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FAO Aquaculture Newsletter

Cultured Indian major carp *Catla catla* (Photo courtesy of FAO Regional Office for Asia and the Pacific)

FAO AQUACULTURE NEWSLETTER FAO AQU
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Who Gives a Dam?

I would like to take this last opportunity, as recent Programme Manager of ALCOM (Aquaculture for Local Community Management), to discuss an important topic with FAN readers. Before beginning my subject, I would like to to thank all of you for your keen interest in the ALCOM Programme. Over the past two years, ALCOM has grown into a truly broad-based aquatic resource management programme. Through this evolution, the Programme has received the support of many within and outside the organization, support for which I am very grateful.

Now, on with my dam subject. Before my indoctrination I considered dams pretty simple things. Not dams like Kariba of course, but your run-of-the-mill earthen impoundment of a dozen or so hectares didn't seem too problematic. Not so.

There is first and foremost the issue of ownership — ownership of land and ownership of water. By design the dam is blocking downstream flow. What of the rights of downstream inhabitants to what may amount to usurped water? What of the rights of communities bordering the newly formed water body versus the rights of a government agency funding the construction of the dam itself? Many of these proprietary issues will find their solutions in the statutes and regulations of the governmental entity involved. Nonetheless, they should be considered before and not after the fact.

I have been discussing the ownership of dams as though it only involved the site of the planned impoundment and the impounded water itself. Obviously it is much more. The dam corresponds to a watershed, often with orders of magnitude larger area. Everything that happens on this watershed, all land use affects the quality and quantity of water in the dam and, to a certain extent, dictates what uses the dam may have. Watersheds may touch scores of communities and the harmonization of interests can be daunting.

Now, let's say you have mastered all these issues; water and land rights clearly delineated, responsibilities assigned and stakeholders identified. Is the worst over? No it is not. There is still the major task of working with the stakeholders to form a cohesive group with a clear management structure and operational priorities. How is the water and the dam to be used?

At pilot project sites of the ALCOM Small Water Bodies Project we frequently encountered opposing views and priorities for the same resource. One faction favouring safeguarding the water for domestic use insisted on regulations that forbid any one from entering the dam to a depth above the knee. Others who wanted to promote hook-and-line fishing for all proclaimed that fishers must enter into the dam to for some distance to be able to fish away from shoreline vegetation. Still others declared the dam should be used by organized fishing groups using canoes and gill nets to better exploit fish stocks. All three groups were at odds with the cattlemen who wanted to water their herds at the dam — the cattle eroding the dikes and muddying the water to the detriment of both consumers and fishers.

This is not to say dams should be avoided due to their socio-cultural complexities. As witnessed by the 11,000 dams in Zimbabwe, inventoried in the ALCOM Water Resource Database, impounded water is critical to maintain the quality of life. Urban Harare as well as the smallest communities rely upon impounded water for their existence; water to drink, water for animals, water for gardens and water in which to fish.

In recognition of the importance of impounding water, governmental and non-governmental agencies across southern Africa have been rapidly building dams. The lessons of the early 90s were hard taught and all now know how devastating water shortages are. However, the point is this: building the dam is the easy part. Having the dam function as an integral part of community life is more difficult. To be able to take a holistic approach to resource management is more easily said than done. ALCOM's experiences have gone a long way to establishing methodologies for analysing the problem and suggesting solutions. I hope these experiences can benefit others who are planning to give a dam.

John Moehl
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CREATING AN ENABLING ENVIRONMENT FOR SUSTAINABLE AQUACULTURE

This article is reprinted from The State of World Fisheries and Aquaculture[1]
It is based on an article prepared by
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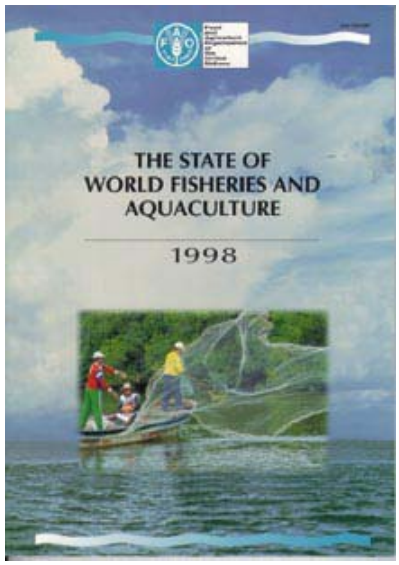
THE ISSUE

Few countries have appropriate legal frame-works and policies for aquaculture. Often, compre-hensive policies and associated legal frameworks have been overlooked because develop-ment has been seen mainly in technical terms and support has been largely focused on technical aspects of production. Also, policy-makers have often treated aquaculture in isola-tion from other sectors, thus ignoring important linkages, including externalities. The need to incorporate political, economic, social, environmental and legal aspects has been neglected, usually with negative consequences for the sector. The recent emergence of industrial aquaculture, the growing competition for resources and the continuing rapid growth of the sector have focused attention on the need for policy measures and regulatory frameworks.



It is essential that appropriate operational conditions are established at all levels (international, regional, national, local and farm) to help make the exploitation of aquaculture in a sustainable manner attractive to farmers, fishers and other entrepreneurs. Governments need to create and maintain a suitable climate for sustainable growth of the sector, i.e. they need to provide an "enabling environment". Such an environment comprises economic, legal, social and physical components and should ensure, *inter alia*, fair access to resources, mechanisms for conflict resolution and access to information, credit and markets. This presupposes that there are functioning channels of commu-nication with institutions and representatives of other competing sectors of the economy.

In creating an "enabling environment", it is essential to strike a balance between the need for development and growth and the need for ecosystem conser-vation. In this context it is necessary to recognize and deal with the increasing competition for resources. The diminishing role of the public sector as a promoter of development and the globalization of markets must also be taken into consideration.

POSSIBLE SOLUTIONS

The complex task at hand is to put the principles of the Code of Conduct for Responsible Fisheries into operation; i.e. to clarify how sustainability choices might work in practice; to incorporate the Code's principles into development policies and plans; and to elaborate specific codes of responsible practice containing norms, standards and guidelines agreed on by all stakeholders. Given the diversity of aquaculture practices and of the political social and economic conditions in which they take place - not to mention the different perceptions of sustainability - balanced and informed approaches are required to address developmental and environmental issues

effectively at any one location. Furthermore, the applicability of various approaches needs to be assessed carefully, particularly where many small-scale farmers are involved and also in view of the often highly decentralized nature of the aquaculture industry.

Existing administrative and legal frameworks need to be reviewed and adjusted to address the specific characteristics and needs of the sector and to set forth clearly the privileges and responsibilities of aquaculturists. However, because aquaculture is frequently regulated by many agencies under a variety of laws, developing a comprehensive regulatory framework for the sector is often legally and institutionally complex. Typically it involves drafting or amending legislation that addresses a variety of issues and establishing institutional arrangements to ensure the cooperation and coordination of many different institutions with jurisdiction over natural resources, animal and public health, environment, etc.

Although new national laws to regulate aquaculture comprehensively may be desirable in many countries, other options are now being explored because developing and passing new comprehensive legislation often takes several years, while the prospect of rapid development of the sector has created an urgent need for regulation. These options include the enactment of regulations under existing legislation, and voluntary approaches such as guidelines and codes of practice.

The formulation of appropriate regulations in many countries is constrained by a shortage of information on the interaction of aquaculture production systems with the environment and on the environmental and financial efficiency of alternative approaches to production management. Even where information is available, reliable predictive models for aquacuIture-environmental interactions still require considerable improvement with regard to their accuracy, general applicability and affordability.

There is also an associated need to strengthen institutional capacity to manage the sector and to expand the knowledge base in order to enable sustainable development policies and plans. There is a general recognition of the need for interdisciplinary and intersectoral approaches to development and resource management in aquaculture. Moreover, it is becoming increasingly clear that sustainable aquaculture development cannot be regulated solely by governments but must involve many interest groups at the national, regional and international levels, including new institutional arrangements and partnerships (consultative frameworks). This is being highlighted by ongoing structural change, namely privatisation and the contraction of governments' role in development.

Consequently, there is a growing and urgent need to create new knowledge and to synthesize information from a broad spectrum of disciplines so that decisions can be based on a much broader perspective and understanding. It is also important to ensure a flow of information among different sectors and interest groups.

International trade, including in aquaculture products, is governed, *inter alia*, by the Agreement on the Application of Sanitary and Phytosanitary Measures (the SPS Agreement). This agreement recognizes the right of World Trade Organization (WTO) members to apply legitimate measures to protect the life and health of their populations from hazards in food, but stipulates that these measures must not be unjustifiably trade-restrictive. SPS measures must be based on risk assessment, taking into consideration the techniques being developed by relevant international organizations. In regard to food safety, the relevant international body is the FAO/WHO Codex Alimentarius Commission (CAQ) in regard to animal (including fish) health and disease, the relevant organization is the International Office of Epizootics (OIE). International safety standards and procedures specific to aquaculture products are increasingly being developed in the context of these instruments. It is important to note, for example, that application of the Hazard Analysis and Critical Control Point (HACCP) system to fish processing operations is becoming mandatory in a number of countries. The application of the same system to large-scale and/or intensive aquaculture production systems is currently being explored and applied in some countries. However, use of the HACCP system in smallscale and subsistence aquaculture is far from a reality at present, as the application of aquatic animal health and disease control regulations is constrained by poor diagnostic capacity (including trained human resources, standardized diagnostic techniques and infrastructure) in many developing countries as well as a lack of reliable information on pathogens and diseases of concern to traded species.

In regional and international trade in aquaculture products, friction over differences in environmental standards among countries is best attenuated through improved coordination and harmonization. If environmental standards are to be raised over time, countries - particularly those with less demand for environmental goods - will need to be encouraged to raise their standards through a variety of appropriate support

mechanisms, for example guarantees for expanded access to the markets of countries with higher standards.

The expected increase in competition for, and regulation of natural resources clearly calls for greater production efficiency and the conservation of critical inputs. This should be a priority topic for systems research. Efficiency in resource use may also be achieved by integrating aquaculture with irrigation systems and agriculture as well as by utilizing inland surface waters and floodplains for certain forms of aquaculture production.

New forms of integrated aquaculture agriculture systems as well as other innovative systems that can effectively respond to resource and environmental challenges need to be developed. In this connection, attention should be given to resolving the economic and environmental challenges of stock enhancement and ranching as well as of offshore cage culture.

The reduced role of government in financing fisheries and aquaculture has resulted in the cessation of public support to resource-poor fish farmers, the negative effects of which may be counteracted by special policy instruments designed to promote training and equitable income distribution and to facilitate access to information, credit and inputs needed in production.

RECENT ACTIONS

The Code is beginning to have a worldwide influence on the development of an enabling environment for sustainable aquaculture; however, much remains to be done. More progress can be expected as guidelines are developed on how to strike a balance among economic, social and environmental concerns, how sustainability choices apply in practice and how to analyse the economic cost of resulting actions.

Certain states have initiated national measures such as workshops to promote the Code and some NG0s, including producer groups, have developed or are developing codes of conduct and practice for particular aspects of aquaculture. Examples of these are: an implementation plan for the code for marine fisheries and marine aquaculture in the United States[2]; a code of practice for mangrove protection by the Global Aquaculture Alliance (GAA)[3] ; a code of practice for Australian prawn farmers[4]; codes of practice for cage culture of finfish and pond culture of shrimp in Malaysia[5]; and guidelines for sustainable industrial fish farming[6].

Over the last few years, there has been a growing interest in many countries to develop a comprehensive regulatory framework for aquaculture that will protect the industry, the environment, other resource users and consumers. This interest is being driven by a variety of factors, including: greater political attention as the economic importance and potential of aquaculture become more apparent; greater awareness that inappropriate laws and institutional arrangements can significantly constrain the development of the sector; evidence of environmental damage and social disruption as a result of rapid and largely unregulated expansion of some high-value species in certain coastal areas; and a growing emphasis on assuring the quality and safety of aquaculture products in international trade. Some of these issues were debated at an FAO Technical Consultation on Policies for Sustainable Shrimp Culture, held in Bangkok at the end of 1997.

