaculture that have received less attention include:

- o risks faced by poor aquafarming communities;
- o occupational risks (e.g. physical (injuries), chemical (burns, irritations, allergies), and biological hazards (parasites, diseases) faced by workers; and



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*Photos above: Out of desperation, aquafarmers will use anything in order to prevent losses from diseases, e.g., even using antibiotics for viral infection*



MB REANTASO, FAO

*One of the authors (MB Reantas) during an investigation of Asia's first major outbreak of suspected Koi herpes virus (KHV) in Indonesia in 2002*

- o financial risks such as market (e.g. changes in prices of outputs/inputs, increases in interest rates) and asset (e.g. losses due to predation, power failures, etc.) risks.

On the other hand, the areas which have been afforded adequate attention, and where hazards are clearly defined and risk assessment methodologies are better developed include:

- o import risk analysis (IRA) for pathogens/infectious diseases<sup>5</sup>,
- o hazard analysis and critical control point (HACCP) for food safety and public health hazards<sup>6</sup>, and
- o geoinformatics/risk mapping for natural disasters<sup>7</sup>.

The levels of risk assessments used in these areas of concern range from qualitative (most common) to semi-quantitative or quantitative. Such categories provide useful information and the choice of assessment methodology will depend on the scope of the analysis required and the availability of information that will support the analysis.

Disease is considered a high risk due to the frequency of occurrence and the magnitude of spread and effects experienced by the sector, not only in terms of economic and social impacts but as well as investment costs for disease control and other development programmes. Some examples of the economic and other impacts of aquatic animal diseases are shown in [Table 1](#); while [Table 2](#) presents examples of investments in aquatic animal health programmes. Most studied risk analysis<sup>9,10</sup> in aquaculture include its application to avoid pathogen incursions and other ecological impacts resulting from the movement of live aquatic animals or animal products and assessment of antimicrobial resistance<sup>11</sup>.

### **CAN WE MANAGE THE RISKS?**

Some risk management measures currently applied in the aquaculture sector are highlighted in [Box 1](#) (see page 25). Aquaculture stock insurance<sup>12</sup> can provide protection against disease incursions and natural hazards; secure incomes, greater stability and welfare in the farming communities; improve access to investment and credit; and increase incentives for farm improvements. However, access to

**Table 1.** Examples of socio-economic and other impacts of diseases in finfish, shrimp and molluscan aquaculture in selected countries (from Bondad-Reantaso *et al.* 2005)<sup>8</sup>

COUNTRY/YEAR	DISEASE/PATHOGEN	LOSSES AND OTHER IMPACTS
<b>FINFISH</b>		
Japan (1994-1998)	Marine fish disease	US\$ 114.4 M
China (1990-1992)	Bacterial diseases of fish ( <i>Aeromonas hydrophila</i> , <i>Yersinia ruckeri</i> and <i>Vibrio fluvialis</i> )	>US\$ 120 M annual losses
Indonesia (2002)	Koi herpes virus (KHV)	US\$ 15 M
UK (1998-1999)	Infectious salmon anaemia (ISA)	US\$ 37 M (approximately)
<b>CRUSTACEAN</b>		
Ecuador (1999)	White Spot Disease (WSD)	US\$ 280.5 M in 1999 equivalent to 63 000 tonnes; closing of hatchery operations; 13% laying off of labour force (26 000 people); 68% reduction in sales & production of feed mills & packing plants
Thailand (1994)	Yellowhead Disease (YHD) & WSD	US\$ 650 M in 1994; 12% production decline from 250 000 tonnes in 1994 to 220 000 tonnes in 1995; shrimp losses for 1997 reached nearly 50% of total farm output value. (Excludes losses in related businesses such as feed production, processing & exporting, ancillary services & lost income for labourers)
China (1993)	Shrimp Diseases	US\$ 420 M in 1993
<b>MOLLUSC</b>		
USA (since 1959)	<i>Haplosporidium nelsoni</i> of Eastern oyster	>90% of oysters grown in the Bay
Japan (1994-1996)	Mass mortalities associated with a viral disease of pearl oyster	1996-1997 – annual mortality in all western regions, >400 M oysters equivalent to 50% of oyster production in Japan. Total economic loss: >30 000 million Japanese yen (mortalities & decreased quality of pearls produced)

**Table 2.** Examples of economic investments in aquatic animal health programmes (from Bondad-Reantaso *et al.* 2005)<sup>8</sup>

TYPE OF INVESTMENT	COUNTRY/ ORGANIZATION	AMOUNT	DETAILS/REMARKS
Aquatic animal health strategy	Australia	US\$ 2.09 M	Over four years to develop AQUAPLAN (1998 - 2003)
	USA	US\$ 375,000.00/year	Development of National Aquatic Animal Health Plan
Research	China	US\$ 6 M	Research on aquatic animal diseases
	Thailand	US\$ 5 M	Research work at the Aquatic Animal Health Research Institute (AAHRI) and universities
	Norway	US\$ 50.1 M	Aquatic animal health research from Norwegian Research Council provided to National Veterinary Institute (2005), Marine Laboratory
Disease Control Programmes	USA	(a) US\$ 8.3 M (b) US\$ 11.7 M	(a) To combat Infectious salmon anemia (2002) (b) To combat spring viremia of carp (2003-2004)
	China	US\$ 73 M	Disease control
	Canada	US\$ 34 M	Reactive disease control
Development programmes	Food and Agriculture Organization (FAO)	(a) US\$ 345,000.00 (b) US\$ 395,000.00 (c) US\$ 364,000.00	(a) FAO/TCP/RAS 6714 (A) and 9605 "Assistance for the Responsible Movement of Live Aquatic Animals", 1997-2000, regional programme, 21 governments in Asia-Pacific (b) FAO/TCP/RLA/0071 (A) "Assistance to health management of shrimp culture in Latin America", regional programme, 14 governments in Latin America (c) FAO/TCP/INS/2905 (A) "Health management in freshwater aquaculture", national programme, Indonesia
	Asian Development Bank (ADB)	US\$ 290,000.00	RETA 5358, Fish Health Management in Asia-Pacific
	Asia-Pacific Economic Cooperation (APEC)	US\$ 116,000.00	APEC FWG 01/2002 "Capacity and awareness building on import risk analysis for aquatic animals", excludes contribution from other partner organizations such as FAO, OIE, private sector.

such insurance is still lacking for small- and medium-scale farmers (see related article on [Aquaculture Stock Insurance on pages 10-12](#)). Geoinformatics/GIS is another risk management tool that will become essential in the near future (see related article on [Use of Geographic Information Systems \(GIS\) for Responsible Aquatic Resource Management on pages 13-19](#)).

### KEY CHALLENGES TO MANAGING RISKS IN AQUACULTURE

Countries will often be confronted with the lack of scientific information (both quality and quantity) to support the risk analysis process. Nevertheless, governments must often act under these uncertainties, as well as make decisions in the face of a great deal of complexity, significant variability and multiple management goals. An important approach that needs to be considered when data are lacking and evidence of serious risk exists is the [precautionary approach](#)<sup>13</sup>. It must be applied responsibly and should be used as a temporary measure until such time that a more thorough risk analysis (supported by scientific information) can be undertaken. Another great challenge is deciding on the [Appropriate Level of Protection or ALOP](#), a societal value judgement about how much a country is willing to pay in forgone trade for protection against incursions, versus the benefits of that trade. Deciding an ALOP will need to take into consideration the economic and social values of aquaculture and capture fisheries, the perceived value of natural biodiversity and the likely economic and social benefits of trade in cultured aquatic animals and their products.

It is important *that the people at risk (those most vulnerable [i.e. fishfarmers, people in poverty]) and their needs* be the focus of the 'first mile' of protection. Risk communication will play an essential role and is a critical step that will provide over-all system integrity. Civil society dialogues and partnerships should be widely and actively promoted to enhance risk prevention. Good science, and information dissemination should form part of an integral approach to risk management (e.g. early warning systems, studies on biological pathways, public education, preventative and risk management measures, surveillance, risk mapping). National level enabling legal and policy environments for risk assessments as well as economic incentives must be provided to prevent and mitigate risks in aquaculture. Awareness raising and capacity building to:

- o better understand the risks, hazards and vulnerabilities;
  - o develop methods to assess them as well as study the connections between the different risk events and patterns; and
  - o identify integrated approaches to risk management,
- will be necessary and should be considered as a matter of priority, especially for developing countries.

### FAO'S INITIATIVES

FAO has been actively involved in risk assessment in the area of risk analysis for the safe movement of aquatic animals in cooperation with the Asia-Pacific Economic Cooperation (APEC) and NACA, through the APEC FWG 01/2002 "Capacity and Awareness Building on Risk Analysis (IRA) for Aquatic Animals" and the FAO TCP/RLA/0071 "Assistance to health management of shrimp culture in Latin America" which jointly trained in 2002, 130 participants representing 37 countries comprised of regulatory authorities, administrators and aquatic animal health specialists responsible for trade of aquatic animals. On the same area, a number of TCPs have small component in building capacity on risk analysis, namely.

- o TCP/BZE/3003 Strengthening the Bio-security Framework,
- o TCP/LAT/3001 Improving Aquatic Animal Health and Quality and Safety of Aquatic Products,
- o TCP/IND/2902 Health Management in Shrimp Aquaculture in Andhra Pradesh,
- o TCP/BIH/3101 Strengthening Capacity of Aquaculture Health Management, and
- o TCP/RAS/3101 (A) Sustainable Aquaculture Development in Pacific Micronesia (see related article on [TCP/RAS/3101 on page 45](#)).

FAO supports GESAMP's<sup>14</sup> Working Group 31, which has commissioned a background and discussion paper "Environmental Risk Assessment and Communication in Coastal Aquaculture" in preparation for its Second Session planned for November 2006 in cooperation with the ICES Working Group on Environmental Interactions of Mariculture.

FAO is also completing a world review of aquaculture insurance. Recognizing the importance of risk management in aquaculture and responding to needs for advice on this subject,

expressed mainly in Asia, a regional workshop on the promotion of fisheries and aquaculture insurance for sustainable development of the sector is being planned for 2007 (see related article on Aquaculture Stock Insurance pages 10-12).

More recently, responding to a request emanating from the Second Session of COFI's Sub-Committee on Aquaculture (Norway, 2002) to undertake studies in risk assessment, a new biennial output has been included in the FI Department's Programme of Work and Budget (PWB) 2006-2007 to support the theme "Application of Risk Analysis in Aquaculture Production". With funding from the FI Regular Programme and under FAO's New Cooperation Agreement with Norway, a study will be undertaken to: (1) review the (1a) current state of knowledge and understanding on the risks involved in aquaculture development and management, and (1b) application of risk analysis (hazard identification, risk assessment, risk management and risk communication) in aquaculture with the view of reducing those risks; and (2) to prepare and compile

a technical document that will provide advice and assistance to FAO Member Countries in the application of risk analysis in aquaculture as a decision-making tool for the sustainable development of the sector.

FAO is completing the FAO Technical Guidelines for Responsible Fisheries: Health Management for the Responsible Movement of Live Aquatic Animals developed to support sections of the FAO Code of Conduct for Responsible Fisheries (CCRF) addressing responsible fisheries management (Article 7), aquaculture development (Article 9), international trade (Article 11) and fisheries research (Article 12), with inputs from the recently concluded FAO Expert Workshop on Health Management held in Dambulla, Sri Lanka from 1-4 November 2005. The Technical Guidelines has a companion document, Compliance to FAO Technical Guidelines for Responsible Fisheries: Health Management for Responsible Movement of Live Aquatic Animals, which will provide more detailed documentation to assist countries and individuals in promoting health management for the safe movement of live aquatic animals.