Progress is also being made in the establishment of legal and regulatory frameworks for aquaculture in individual countries. Among these are Bulgaria, Cyprus, Madagascar, Malaysia, Mozambique, Papua New Guinea, Sri Lanka and Suriname. The Government of India has set up an Aquaculture Authority, which will license the adoption of improved technology for increased production and the establishment of new farms within and outside the Coastal Regulation Zone. In India, the Tamil Nadu Aquaculture (Regulation) Act of 1995 sets out conditions to improve siting and management of aquaculture facilities and establishes an Ecorestoration Fund, supported by deposits from aquaculturists, to remedy environmental damage caused by aquaculture farms.

Concerning quality and safety of aquaculture products, FAO is currently involved in revising the FAO/WHO Code of Hygienic Practice for the Products of Aquaculture under the auspices of the Codex Committee on Fish and Fishery Products. International meetings continue to be held as part of efforts to develop risk analysis for food safety, synthesize and to disseminate information on food safety (including food production from aquaculture) and address any related issues[7].

Meetings focused exclusively on aquaculture have covered subjects such as the use of chemicals[8], environmental impacts of coastal aquaculture[9] and food safety issues associated with products from aquaculture[10].

In the United States, the industry and government have succeeded in developing comprehensive HACCP plans for cultured catfish, crayfish and molluscs. A similar approach is being

introduced in Australia, Chile, New Zealand, Norway and Thailand. The EC currently imposes detailed conditions on the handling, slaughter, inspection, processing, packaging, identification and storage of fishery products[11], and applies stringent controls to the animal health conditions applicable to the marketing of aquaculture animals and products[12]. FAO, the Network of Aquaculture Centres in Asia-Pacific (NACA) and OIE are collaborating to develop guidelines on aquatic animal quarantine and health certification to be applied in Asia when moving live aquatic animals.

There is increasing interest and hence a growing experience in the incorporation of aquaculture activities in resource management for coastal and inland areas. Integrated resource management forces long-term planning (e.g. through the designation of zones where different users will have priority), which provides predictability required for any long-term investment while also reducing conflicts among actual and potential users. A variety of tools are being used in the planning process, including: geographic information systems (GIS); predictive systems for assessing carrying capacity (particularly for finfish cage culture and mollusc culture); and environmental and social impact assessments.

(Drawing from BOBP 1999 calendar)

An example of what can be done to integrate aquaculture into resource use plans is provided by the Australian State of Tasmania. Under new legislation (notably the 1995 Marine Farming Planning Act and the 1995 Living Marine Resources Act), marine farming development plans must be designed to cover areas rather than sites, and broad community participation in the preparation of such plans is also provided for by laws. An environmental impact assessment must be carried out and a marine farming zone established before leases are granted to marine farms.

Progress towards participatory planning has been reflected in the growing participation of NG0s, farmers' associations, researchers and public officials in national, regional and international fora, particularly for the development of codes of practice and conduct and the formulation of regulations and legislation. There has also been progress in the development and testing of participatory rural appraisal (PRA) and rapid rural appraisal (RRA) methodologies, and of concepts and possible local structures for community management of resources.

GLOBAL PERSPECTIVES

Sustainable development is the overriding strategic issue and challenge to all economic sectors, including aquaculture, and will continue to be so in the foreseeable future. Issues of sustainability can be expected to change our perceptions of desirable forms of aquaculture development and management, and new ways of farming that strike a balance between food security and the environmental and resource costs of production will have to be adopted. In the future, and with the growing trend towards ecolabelling, the longstanding goal of producing particular species at competitive prices is, in itself, likely to be insufficient for realizing full market potentials. In the future, acceptable sustainability credentials will probably be as essential as quality and safety standards are today.

In the short term, the elaboration of legal and regulatory frameworks, particularly in developing countries, will be the probable outcome of local social pressure and environmental and public health standards associated with trade in aquaculture products (e.g. in the case of shrimp and Atlantic salmon). This development will provide a window of opportunity to begin the process of providing the sector with a specific identity in national development - which could eventually be expanded to cover the entire sector.

Politically, food production will remain an overriding priority, and intensification as well as diversification in food production will both constitute important approaches to development. The move towards intensification in aquaculture is evident in many countries, and this trend will probably continue. This will promote investment in research, which will eventually lead to improved production efficiency, as in the case of Atlantic salmon and American catfish. It will also enhance integration with agriculture for the compatible multiple use of resources and for the utilization of by-products and unconventional inputs in general. In industrialized countries, competition for quality freshwater and suitable production sites will lead to an increased use of recycling systems and to more intensive research in open sea aquaculture. The extent of the challenge to aquaculture development will depend on the nature and magnitude of available resources as well as on the existing competition for these resources and the aquaculture development policies adopted at the national level. Finally, increasing privatization and the contraction of the role of governments in development are likely to worsen the situation of resource-poor artisanal and subsistence fish farmers in the near-term unless specific action is taken to deal with this problem.

(Drawing from BOBP 1999 calendar)

[1] FAO, 1999. *The State of World Fisheries and Aquaculture* 1998. Rome, FAO. 112 pp.

[2] Government of the United States. 1997. *Implementation Plan for the Code of Conduct for Responsible Fisheries.* United States Department of Commerce, National Oceanic and Atmospheric Administration and National Marine Fisheries Service. 20 pp.

[3] Anon. 1997. Global Aquaculture Alliance formed to guide industry toward environmental sustainability. *World Aquaculture*, September 1997, p. 48.

[4] D.J. Donovan. 1997. *Environmental Code of Practice for Australian Prawn Farmers*. July 1997. 32 pp.

[5] O. Pawaputanon. 1997. *Manual for harmonization of good shrimp farm practice*. ASEAN Fisheries Network Project.

[6] Anon. The Holmenkollen Guidelines for Sustainable Aquaculture. In: *Proceedings of the Second International Symposium on Sustainable Aqualculture,* Oslo, 2-5 November 1997. Trondheim, Norway, Norwegian Academy of Technological Sciences. 9 pp.

[7] FAO. 1997. *Risk management and food safety. Report of a joint FAO/WHO Expert Consultation,* Rome, 27-31 January 1997. FAO Food and Nutrition Paper No. 65. Rome; and FAO. 1998. *Animal feeding and food safety. Report of an FAO Consultation,* Rome, 10-14 March 1997. FAO Food and Nutrition Paper No. 69. Rome.

[8] SEAFDEC/FAO/CIDA. *Report and proceeding of SEAFDEC/ FAO/CIDA Expert Meeting on the Use of Chemicals in Aquaculture in Asia,* 20-22 May 1996, Southeast Asian Fisheries Development Centre, Iloilo, the Philippines. (in preparation)

[9] FAO. 1997. *Towards safe and effective use of chemicals in coastal aquaculture*. GESAMP Reports and Studies No. 65, Rome. 40 pp.

[10] FAO/NACA/WHO. *Food safety issues associated with products from aquaculture. Report of a Joint FAO/NACA/ WHO Study Group on Food Safety Issues associated with Products from Aquaculture,* Bangkok, Thailand, 22-26 July 1997. WHO Technical Report Series No. 883. Geneva, WHO. (in press)

[11] Directive 91/493/EEC as amended by Directive 95/71/EC.

[12] Directive 91/67/EEC as amended by Directives 93/54/EC and 95/22/EC.

FAO E-MAIL CONFERENCE ON FISH TRADE AND FOOD SECURITY

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Even though the conference did not deal explicitly with aquaculture, many of the topics touched upon are highly relevant (export revenues and food security, eco-labelling, HACCP, food security obtained through aquaculture production for local consumption, etc.).

BACKGROUND

The FAO E-mail Conference on Fish Trade and Food Security (FTFS) was held between 19 October and 12 December 1998. The Conference had its genesis in a recommendation in 1997 of the FAO Advisory Committee on Fishery Research (ACFR) which identified three topics as deserving particular scrutiny: trade and food security; the distribution of benefits from trade; and barriers to international fish trade.

In response, FAO's Fish Utilization and Marketing Service (FIIU) commissioned three papers, one on each of the particular topics, and those papers were put forward as starting points for discussion in the e-mail conference:

- does international trade in fishery products contribute to food security ? (by John Kurien)
- distribution of benefits from international trade in fishery products (by Ragnvaldur Hannesson)
- barriers to international trade in fisheries (by Cathy R. Wessels).

There were over 150 persons on the list of participants, with a significant participation from developing countries. In all, there were 21 formal interventions, plus additional notes and comments from the Secretariat.

MAIN ISSUES DISCUSSED

The discussion centred quickly on various aspects of globalization and the implications for fish trade and food security. It became clear that there exist varied interpretations of food security, depending on level of aggregation: local, national, international, regional and global. The lack of a clear definition of "trade barrier" with its various implications was also addressed by many.

Certain topics stimulated more response than others. In particular, issues such as eco-labelling and HACCP, and the need for more market and product development were debated by many participants.

The key arguments stated were the following:

- Several participants stated that, in general, international trade could only marginally solve the food security problem, but that fish trade is necessary for food security for many landlocked countries. There is no firm evidence to show that fish exports are detrimental to food security in the export country as the products exported generally are different from those consumed locally. At the same time, there is no substantial evidence that fish export revenues substantially alleviate poverty problems in the exporting country. Several participants stated, however, that this aspect is more a problem related to distribution of benefits from trade rather than a problem inherent in trade as such.

- Several countries fear that their sovereign right to fishery management might be infringed by eco-labelling schemes. However, eco-labels may be attractive to consumers in some markets but it is in doubt whether consumers are willing to pay enough to cover the costs. If not, the costs will have to be born by producers. With 50% of fish exports coming from developing countries, this fact will have particular consequences for producers in these countries. Some participants stressed that eco-labels must in any case be considered just an additional tool in fisheries management, alongside more traditional measures.

Cultured seabream being prepared for export from Greece (Photo by Audun Lem)

- The introduction of mandatory HACCP schemes for fish exports to the most important markets has had consequences for exporters in developing countries. There was disagreement over whether HACCP can be considered a non-tariff trade barrier, as exporters are able to influence their own position and adapt to the new regulations. Several participants mentioned that trade barriers, even though lower than in the past, remain considerable in many parts of the world, especially for processed fish products.

- Several participants stressed the need for more research into the development of new products to satisfy low-income markets. There was disagreement over whether available processing techno-logies are insufficient for production of low-cost fish products or whether there are particular causes behind lack of distribution of available products, such as frozen pelagic species. Several participants urged a reduction in use of fish for non-food purposes and a reduction in discards.

- Some participants stressed that subsidies and overcapacity are problems in international fisheries,as are ill-defined property rights to resources in many countries.

RECOMMENDATIONS ARISING

It was recommended that the FAO Advisory Committee on Fishery Research consider the possibility of investigating the effects of trade in fish products on those individual countries that are thought to be at risk of uncertain food supplies.

It was recommended that FAO and other international, non-industry organizations attempt, within the resources available, to undertake more market research and stimulate further product development in low-cost fish products, including improvement of traditional production methods such as drying, smoking, curing and freezing.

CONFERENCE MODALITIES

Participants seemed satisfied with the format and operation of the conference, despite the limitations that it was conducted in English only, a fact that caused several comments. The e-mail conference format was regarded as a cost-effective way to reach a large, disperse and diverse group of persons with an interest in international fish trade and food security issues. The Secretariat requested suggestions for future activities related to the topic, and proposals were made for similar conferences on related topics. To reach more focused and profound discussions in each theme, suggestions were made to concentrate on one topic for each conference.

WHERE TO GO FROM HERE?

The primary output from the conference is the Proceedings. The commissioned papers, the material in the interventions, together with FAO in-house material, is expected to provide valuable input for further work in analysing the effects of globalization on fish trade and food security.

If funding can be found, FIIU envisions a second conference to take place in late 1999. Suggested possible themes for future conferences are:

- fish exports from developing countries in the light of the Agreements of the Uruguay Round;
- recent experiences by developing countries in adapting to changes in fish import regimes in major markets;
- the potential for increased regional fish trade with LIFDCs; and
- regional experiences in successful development of new low-cost fish products based on exploitation of improved production technologies.

Overview of inland fishery enhancements from a global perspective

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This article is a slightly edited version of the original in : FAO. 1999. *Review of the state of world fishery resources: inland fisheries.* FAO Fish. Circ. No. 942. Rome, FAO. 54pp.

Introduction

Most inland capture fisheries that depend only on natural production are exploited above or close to their sustainable maxima and as a result global capture fisheries production is increasing at a slow rate. Increasing pressure on the fishery resources, environmental degradation of aquatic habitats and poor fisheries management have contributed to this situation. Conventional fisheries management measures such as regulation of minimum mesh sizes, closed areas and closed seasons are used to counteract this situation, but these measures can be difficult to enforce. In such cases, other techniques can be used. These techniques can be collectively termed as enhancements and include various possibilities to intensify fishery production. These include:

- introduction of new species to exploit under-utilized parts of the food chain or habitats not colonised by the resident fauna;
- stocking natural waters to improve recruitment, bias fish assemblage structure to favoured species or maintain productive species that would not breed naturally in the system;
- fertilization to raise the general level of productivity and hence growth of the fish;
- engineering of the environment to improve levels of reproduction, shelter, food resources and vital habitat;
- elimination of unwanted species that either compete with or predate upon target species.
- constituting an artificial fauna of selected species to increase the degree of control and the yield from the system;
- modification of water bodies to cut off bays and arms to serve for extensive and intensive fish ponds to increase control and nutrient flows;
- introduction of cage culture and parallel intensification of effort of the capture fishery;
- aquaculture through management of the whole system as an intensive fish pond;
- genetic modification to increase growth, production, disease resistance and thermal tolerance of the stocked or cultured material.

Inland fishery enhancements are becoming a central theme in inland waters and are widely applied nowadays. The exact contribution of enhancements to the total inland capture fisheries production is difficult to estimate, but it is believed that many inland fisheries are supported by various forms of enhancement, often combined with conventional fisheries management practices.

FAO has been increasingly involved with the promotion of inland fishery enhancements; however, this is the first attempt to globally and comprehensively characterize inland fishery enhancements by taking into account enhancement types, their geographic distribution and the species employed. The results are summarized in the following sections.

Of the first four enhancement types mentioned above (i.e. introductions, stocking, engineering of the environment and fertilization), introductions and stocking are the most commonly applied (Table 1). Introductions and stocking programmes are mostly applied to lakes, reservoirs and rivers and less information is available on the enhancements of fisheries in other kinds of water bodies, although specific examples exist. There exist also a large number of small water bodies such as village ponds, and small irrigation tanks that have potential for enhancement. Stocking of fish in these smaller

water bodies has been generally more successful because these are easier to manage, do not require large amounts of stocking material and are often more productive. In contrast, introductions of new species with the aim to establish self-reproducing populations (auto-stocking) have been more effective to enhance fisheries in the larger water bodies.

Most enhancements are carried out to produce food and generate income (fisheries production), but also for the benefit of recreational fisheries, to restore collapsed fisheries and to control pests (aquatic weeds, mosquitoes).

Table 1. Available information on enhancements in Aquatic Sciences and Fisheries Abstracts [1]

Enhancement Type	No. of references in ASFA
Introductions	1355
Stocking	1274
Environmental Engineering	404
Fertilization	21

[1] ASFA was searched as follows: 1/1978 – 8/1996 for stocking; 1/1978 - 12/96 for introductions; 1/1978 – 6/97 for engineering and fertilization

World Perspective on Established Introductions

The most widespread introduced species that have established self-reproducing populations in open waters and globally contribute significantly to food production are Mozambique tilapia, common carp, rainbow trout, Nile tilapia and brook trout (Table 2). Mosquito fish and guppy have been widely introduced for mosquito control and grass carp for the control of aquatic weeds. The goldfish has been mainly introduced for ornamental reasons. The distribution of introduced species that established in the wild is given in Figure 1.

World Perspective on Stocking

With regard to stocking, common carp, rainbow trout, Atlantic salmon and brook/sea trout are relatively widespread as can be seen in Table 3. Most of the species in the table are stocked for food production, income generation and for recreational fisheries. Common carp and rainbow trout are also important introduced species that successfully established, but these species are also supported by hatchery production. The geographic distribution of stocked freshwater species is given in Figure 2. This figure is primary based on hatchery production data provided to FAO by its member countries, but for some countries with incomplete hatchery production data (e.g. China, Canada), species have been added on the basis of scientific literature.

Table 2. Introduced/translocated species that have established self-reproducing populations in the wild (Source: FAO Database on Introductions of Aquatic Species (DIAS))

Common Name	Scientific Name	No. of countries	Main Continents
Mozambique tilapia	*Oreochromis mossambicus*	59	Worldwide
Common carp	*Cyprinus carpio*	56	Worldwide
Mosquitofish	*Gambusia affinis*	41	Oceania, Worldwide
Rainbow trout	*Oncorhynchus mykiss*	41	Worldwide, North America (translocated)
Goldfish	*Carassius auratus*	39	Europe, Latin America, North America
Largemouth bass	*Micropterus salmoides*	35	Africa, Europe, Latin America, North America
Nile tilapia	*Oreochromis niloticus*	29	Latin America, Asia, Africa
Guppy	*Poecilia reticulata*	27	Oceania, Asia, Africa, Latin America
Brook trout	*Salvelinus fontinalis*	23	Europe, Latin America, North America (translocated)
Brown bullhead	*Ameiurus nebulosus*	21	Europe, North America
Grass carp	*Ctenopharyngodon idella*	20	Europe, North America

Figure 1. Geographic distribution of the number of introduced freshwater species that are established in the wild (Source: FAO Database on Introductions of Aquatic Species (DIAS))

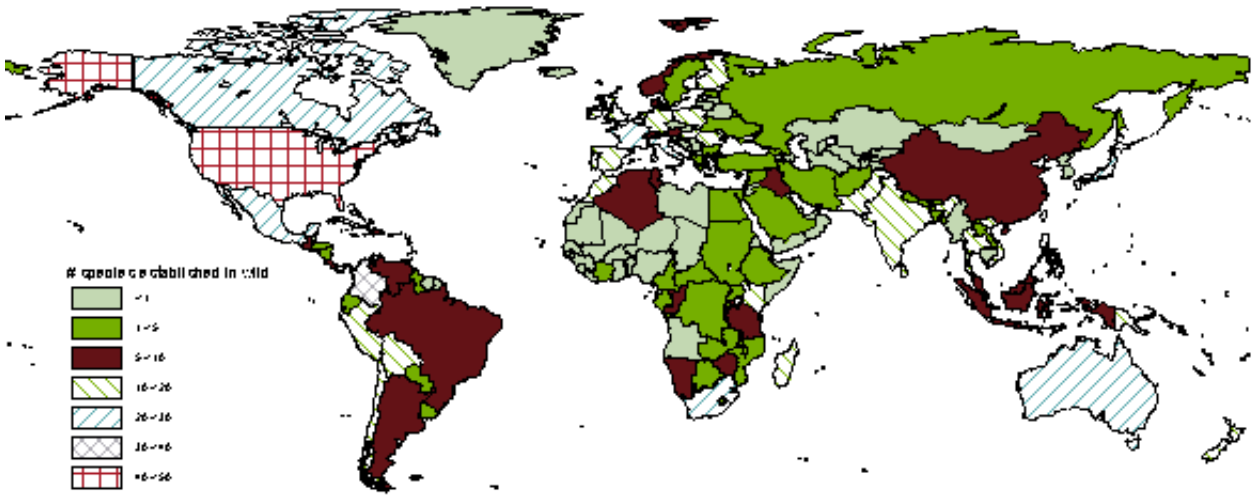


Figure 2. Number of freshwater species reported to FAO as produced in hatcheries and released into the wild (Source: FAO Hatchery Production Database)

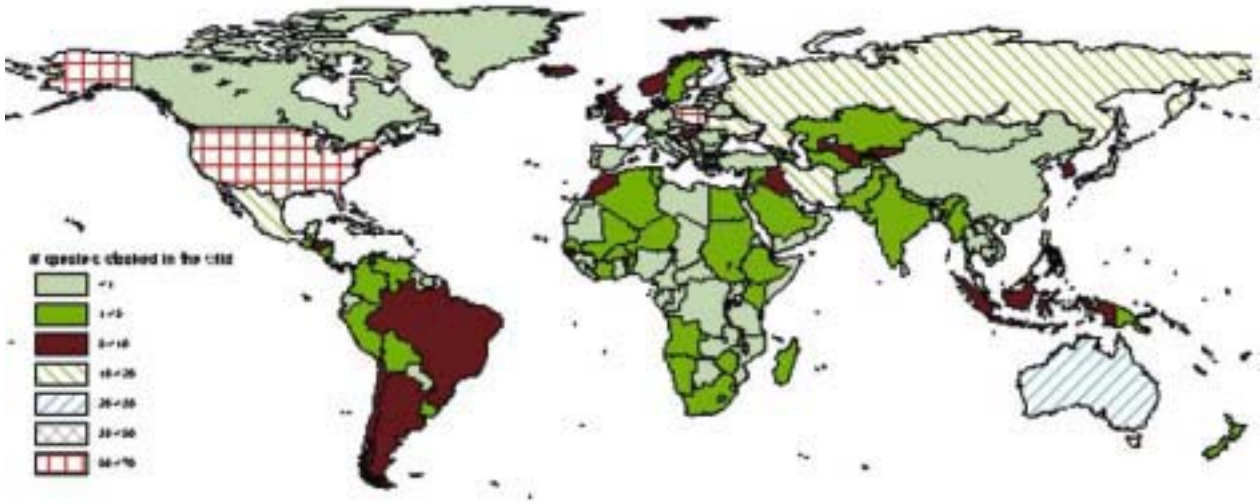
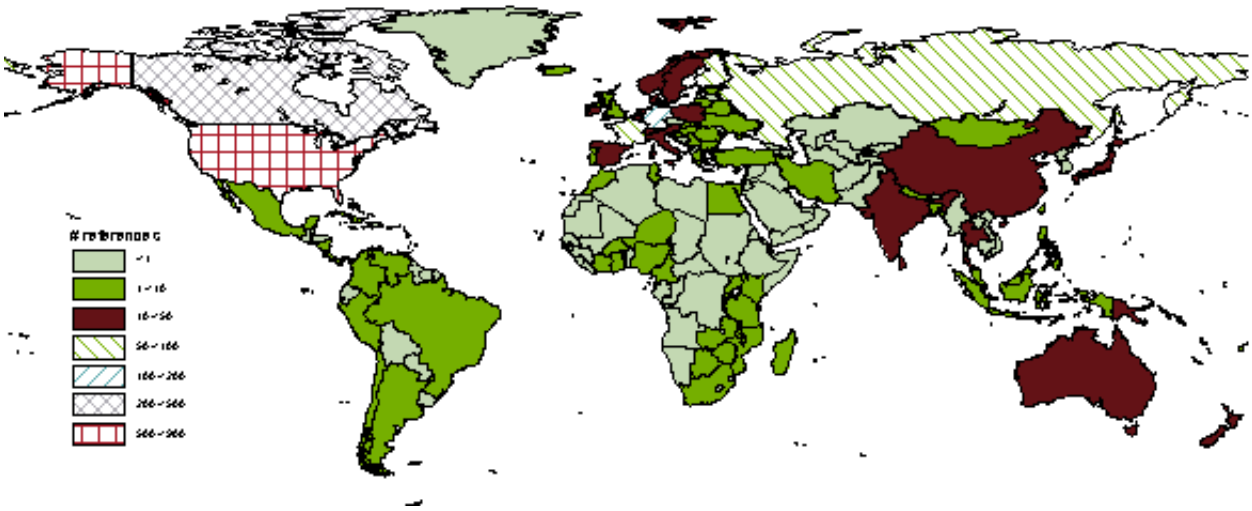


Table 3. Most commonly stocked freshwater species (Source: FAO hatchery production Database)

Common Name	Scientific Name	No. of countries	Main Continents
Common carp	*Cyprinus carpio*	44	Worldwide
Rainbow trout	*Oncorhynchus mykiss*	39	Europe, North America, Latin America, Africa
Atlantic salmon	*Salmo salar*	24	Europe, North America
Brook trout/sea trout	*Salmo trutta*	23	Europe, North America
Nile tilapia	*Oreochromis niloticus*	19	Africa, Latin America, North America
Pike	*Esox lucius*	17	Europe, North America
Grass carp	*Ctenopharyngodon idella*	16	North America, Asia
Silver carp	*Hypophthalmichthys molitrix*	15	Asia
Pikeperch	*Stizostedion lucioperca*	14	Europe, North America
Mozambique tilapia	*Oreochromis mossambicus*	10	Africa, Asia, North America

Figure 3. Number of ASFA references on introductions, translocations and stocking of inland waters (Source: FAO Inland Fishery Enhancements Database)



The United States, Poland, Australia, Finland, France, Iran and Mexico report the highest number of species.