**Box 1. Examples of risk management measures applied in the aquaculture sector**

Risk/Hazard	Risk Management Measures
Management and operational risks	Best Management Practices/Standard Operating Procedures (e.g. good governance; good aquaculture practices at hatchery, nursery and farm levels; good practices for feed/drug and chemical suppliers; good practices for harvesting, marketing and processing); cluster management; other forms of risk-sharing mechanisms; aquaculture insurance
Aquatic animal pathogens/diseases	Import risk analysis, national strategies on aquatic animal health, biosecurity, disease surveillance and reporting, early warning, emergency response and contingency planning, good health management practices, vaccination, GIS risk mapping
Antimicrobial resistance	Regulatory interventions, vaccination, good husbandry practices to minimize use of antibiotics
Disease/climate perils/natural hazards	Aquaculture insurance, geoinformatics
Food safety and public health risks	HACCP; good management practices [good aquaculture practices (GAP), good hygienic practices (GHP), good manufacturing practices (GMP)]; food safety controls; consumer education; integrated approaches involving health education, vector control and selective population chemotherapy (for parasitic infections)
Occupational risk/hazards	Good orientation of employees and increasing their awareness on risks/hazards and safety consciousness; use of protective gear; provision of first aid kits; traceability measures etc.
Environmental risks	Proactive policies and regulatory frameworks

Under the Government of Japan Trust Fund (GCP/INT/936/JPN), a project is being implemented to address key issues in sustainable aquaculture, including food safety of aquaculture fish.

These initiatives will hopefully provide a better understanding of the risks involved in

aquaculture so that they can be communicated well, assessed and risk management measures made available to reduce the vulnerability of people who depend on aquaculture for their livelihood and so that improvement in sector sustainability, profitability and efficiency can be achieved.

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<sup>2</sup>MacDiarmid, S.C. 1997. Risk analysis, international trade, and animal health. *In* Fundamentals of risk analysis and risk management (V. Molak, ed.). CRC Lewis Publishers, Boca Raton, 377-387.

<sup>3</sup>Subasinghe, R.P., McGladdery, S.E. and Hill, B.J. (Eds.) 2004. Surveillance and zoning for aquatic animal diseases. FAO Fisheries Technical Paper 451. Rome, FAO. 2004. 73 p.

<sup>4</sup>OIE. 2003. Aquatic Animal Health Code. 6<sup>th</sup> edn. Office International des Epizooties, Paris.

<sup>5</sup>Arthur, J.R., Bondad-Reantaso, M.G., Baldock, F.C., & Edgerton, B.F. 2004. Manual on risk analysis for the safe movement of aquatic animals (FWG/01/2002). APEC/DoF/NACA/FAO, 59 p. APEC Publication Number: APEC # 203-FS-03.1.

<sup>6</sup>Sumner, J., Ross, T., & Ababouch, L. 2004. Application of risk assessment in the fish industry. FAO Fisheries Technical Paper- No. 442. Rome, FAO. 2004. 78 p.

<sup>7</sup> <http://mrnathan.munichre.com/>

<sup>8</sup>Bondad-Reantaso, M.G., Subasinghe, R.P., Arthur, J.R., Ogawa, K., Chinabut, S., Adlard, R, Tan, Z. & Shariff, M. 2005. Disease and health management in Asian aquaculture. *Vet. Parasitol.* 132:249-272.

<sup>9</sup>Bondad-Reantaso, M.G., Lovell, E.R., Arthur, J.R., Hurwood, D. & Mather, P.B. 2005. Pathogen and ecological risk analysis for the introduction of blue shrimp, *Litopenaeus stylirostris*, from Brunei Darussalam to Fiji. Secretariat of the Pacific Community, New Caledonia. 80 pp.

<sup>10</sup>Arthur, J.R., Hurwood, D., Lovell, E.R., Bondad-Reantaso, M.G., & Mather, P.B. 2005. Pathogen and ecological risk analysis for the introduction of giant river prawn, *Macrobrachium rosenbergii* from Fiji to the Cooks Islands. Secretariat of the Pacific Community, New Caledonia.

<sup>11</sup>Hernandez-Serrano, P. 2005. Responsible use of antibiotics in aquaculture. FAO Fisheries Technical Paper. No. 469. Rome, FAO. 97p.

<sup>12</sup>Van Anrooy, R., Secretan, P.A.D., Lou, Y., Roberts, R., & Upare, M. 2006. Review of the current state of aquaculture insurance in the world. FAO Fisheries Technical Paper No. 493. Rome, Italy. 82 p.

<sup>13</sup>Garcia, S. 1996. The precautionary approach to fisheries and its implications for fishery research, technology and management: an updated review. In Precautionary approach to fisheries. Part 2: scientific papers. Prepared for the Technical Consultation on the Precautionary Approach to Capture Fisheries (including species introductions). Lysekil, Sweden, 6-13 June 1995. FAO Fisheries Technical Paper No. 350, Part 2, 210 p.

<sup>14</sup>Joint Group of Experts on Scientific Aspects of Marine Environmental Protection (GESAMP) <http://gesamp.imo.org/>. Contact person at FAO, Uwe Barg, e-mail: [Uwe.Barg@fao.org](mailto:Uwe.Barg@fao.org)

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Rice-fish farming in Lao PDR

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G. BIZZARRI, FAO

Participants to the IAMSLIC Conference, Rome 2005

## FAO FISHERIES LIBRARY: PART OF A WORLDWIDE NETWORK

Jean Collins<sup>1</sup>

**A**s anyone who ever used a Library knows, what you see is actually much less than what you can get. Most libraries have their own core collection and also provide a window on the world of information outside of their walls. With the advent of the digital age, this is more than ever the case as libraries move towards providing access rather than physical ownership of parts of the collection. Whether providing access to digital resources or obtaining copies of print and multi-media information from external sources, one thing which has not changed is the inter-library collaboration and networking that allows libraries to serve users more quickly and less expensively than otherwise possible.

### LOOKING BACK

I was reminded of the development of fisheries library networks last year when I wrote a small obituary expressing appreciation for the work of my predecessor in FAO Fisheries Library, Clare Cuerden. Clare passed away in July 2005 after enjoying fifteen years of retirement from FAO. Because she was known to so many fisheries people, the message was widely distributed and

the responses have acknowledged her work of building and managing the FAO Fisheries Library collection for over 20 years. In particular, the collection of fisheries publications from developing countries has made this unique information available to the staff and many visiting experts at FAO, to the Aquatic Science and Fisheries Abstracts (ASFA) database and in some cases has probably saved it from extinction.

Clare's priorities were clearly expressed in the paper she presented to the 12th Annual Conference of the International Association of Aquatic and Marine Science Libraries and Information Centers (IAMSLIC) Conference in 1986. The paper "*Including fisheries: the development of a fishery library network within the framework of FAO*" gives a brief history of the FAO Fisheries Library and the work of reaching out to smaller libraries in developing countries (Cuerden, 1988).

FAO Fisheries Library was established in 1967 and is one of the Branches of FAO's David Lubin Memorial Library, one of the world's large agricultural libraries. A good insight into

its history and of David Lubin himself was given at the 31<sup>st</sup> Annual IAMSLIC Conference by the Chief Librarian of FAO (Wu, 2006). The collections of FAO Library have grown to 1 million volumes and one of the strengths of the Fisheries Library is having access to this large multidisciplinary collection, which is essential to fisheries and aquaculture.

## WHERE WE ARE TODAY

The need to provide access to global information resources has not diminished despite the growth of our own collection. Indeed, making decisions and policy in response to a more rapidly changing world makes our dependence on reliable and timely information even more critical. The importance for FAO and its Members of a world-class library was identified as a priority area by the FAO Committee on Fisheries at its 25<sup>th</sup> session (FAO, 2003).

Modern information and telecommunication infrastructures have revolutionized the speed and efficiency with which we can provide access and they enable improved sharing of information resources between libraries in all parts of the world. Library networks aim to strengthen the capacity of individual libraries to satisfy their own user community. In recent years we have worked with a small group of fisheries libraries in Africa to assess information needs and to test mechanisms for library networking. A Workshop organized by FAO in collaboration with the South African Institute for Biological Diversity (SAIAB) in 2003 provided the opportunity to gain a better understanding of the resources available and the information needs of fisheries institutions in several African countries (FAO, 2004). It also highlighted the need for improved dissemination and preservation of African fisheries and aquaculture publications, better coverage in international databases and their integration in both print and full text repositories being developed at regional and international level.

## AN INTERNATIONAL LIBRARY NETWORK

In the aquatic and marine sciences, including fisheries and aquaculture, the IAMSLIC international network provides an excellent forum for the exchange of information and expertise as well as an increasing number of technical services to facilitate these. IAMSLIC (<http://www.iamslc.org>) has a worldwide membership of almost 400 libraries which communicate and share resources via an electronic bulletin board, a web site, newsletter

and annual and regional conferences. The IAMSLIC Z39.50 Distributed Library is a web based system that facilitates international resource sharing. More than 50 libraries have entered their serials into the IAMSLIC Union List of Marine and Aquatic Serials, which provides access to several thousand titles. The FAO Fisheries Library collection of over 600 fisheries and aquaculture serials from developing countries is included, making this unique collection more readily available to aquatic science libraries worldwide. The most recent project being undertaken by IAMSLIC is to investigate the feasibility of an aquatic commons digital repository, metadata harvester, search engine and Z39.50 server. This would be of particular benefit to those smaller institutions which do not have the resources to establish an institutional repository and it would provide easier access to full text documents for all.

A priority area for the FAO Fisheries Department is the implementation of the 1995 FAO Code of Conduct for Responsible Fisheries. In biennial surveys of FAO Members it is regularly stated that the lack of information continues to constrain the full and effective implementation of the Code. An FAO study was carried out during 2004 to assess what information is needed and what resources are available, in particular in developing countries (Webster and Collins, 2004). The theme of *Information for Responsible Fisheries: Libraries as Mediators* was chosen for the 31<sup>st</sup> Annual Conference of IAMSLIC, which was hosted by FAO in 2005. This provided a forum in which to further discuss the issues and to propose activities where FAO and IAMSLIC can work together to address them. A summary from a session of the Conference is provided by Janet Webster below.

## 31<sup>ST</sup> ANNUAL IAMSLIC CONFERENCE REPORT: FISHERIES AND AQUACULTURE DAY, 13 OCTOBER 2005. JANET WEBSTER (HATFIELD MARINE SCIENCE CENTER, PORTLAND, OREGON)

The following is a brief overview of the IAMSLIC Conference session devoted to fisheries and aquaculture information. Sidney Holt started the conversation with a brilliant address on the role of information in his life as a scientist. He noted that "science is rooted in conversation" and went on to identify three important connections for successful fisheries science: connections with people, connections through time, and connections through disciplines. John Kurien followed with thoughtful comments on the economics of fisheries, focusing on the three



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*José Garnica (left) and Armand Gribling (right) at the FAO's Fisheries Library*

A's of food security: accessibility, affordability and absorbability. These same concepts apply to fisheries information and its successful use. Rachele Oriente and Anton Immink both discussed the challenges of information outreach and education from very different perspectives. Joan Parker reviewed the efficacy of ASFA as the finding tool of choice. David Doullman and Eric Reynolds, both of the FAO Fisheries Department, reviewed the importance of the Code of Conduct to worldwide fisheries management and the role of information in its successful implementation. Many in the audience were challenged to think differently about the role of the librarian to advocate for changing policies and to assume a more active role in outreach to new audiences.

The afternoon session focused on specific case studies of libraries and fisheries information. Simon Wilkinson presented an innovative strategy for sharing aquaculture information across 16 countries in Southeast Asia and the Pacific using low-tech digital publishing. Moses Ibeun succinctly described fisheries information issues in Nigeria while Geoffrey Salanje did the same for Malawi. These provided background for Margaret Shaw's presentation on resource sharing strategies for fisheries libraries in Africa. Concepts articulated by Holt and Kurien were repeated throughout the day providing a

framework for the final discussion on how to develop the joint activities of FAO Fisheries Department and IAMS LIC. The Conference Proceedings will be published in 2006 and ordering details can be found at <http://www.iamslic.org/index.php?section=36>

#### **FAO PUBLICATIONS AND REPORTS ON INLAND FISHERIES AND AQUACULTURE**

FAO Fisheries Department is gradually digitizing its older publications in order to make them available to a wider audience, in particular the titles that are no longer available in print and are still frequently requested. New publications are automatically made available in full-text in the FAO Document Repository <<http://www.fao.org/documents>>. In addition to access via the Internet, the publications are also disseminated selectively on CD ROM.

We hope to finalize in 2006 a CD ROM that includes the publications of the following FAO inland fishery bodies:

Committee for Inland Fisheries of Africa (CIFA)

Commission for Inland Fisheries of Latin America (COPESCAL)

European Inland Fisheries Advisory Commission (EIFAC)

It will also include selected FAO Fisheries Reports on aquaculture and inland fisheries.

We are also hoping to finalize an updated version of the FAO Field Project Reports on Aquaculture CD ROM during 2006.

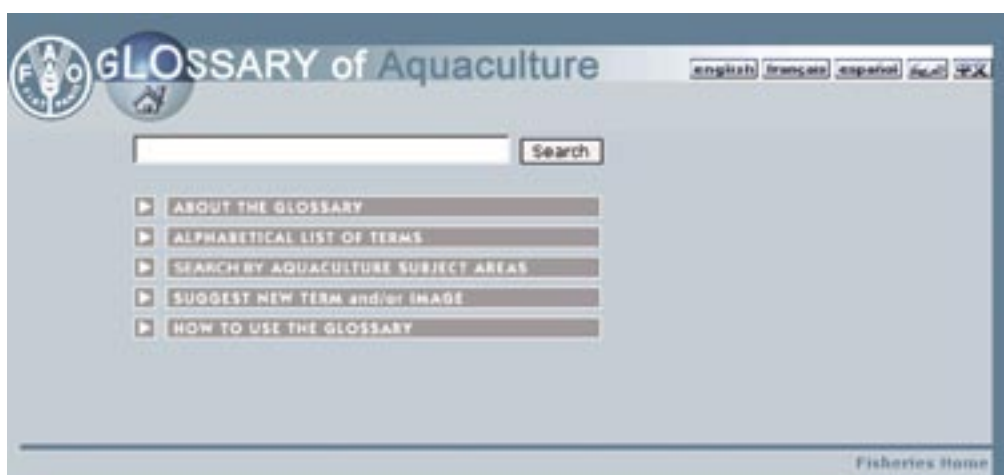
Further information on FAO Fisheries publications may be requested from: [fi-library@fao.org](mailto:fi-library@fao.org)

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- Wu, J. 2006. *David Lubin as mediator: His letters, his library* In Thirty First Annual Conference of the International Association of Aquatic and Marine Science Libraries and Information Centres, Oct 10-14, 2005, Rome (Italy) in press.



## FAO GLOSSARY OF AQUACULTURE

The Food and Agriculture Organization of the United Nations (FAO) Fisheries Department has published a multilingual [Glossary of Aquaculture](http://www.fao.org/fi/glossary/aquaculture/) containing, at the time of publication, 2 958 terms with definitions, synonyms, related terms, information sources and images, when available.

The primary objectives of the glossary are to: (i) serve as a reference to fish farmers, consultants, administrators, policy makers, developers, engineers, agriculturists, economists, environmentalists and all those interested in aquaculture; and (ii) facilitate communication among experts and scientists involved in aquaculture research and development.

Aquaculture development involves many other disciplines such as agriculture, economics, engineering, food processing, genetics, irrigation, agriculture, legislation, marketing, pathology, planning, sociology, remote sensing, soil science and taxonomy. Therefore, the choice of terms has been limited to those directly related to world aquaculture practices and to the most commonly used terms pertaining to other disciplines. Twenty one broad aquaculture subject areas have been defined in which the multidisciplinary aspects of aquaculture have been tentatively regrouped.

The glossary has been compiled using existing textbooks and glossaries, in particular those already prepared within the various Services of the FAO Fisheries and Agriculture Departments. The information source(s) from which each definition has been obtained is always provided for each term.

The online glossary of aquaculture is available in the five official FAO languages (Arabic, Chinese, English, French and Spanish) and can be accessed at the following address:

<http://www.fao.org/fi/glossary/aquaculture/>

The glossary is presented in the following format: terms, definitions, information sources aquaculture subject areas, synonyms, related terms and images.

Instant definitions and translations of the terms to and from Arabic, Chinese, English, French and Spanish are available by clicking on the related language.

Terms can be searched through the search engine, by alphabetical order or by aquaculture subject area.

The FAO Glossary of Aquaculture will continuously be revised and updated through inputs from the users. Suggestions of new terms or definitions, comments on current terms and submission of new images are strongly encouraged. Inputs from end users are easy and can be done simply by using specific submission forms which are automatically submitted to the FAO-Glossary administrators. The administrators, through the Glossary Management System, can upload very quickly, after validation, the new items into the online glossary.

Further details can be obtained by writing to :  
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# Highlights from the FAO database on Aquaculture Statistics

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The FAO Fisheries database of statistics on aquaculture production and values has been updated to include data for 2004. Total aquaculture production of aquatic animals (i.e., excluding aquatic plants) for 2004 was reported to be 45.5 million tonnes<sup>1</sup> with a farm-gate value of US\$ 63.4 billion. With the inclusion of aquatic plants, the production increases to 59.4 million tonnes with a value of US\$ 70.3 billion. Growth in global aquaculture continues to be strong as these figures represent an increase in production of 7.7 percent from the total aquaculture production reported for 2003, and a 6.6 percent increase when only aquatic animals are considered. Considering the ten-year period from 1994-2004, total aquaculture production shows an average annual increase of 7.9 percent.

For culture of aquatic animals, China continues to far exceed the production of other nations accounting for over two-thirds of the global total. The top ten producing countries for 2004 are listed in Table 1. These countries account for 88.2 percent of the total global production. The top seven producing nations are all from the Asia-Pacific region and in 2004

**Table 1.** Top ten countries in aquaculture production of aquatic animals in 2004

Country	Production (tonnes)	Percent of world total
China	30 614 968	67.3
India	2 472 335	5.4
Viet Nam	1 198 617	2.6
Thailand	1 172 866	2.6
Indonesia	1 045 051	2.3
Bangladesh	914 752	2.0
Japan	776 421	1.7
Chile	674 979	1.5
Norway	637 993	1.4
USA	606 549	1.3
Rest of world	5 353 825	11.8
Total	45 468 356	100.0

Note: Includes fish, crustaceans, molluscs and amphibians

the countries of this region were responsible for 88.9 percent of production, followed by Western Europe (4.6%), Latin America and the Caribbean (2.9%) and North America (1.7%) Production volume and value are presented by region in Figure 1. Note that, because of the huge production of China, the rest of the Asia-Pacific region is considered separately.

The species with the greatest production volume was the Pacific cupped oyster (*Crassostrea gigas*) with 4.4 million tonnes, followed by three species of carps – silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idellus*) and common carp (*Cyprinus carpio*). In terms of ISSCAAP (International Standard Statistical Classification of Aquatic Animals and Plants; <http://www.fao.org/fi/statist/fisoft/asfis/asfis.asp>) groups of species, by far the most production is in the group consisting of carps and other cyprinids. In addition to the three carps already mentioned, the bighead carp (*Hypophthalmichthys nobilis*) and the Crucian carp (*Carassius carassius*) also had production over 1.9 million tonnes in 2004. The top ten ISSCAAP species groups in terms of production are listed in Table 2. If aquatic plants are included, the species with the highest production is Japanese kelp (*Laminaria japonica*) with a production of 4.5 million tonnes.

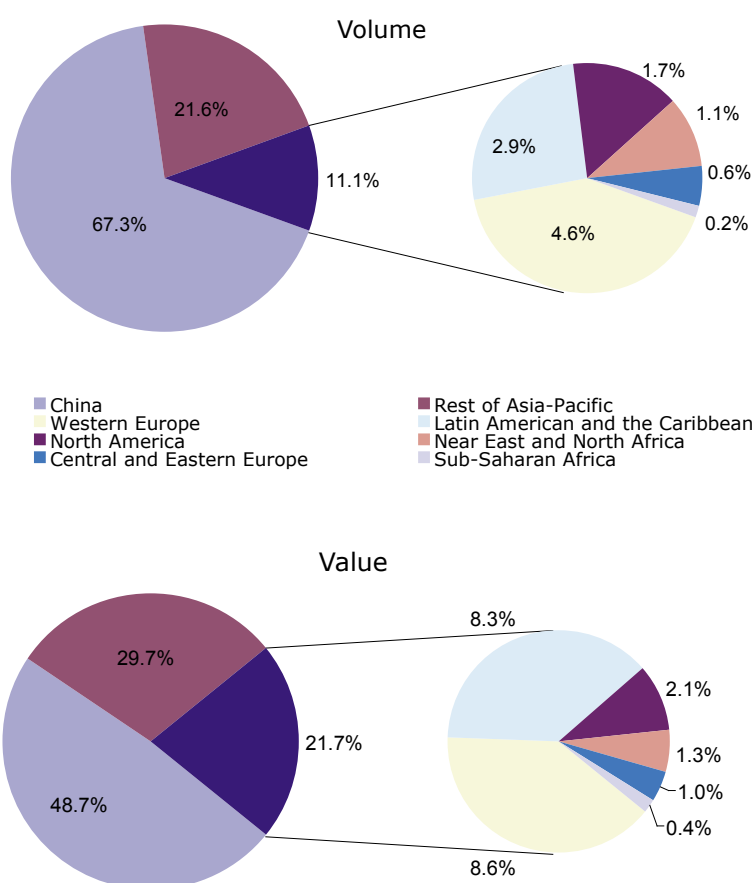
For 2004, carps were the species group with the highest reported value – US\$ 16.4 billion. They were followed by shrimp and prawns (US\$ 9.7 billion), salmons and trouts (US\$ 6.6 billion), miscellaneous freshwater fishes (US\$ 6.0 billion), freshwater crustaceans (US\$4.0 billion), clams and cockles (US\$ 3.3 billion) and oysters (US\$ 2.8 billion). The highest reported value for a single species was US\$ 4.9 billion for the whiteleg shrimp (*Penaeus vannamei*), followed by Atlantic salmon (*Salmo salar*) and giant tiger prawn (*Penaeus monodon*).

Over 240 different cultured aquatic animal and plant species were reported in 2004. This is an increase of 20 species from the figure reported in 2002 and demonstrates the

increasing diversification currently taking place in aquaculture. These 240 species represent 94 families. Moreover, the diversity of species is probably under-estimated, as 8.9 million tonnes (15.1%) of global aquaculture production, including an additional 20 families, was not reported to species level in 2004, and this 'unspecified' group is likely to include species not yet recorded as being cultured. Of aquaculture reported to FAO to the species level, the top ten species account for 61.7 percent of the production, and the top 25 species account for 86.6 percent of total aquaculture production. These are less than the corresponding figures of 68.1 percent and 91.0 percent in 2000, providing another indication that species diversification in aquaculture is increasing.