The available information on stocking, introductions and translocations, derived from an extensive search in the Aquatic Abstracts and Fisheries Sciences database, shows that the highest number of references deal with North America, Europe and Russia (Figure 3). Various countries in Asia and Oceania (China, India, Australia, Thailand and Papua New Guinea) have a considerable information base. Published information in the ASFA database is relatively scarce for Africa and Latin America. However, as described in the previous paragraphs, these continents do have fisheries that are supported by stocked and introduced species. It is important that the results of such stocking programmes and introductions are published to allow further evaluation of these techniques.

In the following paragraphs, a brief overview is given for each region.

Asia and Oceania

A variety of species have been introduced to this region, mainly for the purpose of aquaculture. Many of these have established populations in open waters. Mozambique tilapia, common carp, rainbow trout and Chinese carps are important for commercial capture fisheries. For example, Mozambique tilapia established itself successfully in the larger reservoirs in Sri Lanka where it is now the main landed species (de Silva, 1988). This species also established itself successfully in many Indian reservoirs (Sugunan, 1995). Translocations of species within the country have created new fisheries in China. Most recently, icefish (*Neosalax taihuensis* and *Protosanlax hyalocranius*) was very successfully transplanted to various provinces of China. By 1997, the production reached 10 000 tonnes, of which transplanted icefish contributed as much as 8 000 tonnes (Miao, pers. comm.). Translocations of indiginous species have also been one of the major measures for enhancement of inland water bodies in Australia, mainly for the purpose of recreational fisheries (Petr, 1998). Introduction of Nile tilapia and common carp into larger reservoirs of the lower Mekong countries (Laos, Cambodia, Vietnam and Thailand) were generally successful whereas non-indigenous Indian and Chinese carps generally failed to establish themselves (Bernascek, 1997). Introduction of common carp in Indian reservoirs was not successful (Sugunan, 1997).

Stocking has yielded better results in the smaller water bodies, though relatively large lakes and reservoirs have been stocked successfully in China. Bighead carp and silver carp are the main species stocked in China (60-80% of the stocked species). Chinese carps, Indian carps, tilapias, common carp and rainbow trout are the most common species used for stocking in this region. Stocking of the indigenous species (silver perch, golden perch and Australian bass) are important for recreational fisheries in Australia. Environmental engineering practices are not described frequently, but they do exist. Cage and pen culture are widespread, notably in China, Indonesia and the Philippines. Other measures include screening of inlets and outlets, protection and construction of spawning habitats, re-establishment of floodplain-river connections and the construction of brush parks.

Africa

The majority of countries in Africa report introductions. The introduction of the Nile perch (*Lates niloticus*) has created a major commercial fishery with substantial economic and nutritional benefits (Reynolds and Greboval, 1988) but at the same time it is held responsible for disruption of the Lake Victoria ecosystem. It has been a controversial introduction. The successfull introduction of the Lake Tanganyika Sardine (*Limnothrissa miodon*) into Lake Kariba, Cahora Bassa and Lake Kivu (Marshall, 1991; Lévêque, 1998; Spliethof, 1983) has contributed significantly to fishery output.

Apart from these often referred to introductions, tilapias, common carp and rainbow trout have been distributed over this continent. Largemouth bass and sunfish have been introduced for recreational fisheries in 11 and 6 African countries respectively. About 23 species were introduced into Madagascar, of which 14 established in open waters where they contribute to commercial and sport fisheries (Moreau, 1986).

Information on stocking practices in Africa is relatively scarce. Stocking of small man-made reservoirs in Zimbabwe, of floodplain pools in Nigeria and of seasonal small water bodies in Burkina Faso (<50 ha) is reported. Stocking of larger water bodies is reported for Lake Nasser and Lake Quarun in Egypt. Overall, it can be concluded that stocking of open waters is not very common in Africa.

Other enhancements reported include the brush park fisheries in lagoons in Côte d'Ivoire and elsewhere in West Africa and hydraulic management in lagoons, but the information is very scarce.

Latin America

Tilapias have been widely introduced in this region and in many cases contributed significantly to fishery production (Juarez-Palacios and Olmos-Tomassini, 1991). Self-reproducing populations of tilapias were formed in lakes and reservoirs in Colombia and contribute significantly to the total fish production in the country (Castillo Campo, 1996). *T. rendalli* and *O. niloticus* form an important component of the fish catch in the reservoirs of northeast Brazil (Gurgel and Fernando, 1994) and in Cuba they are the main species in culture-based fisheries (see section on stocking). Common carp is also relatively wide spread in this region though they did not successfully establish in Northeast Brazil (Gurgel and Fernando, 1994). Salmonids (pacific salmon, brook trout) have been introduced to Chile and Argentina.

Stocking is practised in various countries, notably in Cuba (tilapia and Chinese carps in reservoirs), Argentina and Chile (salmonids), Brazil (tilapias in Northeast Brazilian reservoirs) and recently in Mexico (tilapias, common and Chinese carps in reservoirs). Cage culture is practised in reservoirs in Argentina and Colombia and experimentally in some other countries in the region. Information on environmental engineering as a tool for fishery enhancement in this region is not available from ASFA.

North America

Numerous species were introduced to this continent and a considerable amount of literature is available (697 references in ASFA). These mainly deal with invasions and the related environmental effects of various accidentally introduced species such as Zebra mussel (*Dreissena polymorpha*), ruffe (*Gymnocephalus cernuus*) and sea lamprey (*Petromyzon marinus*) into the Great Lakes area. Information on intentional introductions involve those of various species to enhance recreational fisheries in small impoundments. For example, in California, 30 exotic species were introduced to enhance recreational fisheries of which black bass, catfish (*Ictalurus* spp.), sunfishes (*Lepomis* spp.) and striped bass (*Morone saxatilis*) contributed 42 to 77 percent to the angling catch in this State (Lee, 1995). In Florida, butterfly peacock bass (*Cichla occelaris*) was introduced into 11 coastal canals, where it has established self-reproducing populations and contributes significantly to the sports fisheries in the area, without significant negative impacts (Schafland, 1995).

In Ontario, Michigan and New York States, introductions of Atlantic salmon (*S. salar*) into Lake Ontario were done to restore the population (Jones and Stanfield, 1993). Pacific salmon (*Oncorhyncus* spp.) was introduced in the tributary streams of Lake Ontario (Rand *et al*., 1992) and the introduction of white perch *(Morone americana*) was successful in that it has become a major commercial species (Haynes *et al.,* 1982). Small numbers of pink salmon (*O. gorbusha*) were released into Lake Superior in 1956 and have established significant populations (Bagdovitz *et al*., 1986). In Florida, blue tilapia (*Oreochromis aureus*) was accidentally released into public waters where it established itself successfully, resulting in a commercial fishery for this species (Hale *et al*., 1995).

S. fontinalis was successfully transplanted in four lakes in Ontario (Fraser, 1989) but it has not been translocated extensively in North America. Lake trout (*S. namaycush*) has been widely introduced also in response to declining populations due to the invasion of the sea lamprey. Evaluation of 183 introductions of this species in Ontario, showed that lake trout failed to establish in shallower lakes with large littoral zones and richer fish communities with potential predators (Evans and Olver, 1995). Rainbow trout has been introduced into Appalachian streams where it dominates native brook trout (Clark, 1997).

Stocking of largemouth bass, its prey species, bluegill and other sport fishes is widely practised in the United States for recreational fisheries. Steelhead (*O. mykiss*) is extensively released to enhance recreational fisheries in British Columbia. Furthermore, grass carp is stocked in the Southern states to control aquatic weeds and various salmonid species are stocked in the Western States to restore and enhance river stocks. Important stocked species with high reported hatchery production in North America are salmonids, pikeperch, striped bass, largemouth bass and bluegill.

Europe and the former USSR

Relatively complete information is available about introductions in the former USSR countries, Norway, Sweden, Finland, Germany, Italy and France. Introductions have been widespread in Europe. Important species are common carp, rainbow trout, pikeperch (*Stizostedion lucioperca*), peled *(Coregonus peled*), grass carp and lake trout (*Salvelinus namaycush*). European eel (*Anguilla anguilla*) is also widely released.

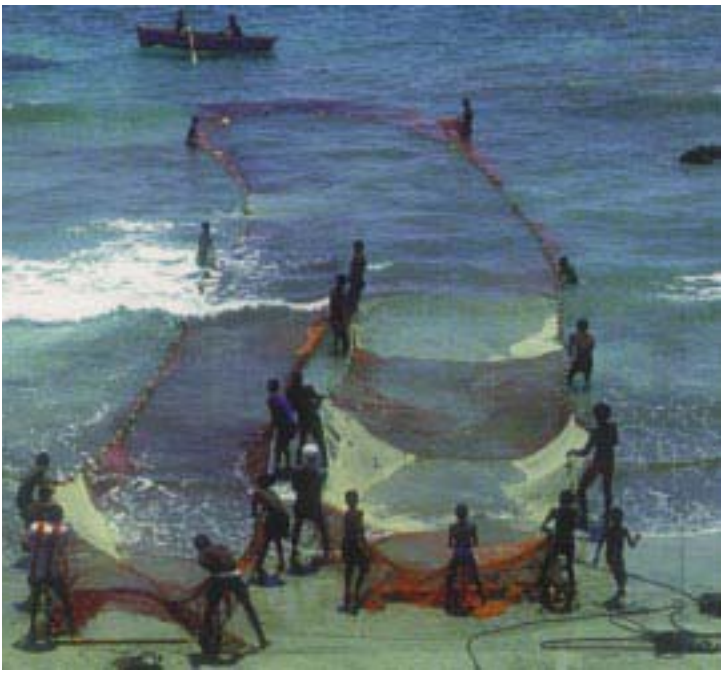
Chinese carps (grass, silver and bighead), bream (*Abramis brama*), common carp, pikeperch (*Stizostedion lucioperca*), wels catfish (*Silurus glanis*) and peled (*Coregonus peled*) have successfully adapted in former USSR lakes and reservoirs (Berka, 1990). Translocation of the sturgeon *Acipenser stellatus* from the Caspian Sea into the Azov Sea basin was ineffective as the introduced stock has an average body weight 13 percent less than the native Azov stocks (Tsvetnenko, 1993). Pikeperch was successfully introduced into Lake Vozhe (Bolotova *et al.,* 1995) and rainbow trout has been introduced in Irkutsk Reservoir (Angara R.) in 1992 and has become widely distributed in the reservoir. There is however a concern for the ecological consequences of this invasion and the probable diffusion of this species in Lake Baikal, where it has been recorded already (Shirobokov, 1993).