The entire aquaculture database, containing data from 1950-2004, can be downloaded from the FAO Fisheries website at [www.fao.org/fi/statist/fisoft/fishplus.asp](http://www.fao.org/fi/statist/fisoft/fishplus.asp). FISHSTAT Plus is a powerful and easy-to-use software package that allows the user to query the databases for aquaculture production and values, as well as the other FAO Fisheries Statistics databases, including global capture fishery data, fishery commodities data, and regional databases. In addition, the databases can be queried online using FIGIS (Fisheries Global Information System) at the FAO Fisheries website: [www.fao.org/fi/](http://www.fao.org/fi/).

<sup>1</sup>All FAO aquaculture and capture fishery production statistics are expressed in live weight-equivalent units. (i.e. irrespective of the form of product at first point of sale, it is expressed as whole weight).



**Figure 1.** World aquaculture production, volume and value, by region with China disaggregated from rest of the Asia-Pacific region, 2004

**Table 2.** Top ten ISSCAAP species groups for aquaculture production of aquatic animals (not including aquatic plants) for 2004

Species group	Production (tonnes)	Production % of world total	Value (billion US\$)
Carp and other cyprinids	18 303 847	40.3	16.4
Oysters	4 603 717	10.1	2.8
Clams, cockles, arkshells	4 116 839	9.1	3.3
Miscellaneous freshwater fishes	3 739 949	8.3	6.0
Shrimps, prawns	2 476 023	5.5	9.7
Salmons, trouts, smelts	1 978 109	4.4	6.6
Mussels	1 860 249	4.1	1.0
Tilapias and other cichlids	1 822 745	4.0	2.2
Scallops, pectens	1 166 756	2.6	1.7
Miscellaneous marine molluscs	1 065 191	2.3	0.6
Other species	4 334 931	9.5	12.9
<b>Total</b>	<b>45 468 356</b>	<b>100.0%</b>	<b>63.4</b>

# The FAO Aquaculture Gateway Page

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The FAO Fisheries Department is currently restructuring its home page, to improve the performance and accessibility of the web-based information facilitating the navigation through and the integration of the different domains. FAO has developed a new Aquaculture Gateway page powered by FIGIS (Fisheries Global Information System) in which viewers are able to access relevant information on aquaculture at international, regional and national levels.

The Aquaculture Gateway page is accessible through the FAO Fisheries Department Web site at the following internet address: <http://www.fao.org/figis/servlet/static?dom=root&xml=aquaculture/index.xml>

Information can be navigated across FIGIS for a multifaceted view to address the needs of a diverse audience – from policy-makers, aquaculture and fishery managers and NGOs to biologists, statisticians and industry leaders.

The Aquaculture Gateway page contains:

**News.** This section presents and highlights all new on-line products and developments. Example of a recent news is the release of a multilingual Glossary of Aquaculture containing almost 3 000 terms with definitions, synonyms, related terms, information sources and images, has been published to properly define the terminology commonly used to facilitate communication among technical experts, scientists and non experts involved in aquaculture domain.

**Fact Sheets.** This section of the gateway page includes specific subject information and profiles supported by graphics (GIS maps and images, etc.). The Fact Sheets contain a synthesis of information tailored to illustrate the various characteristics of each broad aquaculture subject. Search, navigation and information tools are also accessible. The information domains treated by the Fact Sheets are the National Aquaculture Sector Overviews (or NASOs), the

National Aquaculture Legislation Overviews (or NALOs) and the Cultured Aquatic Species Fact Sheets. All the Fact Sheets will be available into the five FAO official languages (Arabic, Chinese, English, French and Spanish).

**National Aquaculture Sector Overview (NASO).** The NASO collection consists of concise and comprehensive products, providing a general overview of the aquaculture and culture based fisheries aspects at the national level. FAO is currently preparing NASOs for more than 100 FAO member countries around the globe. The NASOs contain detailed information on the history of aquaculture; human resources involved in the sector; farming systems distribution and characteristics; main cultured species contributing to national production; production statistics; description of the main domestic markets and trade; promotion and management of the sector; and development trends and issues at the national level.

**National Aquaculture Legislation Overview (NALO).** The NALOs consist of a series of comparative national overviews of aquaculture laws and regulations from the top 40 aquaculture producing countries, and have been prepared in collaboration with the FAO Development Law Service. The preparation of the overviews is primary based on FAOLEX (<http://faolex.fao.org/faolex/index.htm>), a legislative database containing the world's largest electronic collection of national laws and regulations on food and agriculture. Further material has been collected from national sources.

**Cultured Aquatic Species Fact Sheet.** The Cultured Aquatic Species Fact Sheet collection, is directed at those wishing to gain an understanding of the steps that should be followed to start to raise aquatic species (fish, mollusc, seaweeds and frogs) and learn about current techniques at the global level, provides a general overview of various cultural aspects (e.g. production systems, diseases and control measures, production statistics, market and

trade) for the most important species in aquaculture. A detailed and comprehensive bibliography as well as related links are also provided.

**Data.** The section on Data provides sophisticated statistical graphics constructed from available time-series datasets of aquaculture production data, coming from FAO Fishstat Plus database (version 2.3).

Under this section users can access the FAO Database on Introductions of Aquatic Species (DIAS: <http://www.fao.org/figis/servlet/static?dom=collection&xml=dias.xml>) that was developed by Robin Welcomme in the early 1980s and formed the basis for the 1988 FAO Fisheries Technical Paper No. 294. In the mid-1990s questionnaires were sent to fisheries experts to gather additional and up-to-date information on introductions and transfers of aquatic species in their countries. DIAS now includes additional taxa of plants, molluscs, and crustaceans, and marine species. DIAS is being coordinated by Devin Bartley ([Devin.Bartley@fao.org](mailto:Devin.Bartley@fao.org)) of FIRI.

**Related information** is a section containing the following:

**FAO Aquaculture publications** which catalogue relevant on-line documents. The aim of this section of the webpage is to compile a list of available FAO field project reports on aquaculture which have been received by the David Lubin Memorial Library of FAO and entered into the FAODOC database; the most part of them is available in HTML format.

**Issues related to aquaculture** focus on main problems and issues facing sustainable aquaculture, policy and governance matters, key points of discussion.

**Multimedia** offers information on CD-ROMs produced by FAO, images, video and audio as well as other FAO products.

**FAO Aquaculture Newsletter (FAN)** provides link to the on-line issues of the newsletter.

Selected links connect to the main information systems and partners of FAO Fisheries Department, dealing with aquaculture.

Further details can be obtained by writing to Valerio Crespi of FIRI at e-mail: [Valerio.Crespi@fao.org](mailto:Valerio.Crespi@fao.org).



The Aquaculture Gateway Page

## Workshops on Managing Aquatic Genetic Resources in Fisheries and Aquaculture

Devin M. Bartley<sup>1</sup>

Two workshops on managing aquatic genetic resources in fisheries and aquaculture were recently convened by FIRI and key partners working on responsible fisheries.

### Regional Workshop on Genetic Resource Management in Sub-Saharan Africa, 27 February to 3 March 2006, Accra, Ghana

FIRI, through the Fisheries Department Group of the FAO Regional Office for Africa (FAO RAF) received financial support from the United Kingdom's Department for International Development (DFID) and a private consulting company, Technoserve, to arrange a regional workshop on *Genetic Resource Management in Sub-Saharan Africa*, 27 February – 3 March, 2006. The workshop was organised to provide a forum for producers, fish geneticists, environmental regulators and other stakeholders to discuss issues surrounding the setting up of programmes to develop local improved varieties and the importation of existing improved strains. Participants received an overview of the technical issues revolving around genetic improvement. Industry representatives drafted a Producers' Position Statement encapsulating their point of view on the political and technical aspects relating to the culture of improved strains. This technical background also served as the foundation for elaborating three technical briefs on central genetics-related subjects. These briefs present the topics in succinct non-technical language for use by farm or hatchery managers as well as to inform technocrats and decision-makers. Participants made the following conclusions:

- ❑ Aquaculture has a significant potential to contribute to poverty alleviation, food security and economic growth.
- ❑ Based on the best available technical information and the legitimate needs for improved food security and economic growth, African fish producers are in general agreement that the rules and

regulations governing access to, and use of improved aquaculture stocks are in need of revision.

- ❑ The illegal importation of alien species and strains is increasing, posing threats to both the indigenous fauna and the aquaculture industry.
- ❑ There are strong commonalities among fish farmers in the region in terms of constraints to growth; however, critical mass (e.g., functional producers' organisations), which could support the development of hatchery and other key elements in the production chain (e.g., feeds) is lacking in most countries and some type of regional structure that could channel support services is clearly needed.
- ❑ Implementation of this process should be based firmly on a public-private partnership built on trust and the appreciation of the potential mutual benefits for farms and the broader society of a prosperous and responsible aquaculture sector.
- ❑ Fish producers will have to fully cooperate with research and regulatory bodies to ensure that best management practices are being adhered to and that changes in biodiversity in areas affected by aquaculture are closely monitored and that any problems arising are rapidly and effectively addressed.
- ❑ The meeting acknowledges the commitment of the farmers and the obligations they have accepted in return for a revision of the policy surrounding the important and use of genetically improved stocks (e.g., GIFT). It will be essential for international, national and regional agencies and natural resource managers to work closely with the fish farming industry.



*Top Photo: Genetically improved Nile tilapia such as this are highly desired by fish farmers in Africa*

*Bottom Photo: Eddie Abban giving lecture on genetic resource management in aquaculture*

The report of the workshop will be published as a CIFA occasional paper. For further details, please contact John Moehl of FAO RAF at e-mail: [John.Moehl@fao.org](mailto:John.Moehl@fao.org).

### **Expert Workshop on Status and Trends in Aquatic Genetic Resources: a Basis for International Policy, 8-10 May 2006, Victoria, British Columbia**

A second workshop, *Status and Trends in Aquatic Genetic Resources: a Basis for International Policy*, was convened in Victoria, British Columbia on 8-10 May, 2006. In 1995, the FAO Conference decided to broaden the mandate of the Commission on Plant Genetic Resources to cover all components of biodiversity of relevance to food and agriculture and thus created the FAO Commission on Genetic Resources for Food and Agriculture (CGRFA). At its Tenth Session, the CGRFA agreed that its Secretariat, in cooperation with the FAO's relevant services and inter-departmental working groups, should submit a Multi-Year Programme of Work to its Eleventh Session. In the medium and longer

term, the Commission would implement its full mandate, which would include work related to Fisheries. The Secretariat was requested to prepare a document on the status of the resources and needs of the various sectors, including fisheries. In response to the above request, the Fishery Resources Division of FAO (FIR) and the CGRFA, in collaboration with the World Fisheries Trust (Canada), brought together a small group of internationally recognized experts in the fields of aquaculture, capture fisheries, molecular genetics and genomics, the deep sea, international development, and aquatic conservation to:

- ❑ review the status of trends of aquatic genetic resources and biodiversity in key areas within fisheries and aquaculture that include aquaculture, capture fisheries (inland and marine), the deep sea, and modern genomics and biotechnology; and
- ❑ identify key policy issues, priorities and implications for the international development community, and specifically for FAO and the CGRFA, in regards to aquatic genetic resources and biodiversity.

The workshop identified areas of work that FAO could pursue to address improving information on status of aquatic genetic resources, capacity building, creating policy instruments, raising awareness and education. Creation of Technical Guidelines on Genetic Resources in Fisheries and Aquaculture was a specific recommendation from the workshop. Mr Brian Harvey (Canada) further offered support for a workshop on how to reach target audiences, i.e., stakeholders, in order to raise the profile of genetic resources for fisheries and aquaculture.

The report of the workshop including the reviews of status and trends in aquatic genetic resources will be published by FAO. Further details are available from Devin M. Bartley ([Devin.Bartley@fao.org](mailto:Devin.Bartley@fao.org)).

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# Expert Workshop on Comparative Environmental Costs of Aquaculture and other Food Production Systems

24-28 April 2006  
Vancouver, British Columbia

The First Session of the Sub-Committee on Aquaculture of the Committee on Fisheries recommended future work be devoted to “undertaking comparative analyses on the environmental cost of aquatic food production in relation to other terrestrial food production sectors”, and specifically requested the Secretariat to undertake such a study and analysis. In response to that request, the FAO Fisheries Department with the support of the World Fisheries Trust (Canada) and the Vancouver Aquarium brought together international experts on aquaculture development, ecology, environmental economics, environmental impact analysis, energy analysis, and livestock farming in order to:

- ◇ advise FAO on appropriate and accurate accounting systems for comparing environmental costs of aquaculture and other terrestrial food production sectors;
- ◇ evaluate strengths and weaknesses of such accounting systems; and
- ◇ advise FAO on how to deal with this subject in the future.

A range of methodologies, including, Energy Analysis, Ecological Footprint Analysis, Life Cycle Assessment and Material Flows Accounting, were presented, along with results from some comparative case studies. Discussions highlighted the complexity of the request and the challenges it raises in terms of translating environmental impacts into costs and overcoming data, information and methodological gaps. The workshop proceedings and recommendations are being edited by WFT and FI staff and will be published in the FAO Fishery Proceedings Series.

For further information please contact Devin M. Bartley at ([Devin.Bartley@fao.org](mailto:Devin.Bartley@fao.org)).

Stewart Lampe, World Fisheries Trust



*The mountains surrounding Vancouver provided an inspiring setting for FIRI staff (D.Bartley standing) to facilitate experts, seated clockwise from Bartley; Tam Mungkung (Thailand), Yogi Carolsfeld (World Fisheries Trust), Kenneth Brooks (USA), Cecile Brugere (FAO), Randy Brummet (WorldFish Centre), to examine environmental costs of aquaculture and other food production systems.*



*Regional Workshop on Guidance for Credit and Microfinance Programmes in Support of Sustainable Use of Inland Fishery Resources and Poverty Alleviation, 14-17 February 2006, Beijing, PR China*

## MICROFINANCE AND INLAND CAPTURE FISHERIES IN ASIA

Susana V. Siar<sup>1</sup>, Raymon Van Anrooy<sup>2</sup> and Gerd Marmulla<sup>3</sup>

**I**nland capture fisheries are important for food security and biodiversity conservation. In the Asian region, these fisheries are increasingly facing threats from reduction of survival space and variance of habitat of fish and aquatic organisms, pollution of water bodies and aquatic environment, overfishing and destructive fishing practices, local conflict in management and utilization of migratory fish stocks and water bodies, and deforestation. Unavailability of capital for its development and rehabilitation and the lack of awareness on the part of financial institutions of the investment and credit needs are hampering the sustainable development of the sector.

### REGIONAL WORKSHOPS

In 2004, a regional workshop held in Kuala Lumpur, Malaysia, on microfinance and credit programmes in support of the sustainable use of inland capture fisheries resources, was jointly organized by FAO, INFOFISH and the Asia

Pacific Rural and Agricultural Credit Association (APRACA) and co-hosted by the Department of Fisheries, Fisheries Development Authority of Malaysia and the Agricultural Development Bank of Malaysia.

A second regional workshop, jointly organized by FAO, the China Society of Fisheries and the East China Sea Fisheries Research Institute, in Beijing, PR China on 14-17 February 2006 presented and reviewed case studies as basis for formulation of the guidelines. Recommendations were made towards improving credit and microfinance programmes in support of poverty alleviation and the sustainable use of inland fisheries resources. The workshop was attended by 44 participants from Cambodia, India, Indonesia, Malaysia, Myanmar, Thailand, Viet Nam and China. As in the first workshop in 2004, fisheries administration and financial institutions were represented. One of the conclusions reached was that it remained difficult for small-scale fishers to access credit.

## GUIDELINES FOR MEETING CREDIT AND MICROFINANCE NEEDS IN INLAND CAPTURE FISHERIES

The guidelines produced from the Beijing workshop provide orientation, basic considerations and general principles for those institutions and organizations who:

- a. offer formal credit and microfinance services to the fisheries sector, particularly the small-scale fisheries sector; and
- b. want to include inland capture fisheries and inland fishers as part of their client base and lending operations.

The guidelines can also be used by public and private financial institutions and other agencies providing financial and related services including insurance.

Two major sections of the guidelines are:

1. **Lending Policies and Procedures** which elaborate on target groups and their micro-finance needs, loan size and purpose, interest

rates, lending procedures and repayment periods, documentation and collateral requirements, and savings and insurance services; and

2. **Institutional Arrangements** which discuss the role of governments, NGOs, fisher associations, cooperatives and self-help groups, financial institutions, and donors.

The guidelines, case studies and proceedings of the workshops are now being finalized. Publication and dissemination will take place before the end of this year.

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FAO Fisheries Department, Rome

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## INTERNATIONAL SYMPOSIUM ON THE MAHSEER 2006



MB REANTASO, FAO

*Delegates to the International Symposium on Mahseer, 29-30 March 2006, Kuala Lumpur, Malaysia*

*FAO provided support to the symposium through the participation of MB Reantaso who presented a paper co-authored by DM Bartley, MB Reantaso, MR Hasan, RP Subasinghe and S Funge-Smith on 'Status of Mahseer Fishery Resources: Options for Development and Conservation', and travel support to a number of delegates from the Himalayan region to participate in the symposium. The Malaysian Fisheries Society (MFS) extends its kind appreciation to FAO for the the support and assistance extended.*

## MAHSEER 2006 DECLARATION

The delegates (125 from 10 Asia-Pacific nations) of "Mahseer 2006", a 2-day symposium organized by the Malaysian Fisheries Society in collaboration with the

- ⇒ Department of Fisheries Malaysia, (DOF)
- ⇒ Department of Wildlife and National Parks, Malaysia (Perhilitan)
- ⇒ Fisheries Development Authority of Malaysia (LKIM)
- ⇒ Universiti Putra Malaysia (UPM)
- ⇒ INFOFISH
- ⇒ Aquaculture Asia Pacific Magazine
- ⇒ Food and Agriculture Organization (FAO) and
- ⇒ Network of Aquaculture Centers in the Asia-Pacific (NACA),

unanimously recognize that:

1. The Mahseer is a cultural icon of diverse economic, recreational and conservational value in rivers of eleven Asian nations, with many species transcending country/national boundaries.
2. The Mahseer is an integral component of the aquatic ecosystem and an important indicator of its health and supports the livelihood of many rural, indigenous ethnic groups in Asia.
3. The strategies that need to be developed to maintain the sustainability of Mahseer populations are dependant on the effective utilization of available information on this important and iconic group of fishes.
4. There is an urgent need to collate the available information and synthesize them through appropriate mechanisms to facilitate policy developments.

The group is unanimous in its suggestion that the FAO, in conjunction with regional and national organizations, as well as other concerned organizations take the initiative to launch the above activities in the immediate future. The delegates recognize the urgent need to improve the information on the status and trends of this important group of fishes through;

1. Diligent reporting of catch and production information by fishers, mostly comprising of rural, indigenous ethnic groups, anglers, fish farmers and researchers to relevant national resource agencies.
2. The information should be reported to regional and international centres, such as NACA and FAO as well as to the FishBase of the World Fish Centre and relevant national governmental and non-governmental organisations such as the Malaysian Fisheries Society.
3. Contribution of information relevant towards the conservation, taxonomy, biology, breeding and culture of the relevant Mahseer species.
4. The relevant agencies will facilitate and provide guidance for sustained utilization of fish stocks and improve their conservation status.

The specific immediate activities that would facilitate attainment of the objectives as recognized by the group are;

a) Initiation of a suitable network, preferably linked to an existing regional network, such as that of the Network of Aquaculture Centers in Asia-Pacific (NACA) for facilitating information exchange and dissemination on Mahseer biology, culture and conservation in the Asian region.

b) Initiation and coordination of a R&D program, and associated capacity building in participating Asian countries, developed through regional and international organizations such as NACA and the FAO, in consultation and conjunction with national authorities, to address key critical issues as identified at this symposium. These include

- ⇒ taxonomy and phylogeny of the group
- ⇒ population structure and conservation status of important species
- ⇒ best practice approaches to the culture of suitable Mahseer species
- ⇒ development of sound stock enhancement practices, amongst others.

c) The establishment of a Reference Center for the Mahseer to support R&D activities and information gathering and transfer/extension/education/capacity building on aspects of the Mahseer to achieve the sustainable exploitation, conservation and aquaculture.

d) Preparation of relevant literature, including a practical handbook on the taxonomy, conservation, biology, breeding and culture of the relevant Mahseer species.

It is believed that the establishment of a suitable platform for R & D on Mahseer will also have a flow through effect on other important indigenous species groups of economic, cultural and conservational value.



*Participants of the FAO Feed Expert Workshop, Wuxi, PR China, 18 March 2006 with Mr Li Jieren (5th from right), Vice President of Chinese Academy Fisheries Science and Prof. Xu Pao (6th from right), Director, Freshwater Fisheries Research Center (FFRC), Chinese Academy of Fishery Sciences*

## FAO Expert Workshop on Use of Feed and Fertilizer for Sustainable Aquaculture Development

Wuxi, Jiangsu Province, PR China, 18-21 March 2006

Mohammad R. Hasan<sup>1</sup>

The Inland Fisheries and Aquaculture Service (FIRI) of FAO organized an expert workshop on "Use of Feed and Fertilizer for Sustainable Aquaculture Development" in collaboration with Freshwater Fisheries Research Centre (FFRC) and Network of Aquaculture Centres in Asia-Pacific (NACA). The workshop, participated by recognized international experts in the field of aquaculture, aquaculture nutrition and aquafeed including the authors of country reviews, case studies, regional synthesis, global synthesis including participation from FAO, FFRC and NACA, was convened between the 18-21 March 2006, and hosted by the Freshwater Fisheries Centre (FFRC), Chinese Academy of Science at the FFRC Campus in Wuxi, Jiangsu Province, China PR. The workshop was undertaken as part of FIRI's work programme on "Study and analysis of feed and nutrients (including fertilizers) for sustainable aquaculture development" under Programme Entity entitled "Promotion of Responsible Inland Fisheries and Aquaculture".

The objectives of the workshop were to review and analyze the status and trends in aquaculture production (with particular reference to fish and crustacean species that

feed on aquafeeds) and to identify key issues and challenges of feed and fertilizer resources for sustainable aquaculture development. The workshop combined technical presentations and working group discussions. A number of country reviews from Asia (e.g., Bangladesh, China, India, Indonesia, Thailand, the Philippines, Viet Nam) and Africa (e.g., Cameroon, Egypt, Ghana, Kenya, Malawi, Nigeria and Uganda), case studies on economics of aquaculture feeding systems in selected countries of Asia, regional reviews (Asia, Africa and Latin American regions) and one global review was commissioned prior to the workshop and selected reviews, case studies, syntheses were presented during the workshop.

The working group discussion specifically addressed two major themes related to the use of feed and fertilizers for sustainable aquaculture development, namely: (a) development of the aquafeed industries, impact of availability of protein sources and alternatives and their feasibility for use; and (b) home/farm-made aquafeeds (including manures & fertilizers) - opportunities and constraints concerning their availability, feasibility and management. Based on the reviews and analysis during technical

and working group sessions, the workshop identified key issues and suggested appropriate actions (i.e., policy & regulation, studies & research, extension, application & adoption, capacity building, and public & private sector partnership) to address these issues.