Vendace (*Coregonus albula*) was accidentally introduced to Lake Inari, a large oligotrophic lake in northern Finland in the 1950-1960's, and a significant fishery developed for this species (Mutenia and Salonen, 1992). In Norway, common carp has been widely introduced and is established in 30 lakes and ponds in southern Norway (Kaalaas and Johansen, 1995). Pikeperch was introduced in Norwegian Lake Gjersjoeen and changed the fish community from one dominated by roach *(Rutilus rutilus*) to one dominated by pikeperch (Brabrand and Faafeng, 1993). North American crayfish (*Pacifastacus leniusculus)* invaded the fresh waters of Sweden and Finland and is considered responsible for the decline in native noble crayfish (*Astcus astacus*) through competition and disease transfer (Soederbaeck, 1995).

Information on introductions in Germany mainly relates to introduced crayfish, ruffe and grass carp for recreational fisheries. Seventeen species have established in open waters in Germany, among them rainbow trout, white fish (*Coregonid* spp.), *Lepomis* spp., *Salvelinus* spp. and pikeperch. White fish species have also been introduced to Northern Italian lakes. Salmonids have been introduced to the high-elevation streams and lakes in the Pyrenees, France. Brown trout, rainbow trout, brook trout, lake trout and Arctic charr (*Salvelinus alpinus*) did acclimatize but only lake trout and Arctic charr reproduced in their new environment (Delacoste et al., 1997). These species contributed to the development of recreational fisheries in this region. Though Arctic charr is native to France, the introduced exotic species is more important, colonizing 136 lakes (Machino, 1996).

CONCLUSIONS

- Global characterization of fishery enhancements based on the information in ASFA abstracts is an effective means for classification of enhancement by types, water bodies and countries, but less useful for enhancement objectives and measures of success-failure as these require more in depth analysis.
- Stocking and introductions are the most commonly used fishery enhancement techniques in inland water bodies.
- Introductions and stocking are most often carried out for production of food and generating income. Enhancement for recreational fisheries is of secondary importance.
- Enhancement techniques to engineer the environment such as construction of fish attracting devices, fish sanctuaries and spawning habitats, fencing and restoration of floodplain-river connections are used, often with considerable success, but evaluations and reviews of these techniques are scarce for inland water bodies on a global scale. Most information about environmental engineering in the tropical regions relates to Asia.
- Information about fertilization of inland water bodies as an enhancement technique is very scarce on a global scale.
- Enhancement techniques, among the continental regions, are most diverse in Asia.
- Common carp, rainbow trout, Atlantic salmon, Nile tilapia and brook/sea trout are the species most commonly produced in hatcheries for stocking of inland waters on a global scale.
- Globally, introductions of Mozambique tilapia, common carp, rainbow trout, Nile tilapia and brook/sea trout have been important to enhance the production of fish for food and income.



- Introductions of tilapias have been relatively successful in large water bodies due to the fact that this species establishes self-reproducing populations. Although regular stocking of this species is practised world wide, it is not clear in many cases if stocking programmes significantly enhanced fishery yields.
- Translocations and stocking of indigenous species have been an effective measure to enhance recreational fisheries in Australia.
- Stocking practices are least widespread in Africa, introductions are however relatively important in this continent.
- The number of references on stocking and introductions in North America and Europe, including the former USSR, as noted from the ASFA literature, is significantly higher compared to the other continents.
- Introduction and stocking of grass carp for aquatic weed control has been generally successful.

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THE APFIC ad hoc WORKING GROUP OF EXPERTS IN FOOD SAFETY DISCUSSES THE SAFETY OF AQUACULTURE PRODUCTS[1]

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[1] *See related article in FAN No. 19, August 1998, p. 3-7.*

BACKGROUND

The Asia-Pacific Fishery Commission (APFIC) *ad hoc* Working Group of Experts in Food Safety held its first meeting at the FAO Regional Office for Asia and the Pacific, Bangkok, Thailand, from15 to 17 March 1999. The establishment of an *ad hoc* Working Group was agreed by the Twenty-sixth Session of APFIC, held in Beijing, Peoples Republic of China, in September 1998. The recommendation recognized the urgent need for a regional programme of research to address three serious emerging food safety issues associated with sustainable and safe fish production in the region. These issues are:

- human parasitic infestations caused by fish consumption;
- pathogenic (disease-causing) bacteria associated with fish products; and
- emerging safety hazards in the products of aquaculture.

In brief, the Working Group aims to encourage the formulation and conduct of a regional integrated research programme and to report progress to the 27th Session of the Commission. It is understood that the programme will require external funding (for which donor support must be found) and will be designed to:

- quantify current and potential health hazards and risks associated with consumption of fish products; and
- develop sustainable strategies to mitigate the effects.

Immediately following the Working Group meeting there was a specific workshop on the issue of parasitic infestations caused by trematodes. The workshop gave the opportunity for a detailed analysis of the problem and the formulation of a proposal for research.

TREMATODES

Trematodes or liver flukes are a source of widespread human infection resulting from eating raw or undercooked fish and shellfish. Fish-borne trematode disease is endemic over a large area of the world, including E and SE Asia and Russia. WHO indications are that more than 50 million people may be suffering, including more than 10 million each in both China and Thailand. Although the disease is seldom fatal, trematodes can cause serious complications in humans leading to fatalities.

Trematodes are leaf-shaped flatworms (flukes) that have very complex life cycles, generally involving two intermediate hosts, (snails and freshwater fish). Humans become infected through the ingestion of viable encysted metacercareae of the parasites, which are generally found in the flesh of freshwater fish. The life cycle is perpetuated by the constant supply of eggs, shed in human and animal feces, which are taken up by snails. Cercareae released by the snails penetrate the gills and under the scales of fish and encyst in the muscle as metacercareae. The life cycle can be interrupted by not allowing sewage contamination of water bodies and not using nightsoil as fertilizer in aquaculture. Alternatively consumers should avoid eating raw freshwater fish and ensure that what is eaten is properly cooked. While these measures may appear to offer simple solutions, it has proved difficult to change ingrained food habits and there is a tendency to rely on controlling the problem with the effective drugs that are available. However, the cost of these drugs puts them beyond the reach of poor consumers. The role of HACCP in controlling the disease was discussed. While this may be possible in the production phase of industrialised aquaculture it would be difficult, if not impossible in integrated aquaculture systems and in the wild. Control of the disease requires more research on

the epidemiology of infection, better means of identification of infested fish and better diagnostic methods.

Of the trematode liver flukes, *Clonorchis sinesis* is endemic in China, Japan, Korea and Vietnam, while *Opisthorchis viverrini* infests Southeast Asia and *Opisthorchis felineus* is found in Russia. The flukes attach to the bile ducts and cause damage, gastro-intestinal problems, jaundice and fatigue. There is also an associated increase in liver cancers. Cyprinids, the major source of freshwater fish both from capture fisheries and aquaculture, are very commonly implicated as the intermediate fish host. Lung flukes caused by a number of *Paragonimus* species are found in China, Republic of Korea and Viet Nam. The second intermediate hosts are freshwater crayfish and crabs that are often eaten raw, lightly cooked or pickled.

PATHOGENS

Despite the low incidence of food poisoning caused by fish, the safety of fish products carrying bacteria and viruses that are recognized as human pathogens is often questioned. A wide range of organisms has come under suspicion as a result of their isolation by the regulatory authorities of the countries that provide the largest markets for fish products. The list of organisms includes: *Vibrio cholerae, V. parahaemolyticus, V. vulnificus, Salmonella, Shigella, Listeria monocytogenes,* pathogenic varieties of *Escherichia coli, etc.* While the isolation of these organisms in importing countries is considered to be a result of unhygenic handling and processing, some of them may be indigenous in the tropical aquatic environment from which the product came. To ensure food safety it is important to understand which of the organisms are indigenous and which are contaminants. For example there is a lot of scientific evidence to indicate that *V. cholerae* makes up part of the normal flora of the aquatic environment and can be detected even from waters that are not fecally contaminated. This has been demonstrated in the eastern United States and in the United Kingdom, in addition to tropical areas. Only two cholera serotypes (*V. cholerea* 01 and 0139) have been shown to cause the disease and these strains, which produce cholera toxin, are genetically different. Polymerase chain reaction (PCR)-based methods have been shown to be useful in detecting the genetic differences between strains.

Salmonella has previously been of greatest concern, particularly to the USFDA which has consistently maintained a zero tolerance for the organism, claiming that its presence is always the result of fecal contamination as *Salmonella* is not indigenous to the aquatic environment. However, there is increasing evidence that, even in catfish ponds in the United States and eel ponds in Japan, *Salmonella* is naturally present in the environment. The presence of *Salmonella* has previously been convincingly demonstrated in shrimp culture ponds in SE Asia and the coastal environment in India. However, most of these indigenous aquatic strains belong to the serotype *S. weltevreden*, which is not commonly associated with human infections. As further evidence to support the case for removal of the zero tolerance it would be useful to determine whether such aquatic strains possess the potential to cause disease in humans.

EMERGING FOOD SAFETY HAZARDS FROM AQUACULTURE

Although products from marine capture fisheries in the region have a generally good history of safety there are concerns that with increasing intensification of aquaculture new problems may arise. Assurance of the safety and quality of the products is therefore vital.

Potential problems in the domestic markets could occur through trematode infestation, sustained by the use of human and animal wastes for fertilization and the continuation of traditional food habits. While modern industrial aquaculture, with control over all the inputs, is not implicated as a route of infection there are obvious risks from the uncontrolled use of nightsoil and manure in simple integrated systems.

High value products, such as those for export, are produced under controlled conditions but still the problems of the presence of pathogens and their virulence need to be addressed. Of particular concern is the emergence in recent years of a pattern of resistance to antibiotics by disease causing organisms. Although there is little direct proof, in the minds of many, the increasing frequency of resistance has been associated with the excessive use of antibiotics in intensive aquaculture systems. In the past, they were used prophylactically in the feed and, although today use has decreased, large quantities are still employed for the purposes of controlling fish health. The resistance can be transferred both to fish pathogens and human pathogens, causing

eventual difficulties in chemotherapy. Although it has yet to be established whether the emergence of antibiotic resistance is due to aquaculture practices (there is also widespread misuse of antibiotics in the medical and veterinary fields) the extent of the responsibility of aquaculture needs to be studied.

RESEARCH PRIORITIES

The first requirement was recognized as a need for better communication at regional and international levels. There are opportunities to achieve this by making use of the SIFAR OneFish Community Directory, currently under development, where an individual or institute takes on the responsibility of editing that part of the web site devoted to a specific topic.

Within the area of research into pathogens a planning workshop will be held to develop the following research projects:

- studies on the serotypes of pathogens in the aquatic environment and development of an understanding of whether they are indigenous to that environment and also possess virulence genes; and
- studies on antibiotic resistance of bacteria associated with aquaculture systems. Has the development of resistance been correlated with the use of antibiotics to control fish health?

For research into food borne trematode infections, the workshop prepared the following proposals:

- development of PCR-based methods for the identification of live and dead metacercarea in fish muscle, and
- epidemiological studies on food borne trematodes and investigation of means of interrupting their life cycles, including their survival in food processing.

Inland aquaculture research in India; harvesting in stock pond (M.Marzot, FAO)

AQUACULTURE IN AFRICA
PERSPECTIVES FROM THE FAO REGIONAL OFFICE FOR AFRICA

John Moehl
Regional Aquaculture Officer, Accra, Ghana

UPDATE: AQUACULTURE ACTIVITIES IN THE AFRICA REGION

At the risk of being precocious, there appears to be a renaissance in aquaculture development in the Africa Region. After a noteworthy slump in the 1990s, we appear to be approaching the new millennium with a positive outlook for the region's aquaculturists and would-be aquaculturists.