During the plenary, issues identified by the working groups and the actions needed to these issues were discussed and it was recommended that FAO may take up the following actions to assist national governments and regional organizations:

- Review existing national standards and legislation regarding the dietary nutrient specifications (where they exist) for the manufacture of compound aquafeeds/farm-made aquafeeds for the major cultivated fish species, including the provision of guidelines and advisory material for different farming systems and feed types;
- Review existing national mechanisms of incentives, subsidies and taxes affecting the animal feed manufacturing sector and feed ingredient usage, including feed ingredient imports and export/domestic promotion strategies;
- Compile available information (in the form of synopses) on the dietary nutritional requirements of major cultured fish species and the feed ingredients currently used within compound/farm-made aquafeeds, including national/regional feed ingredient source books containing information on nutrient composition,

quality control criteria, seasonality, and market price;

- Encourage the strengthening of national/regional dialogue, exchange of information and research priority setting between researchers/public sector and the aquaculture sector (including farmers and feed manufacturers), through support to the activities of national/regional organizations, the implementation of joint research projects, the establishment of national farmer/aquafeed associations, and the development of web-based information and research networks; and
- Strengthen capacity building in aquaculture nutrition and feed technology, including on-farm feed management, for farmers, feed manufacturers, private service providers, researchers and extension workers within developing countries (and in particular within sub-Saharan Africa). This may also respond well to inter-regional cooperation.

The full report of the workshop will be published as an FAO Fisheries Proceedings and will include selected country reviews, case studies, three regional reviews, global synthesis, invited presentations and working group recommendations. Further details of the workshop report and the proceedings are available from Mohammad R. Hasan at FIRI (e-mail: [Mohammad.Hasan@fao.org](mailto:Mohammad.Hasan@fao.org)).

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M. HASAN, FAO

*Technical Session of the FAO Feed Expert Workshop, Wuxi, PR China, 18 March 2006*

## SAMOA RECEIVES GIANT CLAM BROODSTOCK FROM TONGA

Sub-Regional Office for the Pacific Islands - SAPA

Samoa's Fisheries Department (SFD) is currently experimenting with commodities such as giant clams, sea urchins, tilapia, and trochus in areas of reproduction, grow-out and feeding. Giant clams are one of the most successfully cultured species by the SFD. There are however, no commercial aquaculture activities in Samoa.

The SFD has an extensive **community-based fisheries management (CBFM) programme** involving at least 80 coastal villages on both the main islands of Samoa - Upolu and Savaii. Most of these villages have established **marine protected areas (MPAs)** that are off-limits to fishing activities.

As with many other invertebrates, the natural abundance of giant clams has declined significantly over the years. Thus, the main aim for culturing clams in Samoa is conservation. As part of their CBFM programme, the SFD provides selected villages with juvenile clams for grow-out in their MPAs and trains community members on how to care and maintain them. The long-term view, however, is to commercialize this activity as a source of alternate livelihood and income for coastal communities.

The SFD faced a major setback in their efforts when Cyclone Heta hit Samoa in January 2004. The Department lost almost all of its broodstock clams kept at the Palolo Deep Marine Reserve in Apia.

In response to SFD's request for assistance, FAO provided its support to replenish their broodstock as well as procure two large holding tanks for holding the clams at their mariculture hatchery in Toloa.

Two species namely, *Tridacna gigas* and *T. derasa*, were translocated by air from Tonga with support of the Tonga's Ministry of Fisheries. Samoa has, to-date, received about 180 broodstock clams, now thriving well in the Palolo Deep Marine Reserve.

With the recent regional concerns over biosecurity risks associated with transboundary movement of aquatic species, this translocation also prompted the SFD to formulate and implement an **Import Risk Analysis (IRA)** (see related articles on page 25) for introducing the giant clams to Samoa. The IRA was carried out in collaboration with the Samoan Quarantine Department, Division of Environment and Conservation and the Secretariat of the Pacific Community (SPC).

The SFD re-commenced its giant clam spawning activities in January 2006. Several coastal village communities have also applied for FAO's Telefood Special Funds to commence their giant clam nursery farms. A marketing study, carried out by the SFD and the US Peace Corps in 2004, to explore the aquarium market for giant clams in the United States, looks very promising. It is envisaged that, with the assistance from SFD, coastal communities will consider giant clam farming as an alternative means of income, and managing their coastal fisheries.

For further information about this project, please contact Masanami Izumi of FAO SAPA at e-mail: [masanami.izumi@fao.org](mailto:masanami.izumi@fao.org)



SAMOA FISHERIES DEPARTMENT

*Stocking of juvenile giant clams in a community managed marine protected area at Fagalii Village by a Samoan Fisheries Officer*

# TCP/RAS/3101 (A): Sustainable Aquaculture Development in Pacific Micronesia

Sub-Regional Office for the Pacific Islands - SAPA



S.FUNGE-SMITH, FAORAP

80 ha milkfish farm (ex-shrimp farm) in Kiribati, Pacific Island

FAO has approved a technical cooperation project (TCP) titled "Sustainable Aquaculture Development in Pacific Micronesia" for Palau and four other Micronesian countries in the Pacific (i.e. Federated States of Micronesia, Marshall Islands, Nauru and Kiribati). The project aims to improve the technical, environmental and economical viabilities of the existing small-scale milkfish farming in Palau, to assist the National Governments with the development of a sustainable National Aquaculture Strategy and Action Plan (e.g. guidelines, zoning plan, regulatory framework and national Code of Practice), and to build human capacity through training workshops. The challenge is to improve and develop aquaculture activities in a responsible manner while conserving and managing the pristine aquatic environment of Palau.

Project field activities will be conducted in the project host country, Palau. The project is being executed by the Bureau of Marine Resources, Ministry of Resources and Development, in close cooperation with the Ngatpang State Government, for a period of 18 months with a total budget of \$323 000. The project has a number of activities, such as:

- ⇒ a study on the existing aquaculture facility and operations (e.g. fry resource management and potential environmental impacts);
- ⇒ business plan including cost analysis, market assessment, potential employment and income generation; and
- ⇒ a desk study on risk analysis for the introduction, movement and translocation of aquatic species which will develop an expert decision-making framework for conducting aquaculture risk assessment.

The result of the above studies will be further discussed and shared with relevant stakeholders during national workshops that will be organized under the Project. The outcomes and the experience of the Project will be also discussed in a regional forum. In preparation for the implementation of the Project activities, the FAO's Fishery Officer based at the Sub-Regional Office for the Pacific Islands in Samoa visited Palau early March 2006, and discussed details of the project work arrangements and schedule with the Bureau of Marine Resources.

Further details about the project can be obtained from Masanami Izumi of FAO SAPA at e-mail: [masanami.izumi@fao.org](mailto:masanami.izumi@fao.org)

## CONTRIBUTING TO SUSTAINABLE AQUACULTURE IN LATIN AMERICA THROUGH TECHNICAL COOPERATION PROJECTS (TCPs) IN BRAZIL AND CHILE

Doris Soto<sup>1</sup>



D. SOTO, FAO

*A small shrimp farm in Pernambuco State, Brazil*

Aquaculture is growing exponentially in Latin America with salmon, shrimp and tilapia as the leading cultured species. Most countries in this region are showing a rapid growth of the sector, thus, having important social and economic effects on regional and local economies, mostly through medium and large-scale commercial aquaculture. However, continued growth of the sector will need greater organization and coordination between the private sector and governments, in particular, to insure a larger social impact by strengthening small-scale, family-based and rural aquaculture. On the other hand, it is important to make sure that environmental considerations are formally part of aquaculture management.

Two on-going projects deal with these issues. The [TCP/BRA 3001 - Institutional Strengthening of the Aquaculture and Fisheries Secretariat of Brazil](#) - was formulated in 2003 at the request of the Brazilian government to strengthen the newly created Fisheries and Aquaculture Secretariat (SEAP/PR) and started in 2005. Although aquaculture is considered the activity with the most relevant growth and production in the fisheries sector, policies addressing all the complex issues from legal aspects to productive chains and technological development were lacking. Therefore, improving the technical capacity and policies for sustainable aquaculture development were considered a priority. Thus, the objective of the TCP is to strengthen the ability of SEAP/PR in developing the fundamental infrastructure on

information, legal, and technical components which are essential to support and enhance the capacity of the new secretariat. Of particular relevance has been the component on strengthening strategic planning ability and technical capacity for sustainable aquaculture development. To achieve this, there have been three successful seminars with SEAP personnel in Brazilia. The first seminar was aimed to assess the technical capacities of SEAP personnel identifying major weaknesses and strengths towards a strategic planning for aquaculture with special consideration to family-based/rural aquaculture. Following this diagnosis, two subsequent seminars were planned and adapted to fill some of the weaknesses identified during the first seminar. These included: (a) institutional strengthening for sustainable development of aquaculture; and (b) management of environmental and health issues for sustainable aquaculture. These activities have contributed successfully to the institutional capacity and to improving the interaction between the private sector and government institutions, as well as within government institutions. We shall see a much improved Secretariat as a result of the project.

The second project, [TCP/CHI 3002 - Certification of Compliance to Aquaculture Environmental Regulation in Chile](#) - started in 2005 and is being implemented by CONAMA (National Commission for the Environment). Chilean aquaculture, has been one of the fastest growing in the world (18 percent average annual increase in the past 10 years) reaching in 2004, a volume of 694 thousand tonnes, with an export value of US\$ 2 400 M, 80 percent of which is represented by salmon and trout. The activity has had strong economic and social impacts especially in the southern zone of the country previously less developed and more rural. However, due to the rapid growth of aquaculture and its spread in areas with more or less pristine waters of the country, their environmental sustainability becomes a concern for society and a challenge for the development of the sector. As a way to insure sustainability, in December 2001, the Fisheries Secretariat launched a new law for the [Environmental Regulation of Aquaculture \(RAMA\)](#). However, the State does not have the means to verify compliance to this regulation.

D. SOTO, FAO



D. SOTO, FAO



C. LEAL, CHILE



F. JARA, CHILE



Such limitation triggered the submission of the above TCP project to develop an evaluation and certification system for the compliance of the RAMA.

The TCP project is expected to produce a tool for the verification and certification of the compliance to RAMA, to be applied immediately on a voluntary basis and is likely to be binding on the longer term. The project includes a very active participation through seminars and workshops, of all stakeholders, namely, the industry, farmers, environmental consultants and laboratories, NGOs and the different institutional agencies. The economic and legal implications are also deeply discussed.

The certification process consist of certifying the laboratories and technical personal providing the service on environmental sampling/monitoring and further working with certifying institutions which will take care of accreditation concerning compliance to the RAMA. This includes the direct hiring of consultants or laboratories to verify the different environmental parameters considered as indicators.

The final certification package will constitute a pioneering step for aquaculture sustainability.

For more information, please contact: Doris Soto of FIRI at [Doris.Soto@fao.org](mailto:Doris.Soto@fao.org)

*Photo top left: Children showing shrimp harvest from a family farm in the vicinity of Recife, Brazil*

*Top right: Environmental monitoring of sediments with a grab for the compliance of the RAMA (Environmental Aquaculture Regulation) in southern Chile*

*Bottom left: A rural shrimp farm in the vicinity of Recife, Brazil*

*Bottom right: Salmon farms in the Reloncavi Estuary, Southern Chile*

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# Introduction of Aquaculture and other Integrated Production Management Practices to Rice Farmers in Guyana and Suriname

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W. Settle<sup>4</sup>, B. Chakalall<sup>5</sup>, R. Joshi<sup>6</sup>, M. Halwart<sup>7</sup>



M. HALWART, FAO

*Trainer G. Juanich (Philippines) providing guidance to the rice extension staff trainees on the proper use of a liftnet which was constructed by the trainees themselves (Guyana)*

In February 2004, the Governments of Guyana and Suriname were awarded by FAO with a joint project TCP/RLA/3003 "Introduction of aquaculture and other integrated production management practices to rice farmers".

The project objectives were to:

- ▶ build capacity of rice extension staff to carry out **Integrated Pest Management (IPM)** and aquaculture extension work;
- ▶ develop IPM strategies appropriate for small farmers through participatory **Farmer Field School (FFS)** training and action research; and
- ▶ integrate aquaculture into small rice-based farming systems to diversify production for increased income and improved nutrition.

This two year project represented the first occasion on the use of the **Training of Trainers (TOT)** methodology and the FFS approach for the implementation of rice-fish culture.

Rice farmers in Guyana and Suriname are using pesticides heavily, which results in unnecessarily high production costs as well as environment and health risks. This project sought to introduce aquaculture as a fundamental component and reinforcement of an IPM strategy, with training of rice extension staff being an integral part of the strategy. It was designed to follow the TOT methodology to rapidly increase the skills of rice extension staff, coupled with the FFS approach to empower farmers in the use of the new technology.

Two **Technical Cooperation among Developing Countries (TCDC)** Consultants implementing the project, Mr Wahyu Sutisna (Indonesia) and Mr Godardo Juanich (Philippines), skillfully guided the various activities under the project. Both Consultants spent time in Guyana and Suriname at the beginning of the project, getting a feel for the rice cultivation and aquaculture practices in both countries and subsequently using this information to prepare a suitable curriculum jointly with the trainees.

This curriculum was then used in a 15-week Season Long Training of Trainers programme at a TOT plot in the Black Bush Polder area, Corentyne, Guyana. Sixteen rice extension officers from both Guyana and Suriname were exposed to theoretical and practical aspects of FFS training in rice IPM and aquaculture principles.

Following the weekly training sessions, 16 extension staff fanned out to conduct six FFS in the Corentyne area, with an average of 15

farmers per FFS. The farmers usually met once a week, for several hours, observing and analyzing the rice agroecosystem, doing experiments in the field, constructing their own tools and implementing and discussing rice and fish-related topics. The TCDC Consultants maintained a flexible approach, lending support to various plots, as required.

Plots were planted with various high yielding rice varieties and stocked with Red Tilapia, reflecting farmer preference. As the rice in the plots approached harvest time, a small field day exercise was held at each plot, accommodating cross visits by farmers from other plots.



*The Farmer Field School approach is action oriented - here farmers get ready to sample fish in the pond adjacent to the rice field to monitor growth rates (Guyana)*

All of these activities culminated in a **General Field Day** held on 5<sup>th</sup> March 2005 at the TOT site in Black Bush Polder, Guyana. The general aim of the Field Day was to inform the persons directly associated with the project and the general public as to the objectives of the project and the progress to-date. The Field Day included visits to rice-fish trial plots, a photo exhibition, examination of the trial progress and presentations by Consultants, participating farmers and the trainees themselves. More than 200 farmers were present, representing all the rice growing regions of Guyana. Many people expressed interest in all aspects of the project, and farmers conveyed their desire to participate in the up-scaling of activities in the next season.

In the second season, six additional plots were established in other rice-growing regions of Guyana. Four plots were also established in Suriname. Over 180 farmers actively participated in the IPM and aquaculture participatory training exercises. The TCDC Consultants also supported these activities in additional plots in both Guyana and Suriname, made possible by the proximity of the rice-growing regions in the two countries. A farmer exchange visit was again facilitated, allowing for valuable exchange of views and experiences between farmers of Guyana and Suriname.

The project provided important additional training activities on aquaculture for rice extension staff, including attendance to the Integrated Freshwater Fish Farming (IFF) course in Wuxi, P.R. China and a tilapia seed production course organized at the Mon Repos Aquaculture Station in Guyana.

The results obtained at the end of the project, albeit preliminary, are extremely positive and include the following:

- ▶ The average Region 6 rice yield of conventional rice farmers is about 24 bags per acre (4 173 kg/ha). IPM farmers harvested an average rice yield of 28 bags per acre (4 869 kg/ha); representing an average increase of 4 bags per acre (696 kg/ha).
- ▶ There was an increased rice yield from the rice-fish plot. The average production of rice from seven rice-fish plots was 47 bags per acre equivalent to 8 173 kg/ha in Region 6! This significant increase can be attributed to the elevated attention that farmers provide to the crop in the generally smaller rice-fish plots, but also to the positive impact of the fish themselves as well as the fish farming practices favouring better growth of the rice plants.
- ▶ The quality of grain from the rice plot increased, with less damaged rice grains and a higher milling grade.
- ▶ There is a major reduction in the use of pesticides after the introduction of the IPM/FFS technologies. The average number of pesticide applications in the project area was reduced from 10 applications per crop to between 0-3 applications per crop. One farmer reported a 66 percent reduction in cost of chemicals after the introduction of the FFS/IPM technologies.

- ▶ Given the reduction in the use of pesticides, the increased rice yield and higher quality of the milled rice, farmers have experienced a substantial increase in their earnings.
- ▶ The technical viability of producing rice and fish has been demonstrated at the pilot scale level. Fish yields for a growing period of approximately 150 to 180 days from the ponds adjacent to the fields were variable, ranging from 346 to 1 240 kg/ha, indicating that rice-fish culture is a new activity for rice farmers with a lot of potential for increasing yield as experience grows. Farmers have expressed their desire to continue with this activity as part of the FFS. According to them, an important argument in favour of rice-fish farming is that revenues from the fish crop can offset losses which might occur in the rice crop. In general, since the introduction of IPM, farmers have observed an increase in fish biodiversity in rice fields.

The entire cycle of project activities together with over 200 excellent digital photographs has been documented. The FFS curriculum is considered particularly valuable since it will serve as a basis for introducing similar activities also in other countries and regions. It will be published as part of the series on "Aquatic biodiversity in rice-based ecosystems" available at <ftp://ftp.fao.org/FI/CDrom/AqBiodCD20Jul2005/default.htm> and is expected to be translated into other languages soon.



*Father and son during harvest of their rice-fish plot (Suriname)*

Looking at the larger picture, the adoption of IPM will not only mean savings for farmers in the form of money, but also a significant improvement in the health and well-being of farming communities. It is anticipated that the introduction of aquaculture practices will not only be sustained but be taken up by more farmers in Guyana and Suriname and possibly spread to the surrounding region.

For further information about the project, please contact M. Halwart of FIRI at [Matthias.Halwart@fao.org](mailto:Matthias.Halwart@fao.org), T. Geer of the Guyana Fisheries Department at [tejnarinegeer@yahoo.com](mailto:tejnarinegeer@yahoo.com) or R.J. Debipersaud of the Suriname Fisheries Department.



*One of the highly motivated rice-fish farmers, Mr Kunjbeharry (right), together with the Senior Extension Officer Mr Ramlall, in front of his rice-fish plot in Region 6, Guyana, where he saved 66 per cent of expenses on unnecessary pesticides*

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# FAO GFCM meeting highlights growing profile of Mediterranean aquaculture

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At the 5<sup>th</sup> meeting of the Committee on Aquaculture (CAQ) of FAO's General Fisheries Commission for the Mediterranean (GFCM) (Santiago de Compostela, Spain, 5–7 June 2006) representatives of 11 Member countries met to review recent trends in the fish farming sector and discuss ways to promote its continued sustainable development.

FAO figures show that the aquaculture sector is of increasing importance as a food production activity, both regionally in the Mediterranean as well as worldwide. Globally, it generates around US\$63 billion of revenues per year and supplies over 35 percent of all fish consumed as food.

In the Mediterranean, aquaculture production stagnated during the 2000–2002 period but then grew by over 8 percent a year between 2002 and December 2004 and currently totals more than 1.4 million tonnes a year, according to FAO. This trend is expected to continue as demand for aquaculture products increases, particularly in North-African and Middle-Eastern Mediterranean countries due to population growth, increased tourism and lower prices for aquaculture products.

## TOP PRODUCING COUNTRIES

The top Mediterranean aquaculture producers are Egypt, Spain, France, Greece, Turkey, Italy and Israel, with a combined share of 97 percent of all production. (Egypt and Spain account for 32 and 25 percent of this total, respectively including Atlantic and Red Sea production).

In Western Europe the leading producers are France, Italy and Spain, which together produce over 805 thousand tonnes of aquaculture produce per year, representing 57 percent of all Mediterranean production. Central Europe (Albania, Bosnia and Herzegovina, Bulgaria, Romania, Serbia and Slovenia) currently produces just 2.2 percent of the total (almost 32 thousand tonnes a year). To the east, Croatia, Greece, Malta and Turkey produce about 163 thousand tonnes a year, nearly 11.6 percent of regional production. However the bulk of this production (92 percent) is from Greece and Turkey. With the exception of Egypt and Israel, North African and Middle Eastern production is low (Algeria, Lebanon, Libya, Morocco, Syria and Tunisia) contributing just over 15 thousand tonnes a year or 1 percent of the total.

Key species are carps and tilapia (produced in Egypt) and blue mussel (Spain and France). Flathead grey mullet (*Mugil cephalus*), European seabass (*Dicentrarchus labrax*), and Gilthead seabream (*Sparus aurata*) are important finfish species, and the profile of Atlantic bluefin tuna (*Thunnus thynnus thynnus*) in Mediterranean aquaculture is growing as well. This species is now being caught in the wild and fattened in large marine netcages.

## FAO BODY PROMOTES SUSTAINABLE AQUACULTURE

The CAQ is a subsidiary body of the FAO GFCM, a regional fishery body established by FAO in 1949 which meets on a regular basis, share information on fisheries trends, conduct joint scientific studies, discuss policy and agree on recommended management strategies.

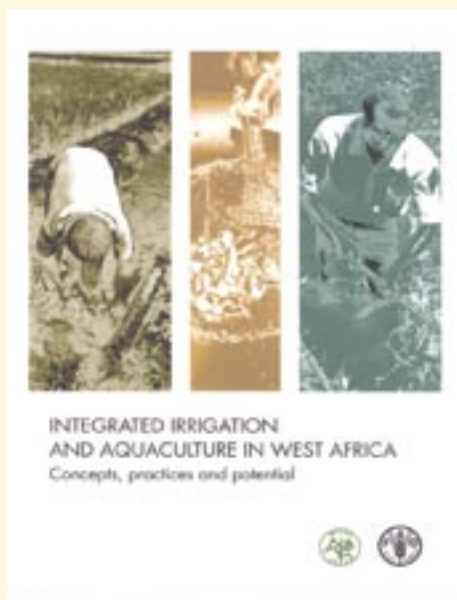
Some 20 delegates representing 11 GFCM Member countries, two inter-governmental organizations and one non-governmental organization participated in the CAQ meeting in Santiago.

During the meeting the CAQ established three *ad-hoc* working groups of experts which will undertake ongoing work related to the responsible management and development of Mediterranean aquaculture.

The first will concentrate on marketing issues, undertaking market assessments and proposing marketing guidelines and a strategy for improving aquaculture's image among consumers. The second will focus on sustainability and will try to develop guidelines for integrated aquaculture management in the Mediterranean. The third working group will focus on developing methodologies for responsible aquaculture site selection and coastal management issues.

The *ad-hoc* working groups are expected to initiate their activities during autumn 2006 with the financial support of GFCM Members. Their work will be overseen by a smaller coordinating group chaired by the newly appointed CAQ Chairperson, Mr Spyros Klaoudatos of Greece.