Much of the renewed interest can be attributed to FAO's ***Special Programme for Food Security*** **(SPFS)** which has identified aquaculture as an important activity in its diversification component. The SPFS places a strong emphasis on improved use of Africa's important water resources. We have long known that good water managers make good fish farmers, so aquaculture is a natural fit within SPFS. Special Programme activities include aquaculture in Cameroon, the Niger, Mali, United Republic of Tanzania and Zambia, to name a few.

FAO implemented projects in Kenya and the SADC Region are involved in a number of important activities and further funding for both is promising. Other aquaculture projects funded by UNDP, World Bank and a number of bi-lateral donors in such countries as Ghana, the Gambia, Rwanda, Zambia, Mozambique and Côte d'Ivoire are testaments to growing interest in aquaculture. The African Development Bank has provide a loan to Côte d'Ivoire (see section Projects and Other Activities in this issue) to develop private fish farms totalling 150 ha and plans to provide a similar loan to Gabon for revitalizing the fisheries sector, including aquaculture.

Many of the on-going projects focus on ***small-scale aquaculture*** production where a farmer will have a few ponds integrated into a complex farming systems producing a variety of plant and animal products. These systems increase household food security and offer the potential for some additional income. ***Medium- to large-scale production*** is also increasing. In addition to farms in Nigeria and Zambia, a large-scale cage culture operation has begun in Zimbabwe and plans are under way to develop a shrimp farm in Gabon. ***Culture-based fisheries*** activities are also on the rise to enhance output from numerous dams in water-stressed areas of the SADC and Sahelian regions.

Across the region we can say that new aquaculture endeavours embrace some general themes:

- taking a holistic approach to aquaculture development where fish culture is a part of a much larger agricultural mosaic;
- accepting that there is not only one preferred production system but a spectrum of systems, different ones suitable for different categories of producer and circumstances;

- shifting from public to private sector support for inputs including a privatisation of government hatcheries and stations in favour of private fingerling suppliers;

- encouraging the formation of producer associations where farmers will have a louder voice for demanding services and be better able to address market issues;

- concentrating effort on high potential areas where there are the greatest probabilities for success;

- assisting with information exchange and networking since access to information and not the lack of the information itself is a major constraint to development;

- focusing assistance on institutional issues since weak institutions have proven to be more of a restraint than lack of technology.

PERSPECTIVES ON AQUACULTURE EXTENSION IN AFRICA

Extension agencies are being rearranged across the region as Structural Adjustment Programmes are implemented. In nearly all cases the Training and Visit System (T&V) has been the extension strategy of choice within the new structures. Although its exact form changes from country to country, the basic organisation is the same: generalist extensionists at the grassroots level are supported by Subject Matter Specialists (SMS) located several levels higher in the hierarchical chain.

There are a number of permutations to this general structure. Agents may deal with farmer groups, contact farmers or individual producers. Extensionists most often are assigned to a relatively large geographic zone and travel between meetings or demonstration sites by motorcycles provided through donor assistance for the restructuring process. Frequently agents receive indemnities for fuel and maintenance as well as allowances for days spent in the field.

The fundamental premise of T&V is that farmers will advise extensionists of their needs in terms of technology and information. Agents will then provide this assistance if it falls within their technical competence. If the technical issues fall outside their generalist background, they will notify the SMSs who will in turn provide the agents with technical training on the designated subject. It is rare that the extensionists have specialized aquaculture qualifications; hence technical assistance on raising fish is provided directly or indirectly by the SMS. However, in the majority of systems SMSs specifically specialised in aquaculture are not foreseen, aquaculture being combined with the variety of activities covered by the animal production specialist.

The widespread adoption of T&V raises a number of important questions. Aside from the uncertainty of its long-term sustainability given high operating costs and diminishing national extension budgets, the ability of T&V to accommodate specialities such as aquaculture is unclear.

As this dilemma becomes more apparent, some countries are looking closely at modifications or alternatives to provide necessary specialised extension support to fish farmers. NGOs are being used in some sites to offer technical assistance for those disciplines not adequately incorporated into the generalist system. Other programmes are trying to focus technical support by overlaying natural endowments (e.g., water availability, soil quality, climate, etc.) and farmer priorities to identify high potential zones to which aquaculture specialists are assigned.

Another tactic has been to reply on fish farmer groups or associations. In several instances these groups have developed a critical mass to "pull" extension support to them. These organisations can operate through different mechanisms. Some groups nominate a member to attend technical sessions arranged at a central location by the extension service. The nominee then returns to inform the group of the new technical messages. Other groups contact aquaculture officers when they have need of their services, at times paying for the officer's transport so he/she can visit the group to address their specific problems in a timely fashion.

The ultimate role of aquaculture extension within the context of a generalist extension service remains ambiguous. It appears probable that a national service dedicated solely to aquaculture extension is beyond the means of most national budgets. A compromise is necessary whereby those requiring it can receive technical assistance and aquaculture production can expand. This compromise will become more evident as different T&V systems evolve to service client needs.

Mario Pedini[1], M. Halwart[1]; J. Moehl[2], Z. Shehadeh[1], Pete Bueno (NACA)
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Cooperative activities with NACA

CONFERENCE ON AQUACULTURE IN THE NEXT MILLENNIUM
21-25 Feb 2000, Bangkok Convention Centre, Central Grand Plaza Hotel.

This latest update on an earlier announcement in FAN No. 20 gives a short background and rationale for the Conference and explains its structure and programme organization as revised recently by the Steering Committee.

Since the first global technical conference in Kyoto in 1976, aquaculture has gained steady progress in most parts of the world. Its global growth has outstripped by a factor of 2-4 that of meat production in the livestock industry. In Asia, and particularly in countries like China (1.23 million tons in 1979 to 15.31 million tons in 1996), Bangladesh, India, Indonesia, the Philippines, Thailand and Vietnam, aquaculture, including culture-based fisheries, has greatly outpaced the growth in livestock production. Africa, Latin America, northern Europe, and Oceania have not produced the volume and variety of products Asian aquaculture has, but recently, their growth has been displaying even higher relative increases than Asia's. But throughout the world — and especially in the developing countries where government policies have been driven by the urgency of having to feed people adequately, lessen the incidence of poverty and contribute to the national economy — a host of problems has loomed threatening the sustainable expansion of aquaculture.

Sustaining Growth and Development

Aquaculture, which has come of age technologically since Kyoto 1976, has been crossing yet another threshold during the last decade of this century. The applicability of technology and management systems which laid the foundation for, and fuelled rapid growth during the early years of the sector's development have been challenged by new development paradigms involving complex issues of environment, resource allocation, distribution of benefits, and community participation in development processes. Application of technology has now to be measured as much by its impacts on ecology and on future generations as on its effect on productivity. Moreover, increasing international trade in aquaculture and seafood products and the trend towards globalization have moved local activities into the global spotlight. As a result, many interest groups, including governments, economic blocs, and non-government organizations, are making demands that translate all the way to how farmers should conduct farming.

The need was felt to address, in a broad and cooperative manner, the issues related to sustainable aquaculture development, food security and poverty alleviation, equity in the access to development benefits, participation in development processes, environmental management, and human resources development, which have become high priority policy and development concerns of governments and widely seen to remain so in the foreseeable future.

The Network of Aquaculture Centres in Asia-Pacific (NACA), an intergovernmental organization spawned by the Kyoto Conference of 1976, currently composed of 14 member countries and territory (most of its regional activities also involve 6 more countries), programmed into its work agenda for the period 1990-94 an international conference on aquaculture. Subsequent experiences and results from a number of projects and conferences — in cooperation with ADB, FAO, UNDP and other international and regional organizations — examined, clarified and defined many of the issues facing sustainable growth of aquaculture in Asia. These activities have built up a capital of expertise in the NACA organization. However, while illuminating many issues, the studies also raised more questions which fuelled the sense of urgency for the global conference. This Conference was endorsed by NACA's Governing Council in 1995, gained shape and substance from various forums and discussions during the following two years, and was finalized in 1998 after FAO offered to cooperate with NACA and bring, among others, the inputs that will provide the global perspective to the Conference.

Several other international and regional organizations are participating as sponsors of the Conference. The Government of Thailand, through its fisheries department, is host.

Envisioning the Future of Aquaculture, Mapping a Strategy to Get There

The broad objective of the Conference is to envision the state of aquaculture in the next millennium and the constraints and problems that the sector is likely to face, and formulate the strategy and action plan to solve the major constraints, especially through effective regional and global cooperation.

The constraints, problems, as well as national plans and aspirations are to be identified through Regional Workshops of national planning (in case of Asia) or regional study groups (in other regions) to be held before the Conference. The results of the regional review exercises will be presented at the Conference. Besides outlining the national action programmes for Asia and regional aspirations and strategies for other regions, special attention will be paid to opportunities for regional and inter-regional cooperation in implementing a global strategy for the orderly and sustainable development of the sector.

Conference Organization

A five-day Conference Programme , preceded by the Inaugural Ceremony on the afternoon of 20 February, has been drafted to realize the conference objective. It will be circulated shortly.

Global and Regional Overviews. The Programme starts with two keynote addresses: (i) a review of the global development in aquaculture since the Kyoto Conference in 1976, and (ii) a look at its global prospects from 2000 and beyond. This will be followed by the presentation of aquaculture development status and trends in Asia, Africa, Latin America, North America, Europe (East and West), the Near East and the Pacific Community.

Sessions on Policy and Technology. Following the global and regional reviews will be two parallel sessions, one on policy and planning for sustainable aquaculture, the other on technologies for aquaculture development.

The **policy and planning session** will consist of discussion groups on:

- increasing the contribution of aquaculture to food security and poverty alleviation, addressing social issues,
- integrating aquaculture into rural and coastal development,
- involving stakeholders in aquaculture policy-making, planning and management,
- promoting sustainable aquaculture with economic incentives,
- creating the information base for policy making, planning and management, and
- establishing legal, institutional and regulatory frameworks for aquaculture development and management.

The **technology session** will consist of discussion groups on:

- aquaculture systems and species,
- genetic manipulation and seed improvement,
- health management and disease control,
- nutrition and feeding,
- culture based fisheries and enhancement, and
- systems approach to aquaculture management.

Other discussion sessions will focus on:

- aquaculture product quality, safety, marketing and trade, and
- aquaculture development financing and institutional support.

Special Sessions and Topics. The following important issues will be covered in separate special sessions or by special lectures and discussions, namely:

- environment and community-based management issues in aquaculture,
- agriculture and livestock production: a model for aquaculture development?
- human resource development,
- demand and supply of aquaculture products
- role of development banks in promoting aquaculture development, and
- regional and inter-regional cooperation.

The final day will be for summary presentations, in plenary, of the syntheses and recommendations of the various sessions, and the Conference conclusions and recommendations.

A thorough exchange of ideas

To highlight and define the issues and subject them to thorough examination, the programme will be structured as follows: ***plenary lectures*** will precede group discussion sessions; the discussion sessions will begin with a broad review of the topic by the session chairman, followed by a ***panel discussion*** to examine the different aspects of the topic, and then a ***general discussion*** to clarify and suggest resolutions to the important issues.

Each session will start with an introduction (or overview) based on available information, in the form of a resource paper, by the Chairperson. This presentation by the Chair will be followed by selected panelists who will deal, in the same manner, with allocated aspects of the Session, in order to facilitate maximum discussions and interaction among Conference participants.

Strategic and future-oriented

Plenary, resource, and panel discussion papers are expected to be strategic and future-oriented rather than focused on narrow technical issues. However, contributed ***technical reviews and experience papers***, will provide scientific and experiential support to the discussions. The authors of these technical reviews and experience papers will be given the opportunity to present the main points in their papers during the general discussion. The papers will also be included in the Conference publications.