GFCM Website: [http://www.fao.org/fi/body/rfb/GFCM/gfcm\\_home.htm](http://www.fao.org/fi/body/rfb/GFCM/gfcm_home.htm)



Halwart, M.; Dam, A.A. van (eds) 2006. *Integrated irrigation and aquaculture in West Africa: concepts, practices and potential*, Rome, FAO. 181p

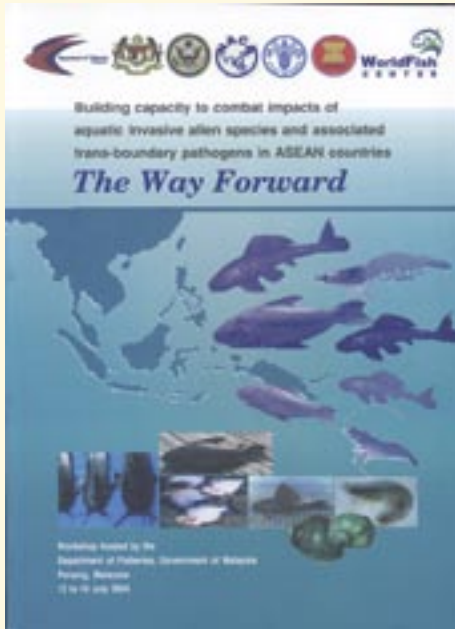
This volume contains background documents and papers presented at the FAO WARDA Workshop on Integrated Irrigation Aquaculture (IIA) held in Bamako, Mali, from 4 to 7 November 2003, as well as the findings of FAO expert missions on IIA in the West Africa region. The rationale for IIA development lies in its potential to increase productivity of scarce freshwater resources, enhance food security and poverty alleviation, and reduce pressure on natural resources, particularly in the drought prone countries of West Africa. Irrigated systems, floodplains and inland valley bottoms are identified as the three main target environments for IIA in West Africa. In irrigated systems, aquaculture is a non consumptive use of water that can increase water productivity. Pens and floating cages are often used to grow fish in the source, delivery and disposal subsystems of irrigation schemes (dams and canals). Rice fish farming is the most common form of aquaculture in the use subsystem of irrigation schemes. Continuity of water supply, the effect of aquaculture on water conveyance

and the use of agrochemicals are the main points of attention for aquaculture in irrigation systems.

Apart from irrigation schemes, river floodplains and deltaic lowlands also offer opportunities for integration of aquaculture. By enclosing parts of these flooded areas and stocking them with aquatic organisms, food production can be enhanced. Examples of community based rice fish culture in Bangladesh and Viet Nam show that fish production can be increased by 0.6 to 1.5 tonnes per hectare annually. Another example is the use of seasonal ponds in the wetlands surrounding Lake Victoria (East Africa) which are stocked with water and fish by natural flooding and are managed using locally available resources like animal manures and crop wastes.

Following the first three chapters which set the stage for IIA in West Africa, the fourth chapter presents a review of IIA systems in 13 West African countries which demonstrates the considerable potential for further development. Traditional marsh aquaculture systems exist in many West African countries and should be developed further, together with fish culture in irrigation schemes. The following chapters deal with current practices and constraints in Burkina Faso, Mali, Niger, Nigeria and Senegal. In addition, examples of development approaches in C6te d'Ivoire and Guinea are given. Concepts of economic analyses of IIA are reviewed and illustrated through an example of integrated aquaculture in Madagascar. This is followed by an overview of regional and international research institutions and networks. The final two chapters summarize the key factors for successful adoption of IIA participation of stakeholders and support for local development; an integrated, multisectoral approach to IIA; and improved knowledge management and networking and indicate the way forward in the form of a proposal for IIA development in West Africa.

For more information, please contact Matthias Halwart of FIRI at:  
e-mail: [Matthias.Halwart@fao.org](mailto:Matthias.Halwart@fao.org)



NACA. 2005. *The Way Forward: Building capacity to combat impacts of aquatic invasive alien species and associated transboundary pathogens in ASEAN countries*. Final report of the regional workshop, hosted by the Department of Fisheries, Government of Malaysia, on 12<sup>th</sup>-16<sup>th</sup> July 2004, NACA, Bangkok. 352p.

This report contains the papers presented and outcomes from the workshop "Building capacity to combat impacts of aquatic invasive alien species and associated transboundary pathogens in ASEAN countries, hosted by the Department of Fisheries, Government of Malaysia, on 12<sup>th</sup>-16<sup>th</sup> July 2004. The workshop was generously supported through a US State Department grant, implemented by NACA, hosted by the Government of Malaysia Department of Fisheries and co-sponsored by several agencies such as ASEAN, FAO, and the World Fish, and supported by other partners such as AIT, CAB International, OIE, SEAFDEC-AQD, Deakin University, Universiti Putra Malaysia, Mahidol University and AusVet Animal Health.

- Part 1 contains the proceedings of the Workshop
- Part 2 contains 19 resource papers and case studies
- Part 3 contains Country Papers from ASEAN countries, i.e. Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Viet Nam.

The participants concluded that aquatic invasive alien species (IAS) and invasive aquatic animal pathogens significantly impact the aquaculture industry in ASEAN, and can have negative implications for aquatic biodiversity, and the social and economic well being of people in the ASEAN region. Participants also recognized the positive social and economic benefits that have come from the introduction and farming of some alien aquatic species in the region. Participants agreed that the way forward is to minimize the risks and costs associated with negative impacts of aquatic IAS and aquatic animal pathogens whilst capturing the social and economic benefits possible through responsible aquaculture of alien species. (See also related article at FAN 32 – December 2004).

See articles of FAO staff:

Aquatic alien species and their contribution to aquatic production, food security and poverty alleviation: an overview of data from ASEAN countries by D.M. Bartley, V. Crespi, I.J. Fleischer and R. Subasinghe.

Movements of economically important penaeid shrimp in Asia and the Pacific by S Funge-Smith, M. Briggs, R. Subasinghe and M. Phillips.

Molluscan pathogens of concern to ASEAN by M.G. Bondad-Reantaso and F.C. Berthe.

For further information, please contact the Network of Aquaculture Centres in Asia-Pacific (NACA) at [naca@enaca.org](mailto:naca@enaca.org)

FAO/Regional Commission for Fisheries. 2006. Report of the second meeting of the Working Group on Aquaculture. Muscat, Oman, 29-30 November 2005. *FAO Fisheries Report*. No. 790. Rome, FAO. 65p.

The second meeting of the Working Group on Aquaculture (WGA) of the Regional Commission for Fisheries (RECOFI) was held in Muscat, Oman, from 29 to 30 November 2005 and was attended by experts from all the members of the Commission. The WGA reviewed the decisions and recommendations of the third session of the Commission held in Doha, Qatar, from 9 to 11 May 2005, and the activities of the WGA that followed. Among the activities, the experts acknowledged that progress had been made with regards to the technical arrangements that would lead to the preparation of the RECOFI Regional Aquaculture Information System (RAIS). However, it was noted that the system could not be developed as the budgeted funds had yet to be submitted by the hosting country. In this regard, the expert from Kuwait reconfirmed the commitment and willingness of its Government to host and finance the system and that the funds would be submitted by the end of the calendar year. The delay of remitting the funds was due to internal procedures involving different national authorities. It was agreed that should there be a further delay the system would be hosted by the Islamic Republic of Iran. The WGA acknowledged that the legal and policy framework project proposal remained a major regional priority and agreed to actively seek funding support from the Commission members as well as to approach regional donor agencies through the coordination of the RECOFI Secretariat. Other activities discussed at the meeting included the introduction of exotic species to the region and the preparation of a regional technical workshop on marine stock enhancement and artificial reefs. The WGA reviewed and adopted the structure of the technical guidelines for the control and responsible use of alien species in fisheries and aquaculture drafted by the Fisheries Department of the Food and Agriculture Organization (FAO) and other organizations in support of the Code of Conduct for Responsible Fisheries (CCRF).

This publication can be downloaded in pdf at the following website:

<ftp://ftp.fao.org/docrep/fao/008/a0386e/a0386e00.pdf>

FAO/General Fisheries Commission for the Mediterranean. 2006. Report of the Experts Meeting for the Re-establishment of the GFCM Committee on Aquaculture Network on Environment and Aquaculture in the Mediterranean. Rome, 7-9 December 2005. *FAO Fisheries Report*. No. 791. Rome, FAO. 60p.

The Experts Meeting for the Re-establishment of the (General Fisheries Commission for the Mediterranean) GFCM Committee on Aquaculture (CAQ) Network on Environment and Aquaculture in the Mediterranean (EAM) was held in Rome, from 7 to 9 December 2005. The meeting was attended by 13 experts from the region. The EAM Network, created in 1992 following the Mediterranean Regional Aquaculture Project (MEDRAP), ceased to operate as an effective network in 1996. The present experts meeting took place following a decision by the GFCM at its twenty ninth session. The meeting was called to update the terms of reference of EAM and identify short and medium term activities. The experts suggested that EAM be re-established as a subsidiary body of GFCM CAQ. It was envisaged that the restructured EAM would work through the following four working groups dealing with:

- (i) harmonization of environmental regulation and standards for aquaculture;
- (ii) scaling aquaculture environmental interactions;
- (iii) integrating aquaculture within a coastal zone management framework; and
- (iv) public perception of aquaculture in relation to environment.

This publication can be downloaded in pdf at the following website:

<ftp://ftp.fao.org/docrep/fao/009/a0466e/a0466e00.pdf>

Coche, A.G. (comp.) 2006. An indexed list of FAO publications related to aquaculture, 1964-2005. FAO Fisheries Circular. No. 924, Rev. 2. Rome, FAO. 111p.

A bibliographical list of about 970 FAO documents related to aquaculture and published during the period January 1964-November 2005. Their availability online on Internet and/or in pdf format (since 2001) is given as well as additional information on Web sites of interest (42) and available CD-ROMs (15). Author, geographic, taxonomic and subject indexes provide further assistance in locating the information required.

This publication can be downloaded in pdf at the following website:

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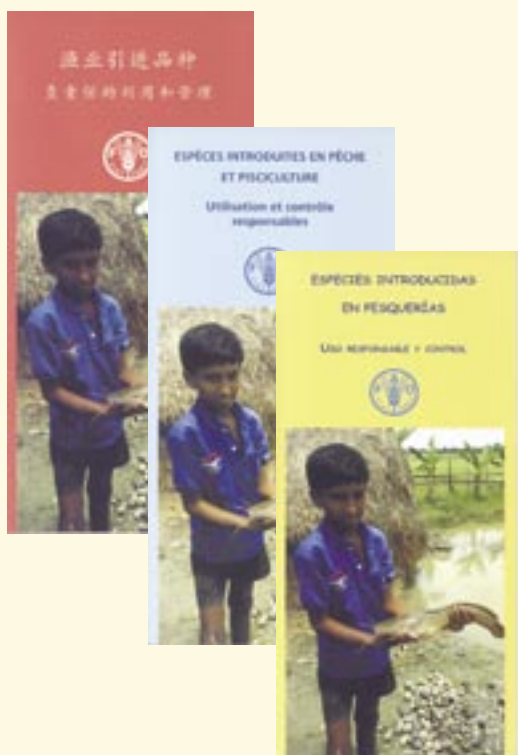


FAO Fisheries Technical Paper 476: Introductions and movement of two penaeid shrimp species in Asia and the Pacific are now available in Spanish and Chinese languages.

Other recent publications in Chinese languages are:

FAO Fisheries Technical Paper 428: Farming freshwater prawns: A manual for the culture of the giant river prawn *M. rosenbergii* by Michael B. New.

FAO Fisheries Technical Paper 451: Surveillance and zoning for aquatic animal diseases by Rohana P. Subasinghe, Sharon E. McGladdery and Barry J. Hill (editors).



Introduced Species in Fisheries: Responsible Use and Control - a brochure presenting some socio-economic impacts, biodiversity impacts of Alien species, what decision-makers and FAO can do, are now available in French, Spanish and Chinese languages

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Halwart, M. and Moehl, J.F. (eds). 2006. Cage culture in Africa. Proceedings of the FAO Regional Technical Expert Workshop held in Entebbe, Uganda. 20-23 October 2004. FAO Fisheries Proceedings 6. Rome, FAO. 104p.



# FAN

## **FAO Aquaculture Newsletter**

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