Global, Regional, Technical Inputs

Several ***pre-conference exercises*** are planned with the view of bringing global and regional reviews and national plans (for Asia) and aspirations into the Conference. NACA will conduct the ***Asian regional planning workshop*** in September, while the Secretariat of the Pacific Community will formulate an ***aquaculture development strategy for the Pacific*** Community. FAO will hold regional expert forums to develop the review of ***status and trends in other regions.*** These regional reviews will be synthesised at a workshop to be held in Bangkok in October 1999. The result will be brought into the Conference to provide the ***global overview***.

The **Inaugural Ceremony** will be held on the afternoon of the 20th of February to formally open the Conference and the Aquaculture Technology and Trade Fair. The host government will arrange an appropriate opening ceremony to be graced by a Royal guest of honour.

Aquaculture Trade and Seafood Fair

An aquaculture technology, trade and seafood fair will be held at the same convention centre. Its theme - "New Age for Aquaculture", connotes the convergence and interaction among people and organizations with ideas, inventions, technologies, products, and services that are expected to propel the industry into a sustainable future.

Aquabusiness-Science-Government-Interactions. The Exhibition and the Conference provide a golden opportunity – on the very start of the millennium — for developers, manufacturers, suppliers, and distributors of products and services to exchange ideas and information with scientists, researchers, technologists, and policy makers participating in the Conference. The Conference is also designed to bring together government planners and scientists so that Governments could tell scientists of their national development plans and aspirations for the first 20 years into the next millennium. Scientists can in turn provide a glimpse of the science and technology that could support the development plans and aspirations of governments.

From the two concurrent events, participants from the business sector will have first opportunity at accessing valuable and strategic information from the science and technology sector and from the national planners. This will enable them to plan effective business strategies to meet the needs of the aquaculture development and seafood processing industries in the new millennium.

Meanwhile, Thailand's Department of Trade and Export Promotion, one of the major sponsors of the Trade Show, has started to invite trade show visitors from other countries.

Application/Registration

For applicants who wish to present papers, abstracts of papers should be submitted by 1 July 1999. The abstracts will be screened and selected by a panel, and authors will be notified of the results immediately. Full papers will be then requested to be submitted by 30 September 1999. The full papers will be also screened and selected. Selection will be completed by 30 November 1999 and contributors will be notified of the results immediately.

For applicants who wish to participate without presenting a paper, simply notify the Secretariat by post, fax, or e-mail of intention to participate before 30 November 1999. Communications to the Secretariat should indicate return mailing address and electronic (fax and e-mail) numbers of the applicant.

Contact addresses : The electronic addresses of the Secretariat are as follows:

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DEVELOPMENTS IN AFRICA

Dr. John Moehl, Regional Aquaculture Officer ,FAO Regional Office for Africa, Accra, Ghana

Côte d'Ivoire/Project ADB-West

The African Development Bank (ADB) has provided a loan to Côte d'Ivoire to promote aquaculture development in the western region of the country. This project is aimed at building on the solid foundation established by the UNDP-funded, FAO-implemented aquaculture development project active from 1977 to 1990. This project introduced fish farming as an innovation providing financial and nutritional benefits to producers. Many farmers adopted the innovation and it has become a common activity across the country.

The ADB project builds on this foundation and exploits Côte d'Ivoire's competitive advantages of high demand for freshwater fish, elevated buying power, inexpensive agricultural by-products and good infrastructure to further expand aquaculture operations.

The project's objective is to develop commercially viable fish farms and support services in the private sector. Participating farmers establish farms with water surface areas ranging from a half hectare to more than two hectares, with the overall project target of 150 ha in production. These farmers obtain loans from the project to construct ponds and purchase equipment. To date, the project has assisted with building or renovating 100 ha of ponds for 127 farmers.

A farm manager trained in fish culture by the project operates the farms. Managers are the owners themselves or their employees. Training includes course work as well as an apprenticeship at an operating fish farm. The project has also trained teams in site selection and pond construction. These teams then contract with the fish farmers to build the ponds and related structures. Eighty farm managers have been trained and another 100 individuals in pond construction.

Farmers raise *Clarias* and tilapia (most often *Oreochromis niloticus*) in mono- or poly-culture. Production from monoculture *Clarias* systems is reported to be as high as 30 t/ha/yr. Project staff indicates monoculture tilapia systems yield 10-12 t/ha/yr while polycultures produce 20-25 t/ha/yr.

To support producers, the project is building a hatchery intended to produce 15 million fingerlings a year — 8 million *Clarias* and 7 million male tilapia. *Clarias* larvae are produced by injections with HCG. Larvae are then transported to project farmers' ponds where they are raised to fingerling size and subsequently sold to nearby producers. Hand-sexed male tilapia are produced both at the hatchery and by private producers. It is intended that the hatchery will be operated by the project for the first year to demonstrate its financial viability, after which time it will be sold to the private sector.

The project is also offering a loan to build a private feed mill to produce palletized and powdered feeds using available by-products. Until this operation comes on-line, farmers are purchasing supplemental feed from a variety of small-scale producers.

Ten aquaculture extension agents supported by the project also assist farmers. At the end of the project it is envisioned that these agents will be integrated into the national extension service. However, one goal of the project is to establish self-sufficient farmers with a solid understanding of fish culture and access to services from the private sector.

Project ADB-West is intended to serve as a model for aquaculture development throughout Côte d'Ivoire. The project emphasizes the important principle of empowerment of farmers through group

action and independence from external forces. The coming years will determine the sustainability of activities as loans are repaid and direct project support withdrawn.

IOFC/Gulfs Committee Ad Hoc Working Group on Aquaculture Focuses on Aquaculture Information

The Working Group held its second meeting in Kuwait on 18-21 May 1998. The Kuwait Institute for Scientific Research (KISR) hosted the meeting. It was attended by 25 participants from eight member countries, including three from the private sector, one representative from ICLARM (Africa and West Asia Regional Centre, Egypt), and two FAO HQ staff. Of the Gulfs Committee members, only Iraq was absent, while Oman and Qatar attended for the first time.

In its first meeting in Cairo in October 1996, (see *FAN* 14) the Working Group recommended that its next meeting should focus mainly on the establishment of an aquaculture information network similar to that in operation in the Mediterranean Region under the supervision of the FAO General Fisheries Council for the Mediterranean (GFCM). The establishment of the aquaculture information network subsequently received strong support from the Committee for the Development and Management of the Fishery Resources of the Gulfs (Gulfs Committee) during its Ninth Session in April 1997, in Sharjah, United Arab Emirates.

In follow up, the Working Group (WG) devoted special attention to this matter during its second meeting. A concept paper was circulated by the Technical Secretariat to WG members in advance of the meeting. The paper described the components of the information network, its co-ordination mechanism, the functions and responsibilities of the national centres and regional centre, and provided an estimate of financial requirements for the national components of the network and the regional network centre.

After a one-day workshop in which the concept of the network was presented and discussed in detail, it was agreed that the next step would be to obtain official confirmation of interest to participate in the network from member countries (from the Government agency in charge of aquaculture). It was noted that a minimum of three participating countries, one of which had to be willing to host and support the regional centre, would be needed to start the system. Members of the WG would request their governments to send an official response to the FAO, addressed to the Assistant Director-General/Fisheries by the end of June 1998, advising (a) whether or not it is interested in participating in the information network, and, if so, to name the national agency designated as the national centre for this purpose; and (b) whether or not it is interested in hosting the Regional Centre of the network and providing the necessary financial support.

With regard to the Regional Centre, it was stressed that, beside the willingness to host and provide financial support for the centre, the host country/institution must have (a) good communications facilities, and (b) good computer and programming capabilities. Bilingual (English and Arabic) capability was also suggested as a desirable attribute of the host institution. In this connection, it was noted that, during the ninth session of the Gulfs Committee in April 1997, the Islamic Republic of Iran had offered to host the Regional Centre. If an adequate number of countries respond positively, the WG will hold a special technical session to begin the design of the system. Two participants would attend from each country, an aquaculturist and a programmer/computer specialist. The presence of the programmer of the Regional Centre at this meeting would be essential.

In looking ahead, the WG decided that the next meeting would consist of three sessions: (a) ***New Developments in Aquaculture***: National reports on new developments including research, commercial production, legislation, etc., to be prepared according to a standard outline. (b) ***Regulatory Framework for Aquaculture Development***: Material for the meeting will consist of (i) country papers on existing legislation/regulations which are either specific to aquaculture or which influence certain aspects of aquaculture; and the agencies involved in their elaboration and enforcement, (ii) specific national needs in the development of regulatory frameworks, (iii) specific case studies, and (iv) experiences and lessons learned in countries of other regions, to be prepared by invited guests and/or FAO staff. (C) ***Potential for Enhancement of Commercial Fish Stocks***: This will involve discussions with representatives of the Gulfs Committee Working Groups on shrimp and demersal fish resources on the need and potential for enhancement of fishery resources, including the rehabilitation of wetlands and nursery areas, establishment of artificial reefs and stocking. A review of recent advances and codes of practice relevant to this topic will also be presented by FAO.

Dr. Abdul Aziz Al-Ameeri, Kuwait Institute for Scientific Research (KISR), Kuwait, and Mr. Yaqoob Khalfan Al-Busaidi, Marine Science and Fisheries

Centre, Oman, were elected Chairman and Vice-Chairman of the Working Group for two years respectively.

BRAZIL

In December 1997 the TCP/BRA/6714 project Aquaculture Development in support of Coastal Communities" was approved by FAO responding to a request of the National Programme for Strengthening of Familial Agriculture (PRONAF) of the Ministry for Agriculture and Food Supply. The objectives of the project were twofold: (a) the inclusion of an aquaculture component in the ongoing development programme carried out by PRONAF, addressed to the coastal communities, and (b) to support the reorganization of the Ministry of Agriculture with respect to aquaculture. As a result of the its work and of the analysis of the reorganization of the sector in Brazil, the project produced two main documents, a first phase of a coastal aquaculture development programme with a duration of two years and a programme approach for the identification and formulation of several projects which would form the bulk of the operation of the newly formed aquaculture department in the Ministry of Agriculture. As a result of the visits of Mr. M. Pedini in June and of Mr. A. Gumy in September, a Unilateral Trust Fund project document for a preliminary phase of six months has been signed with the Brazilian Government.

This first project with the new unit of the Ministry of Agriculture will have six immediate objectives, dealing with several fisheries and aquaculture subjects, and will be implemented through missions of relatively short duration. In the area of institutional strengthening the projects will take care of the preparation of proposals for the institutional structure of the Department of Fisheries and Aquaculture and for alternative strategies for the implementation of a Master Plan for the sector. It will also deal with the preparation of the fisheries and aquaculture legal framework, the improvement of fishery statistics collection and improvement of technical and scientific information flow in the country. For aquaculture development, the project will prepare six project documents for the first two years of operation of the aquaculture unit which will deal with freshwater aquaculture development, aquaculture information, health management in aquaculture, marketing of aquaculture products, interinsitutional and financial coordination for aquaculture development and a major component for coastal aquaculture. The project will make use of Bazilian and international experts and it is expected that it will be the first stage of a more substantial collaboration between FAO and the Brazilian Government.

Eighth Session of the Commission for Inland Fisheries of Latin America

The Eighth Session of the Commission for Inland Fisheries of Latin America was in Belem do Pará, Brazil, from 11 to 14 August 1998. Delegates from 13 Member Countries of COPESCAL and an observer from INFOPESCA attended.

Several recommendations arose regarding: necessary improvement of existing knowledge of social and economic aspects of inland fisheries and aquaculture, better integration between macroeconomic and sectoral policies, greater integration at a policy level that could substantially increase the possibilities of attracting financial support, formulation and implementation of management schemes that favour the decentralization of the decision-making process, management approaches leading to the harmonization of commercial and recreational fishery activities, increasing economic importance of ornamental fish trade, non-tariff barriers of various types to trade in fish products which hinder the marketing of certain fishery products and the export of aquaculture products, the need to give small-scale rural aquaculture the importance it deserves, and to increase the discussion of strategies for its development in the Region.

A strong political will to implement the Code of Conduct for Responsible Fisheries (CCRF) was acknowledged as shown by the commitment made by the Ministers of Agriculture of Latin America and the Caribbean during the XXV FAO Regional Conference held in Bahamas in June 1998. The CCRF has been well received among the countries of the Region and its implementation is progressing well among many of the COPESCAL countries. The CCRF has been found to be very useful for strengthening existing legislation on the environment and reinforcing existing management regulations. Several recommendations were made regarding the ongoing plans and strategies for the implementation of the CCRF at the national and international level.

With reference to the options to strengthen the role of COPESCAL, the Secretariat recalled that the 29th Session of the FAO Conference, November 1997, **recommended** that the Commission

should abolish the subsidiary bodies of COPESCAL (Working Groups) unless the Commission considered, taking into account the financial and programme implications, that there were over-riding reasons to retain any or all of the subsidiary bodies. All the delegations agreed that COPESCAL working parties had carried out an important role in the promotion of research, the management of inland fishery resources, the development of aquaculture, and the improve-ment of fishery technology and marketing of fish products. Nevertheless, due to the lack of a clear and secure source of funds, apart from FAO Regular Programme, and the need for more flexible mechanisms which would allow more effective use of available resources, the majority of the delegates **recommended** the abolition of the Working Parties on Fishery Resources, Aquaculture and Fishery Technology. The Commission **recommended** a set of measures to ensure alternate mechanisms and resources for the operation of ad-hoc working groups, including funding from external sources and association with NGOs and the public and private sectors.

The meeting identified a series of activities to be carried out for the next two years which comprise workshops on: marketing of inland fishery products and aquaculture, aquaculture in small reservoirs, small-scale rural aquaculture, reactivation of the Information System for the Promotion of Aquaculture for Latin America and the Caribbean (SIPAL); studies on: management of shared catfish resources in the Amazon basin, genetic improvement of tilapia and a training programme and technical assistance on problems related to aquaculture sanitation.

Rice-cum Fish Culture at the 19th Session of the International Rice Commission in Cairo

The Nineteenth Session of the International Rice Commission was convened at the Ministry of Agriculture and Land Reclamation in Cairo, Egypt, from 7 to 9 September 1998. The Session was attended by 64 delegates from 30 of the member countries of the Commission and 3 observers from FAO member countries. There were also 23 participants from international and regional organizations.

The world rice market, advances in rice breeding, hybrid rice development, new rice plant types, water availability and management, mecha-nization in rice production, post-production activities, IPM in rice, and the role of women in rice production were among the topics discussed. Up-to-date national reports on the rice situation were provided by country representatives.

M. Halwart, on behalf of the FAO Inland Water Resources and Aquaculture Service, presented a paper on "Fish in Rice-Based Farming Systems - Trends and Prospects". Recent changes in rice production practices and the largely positive implications for fish farming were discussed with special reference to Integrated Pest Management (IPM) in rice. Where fish seed production and marketing networks are in place, an expansion of the enterprise has excellent potential, particularly in rainfed environments where wild fish stocks are declining, and in irrigated rice where the increased water demand for rice-fish farming can be met at low cost to the farming community.

The International Rice Commission, which works within the framework of FAO, was established in 1949 with the objective of promoting national and international action in respect of production, conservation, distribution, and consumption of rice. Membership of the Commission is open to all FAO Member Nations and Associate Members who accept the constitution of the International Rice Commission. The present membership is 60, representing all the rice growing regions. The Commission meets once every four years to review the global status of rice development with respect to production and demand and to draw up strategies to meet future challenges.

FAO - Ministry of Agriculture and Rural Development International Workshop on Integrated Snail Management in Rice in Viet Nam

In the framework of the Technical Cooperation Project (TCP) "Integrated Snail Management in Rice" an International Workshop on Golden Apple Snail Management in Rice, jointly organized by the FAO and the Plant Protection Department of the Ministry of Agriculture and Rural Development in Viet Nam, was held in Vinh City, Nghe Anh Province, from 4-6 September 1998. Representatives from 8 countries (Argentina, Cambodia, Japan, Lao PDR, Malaysia, the Philippines, Thailand, Viet Nam) attended.

An overview on the TCP and its activities by the Plant Protection Department (PPD) was followed by more detailed presentations on biological control activities by the Research Institute for Aquaculture (RIA) No. 1 and on the use of Geographical Information Systems (GIS) by the PPD. An introduction to the FAO Regional IPM Intercountry Programme in Rice was provided by the FAO IPM Country Officer, and the Farmer Field School approach was further elaborated on by an IPM Trainer from Nghe An Province. The results from the pilot studies in three provinces were presented which showed the consistent trend that fish farming in rice fields contributes significantly to the reduction of aquatic pest snails. It was shown that snail numbers in rice fields at the end of the rice-growing season were up to 95% lower in fish treatments as compared to no-fish treatments. Overviews for six Asian countries showed the range of infestation from spotty, as in Lao PDR, to large cover, as is the case in the Philippines. Several papers on recent research activities on aquatic pest snails were presented providing experiences from various countries including Argentina where the Golden Apple Snail is endemic.

Maintaining control action on the snails, studying and completing research on ecology, loss assessment, and natural enemies of the snails, and making farmers aware of control options were among the important recommendations of the workshop. It was emphasized that the results of the TCP have clearly shown the success of raising fish for snail control, and that with the gained knowledge on the use of different fish species in different parts of the country, rice-fish farming should be more actively promoted. The principal importance of farmer training and empowerment was emphasized, and suggestions were made to improve the current snail curriculum for Farmer Field Schools and develop a wider training programme, both nationally and regionally.

Bangladesh

Technical Cooperation Project (TCP/BGD/6714): Diseases Prevention and Health Management in Coastal Shrimp Culture

The TCP project is supporting the Department of Fisheries in collecting farm level data from around 12,000 shrimp farms in the coastal areas of Bangladesh. A database management specialist visited the project from 12 to 18 September 1998 to assist in setting up a database for handling and analysis of the data being collected by the national teams.

The data generated through the survey and analysis will be very important in determining the present situation with shrimp disease in Bangladesh and future directions for assistance to farmers and shrimp disease control strategies. The database and analysis of the data will be an important baseline for the Department of Fisheries and should be analysed fully. The benefit to Bangladesh of the database can be further extended as follows:

- NACA and FAO are working on development of a model for assessing economic impacts of shrimp and fish diseases and cost-benefits of disease control methods. Close cooperation between the Department of Fisheries, NACA and FAO on this initiative would be beneficial to all parties.

- The information would also be useful as a starting point for a shrimp disease surveillance system for the shrimp farming areas in Bangladesh. The setting up of such a system is part of the national activities to be undertaken under the ongoing regional FAO/NACA TCP project "Assistance for Responsible Movement of Live Aquatic Animals" TCP/RAS/6714.

The consultant completed the following tasks:

- setting up of an Access database and data entry form for shrimp farm data;
- development of guidelines for data entry and management;
- training of Department of Fisheries staff in data entry and database management; and
- design of a report form for data analysis and presentation of results.

Harvey, B.; Ross,C.; Greer, D.; & Carolsfeld, J. 1998. Action Before Extinction. World Fisheries Trust, Victoria, Canada. 259 pp.

Though this book is not an FAO publication, it is featured here because it contains a contribution by Dr. Devin Bartley of the FAO Fisheries Department. This Conference, on which the book is based, followed-up on recommendations from several previous meetings sponsored by FAO and partners, such as ICLARM and the Convention on Biological Diversity, and provided input to the FAO/ICLARM Bellagio Conference entitled, "Towards Policy for the Conservation and Sustainable Use of Aquatic Genetic Resources", the proceedings of which are currently being edited by Roger Pullin (ICLARM), Devin Bartley (FIRI), and Jay Kooiman (Netherlands).

Dr Brian Harvey, President WFT, and staff, with the support of several Canadian organizations including, *inter alia*, Canadian Department of Fisheries and Oceans and the International Development Research Centre, have published the proceedings of the International Conference, "Action before Extinction". The World Fisheries Trust invited Dr. Devin Bartley of the FAO Inland Water Resources & Aquaculture Service (FIRI) to participate as part of FAO's ongoing efforts to promote sustainable use and conservation of genetic diversity of aquatic animals. Dr Harvey brought together an excellent mix of about 25 international scientists and policy makers from established fish genetic conservation programmes, genetic conservation programmes being developed, Canadian First Nation groups, and international development agencies and donor groups.

The main topics covered in the book are gene banking and *in situ* and *ex situ* conservation. However, the discussion of these topics quickly expanded, for example into areas of *in situ* gene banks, how to integrate *in situ* and *ex situ* conservation, access and property rights for genetic resources, how to and who will fund conservation efforts, the ethics of gene banking, and even some technical issues.

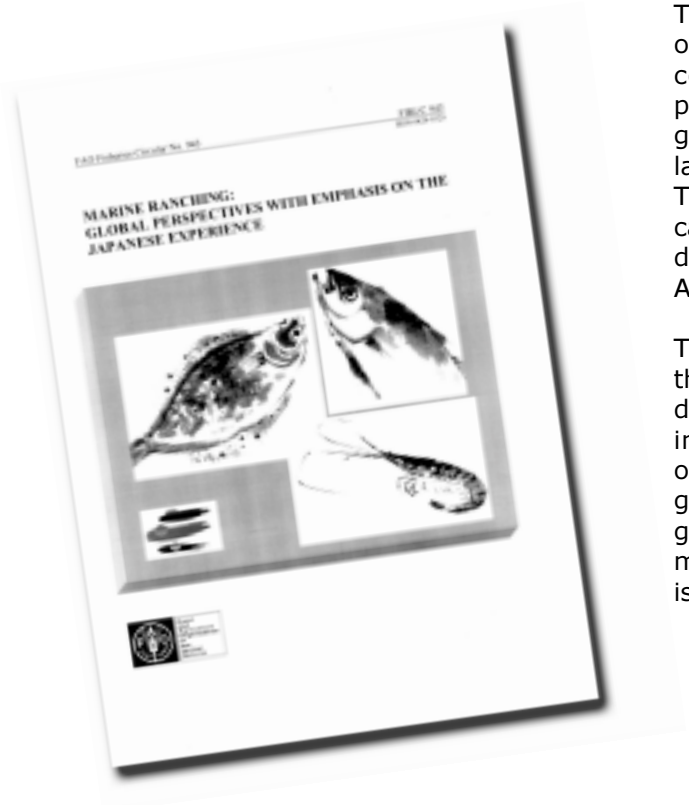
The book is extremely well produced in a very "user friendly" format that includes a brief summary of papers and discussions. *Action before Extinction* will be a valuable addition to the literature on conservation and sustainable use of aquatic genetic diversity. FIRI is pleased to have contributed to this work. Thanks again to Brian Harvey and staff, good job.

Action before Extinction is available from WFT. Please contact:
Sarah Riecken, World Fisheries Trust
202-505 Fisgard Street
Victoria, B.C. V8W 1R3
Telephone: (250) 380-7585; Fax: (250) 380-2621
Email: worldfish@coastnet.com

FAO, 1999. *Marine ranching: global perspectives with emphasis on the Japanese experience.* FAO Fisheries Circular No.943. Rome, FAO. 252 pp.

The International Conference on Sustainable Contribution of Fisheries to Food Security resulted in the Kyoto Plan of Action that calls for a rapid transfer of technology and know-how in enhancement of inland and marine waters. As part of the implementation process of the Kyoto Plan of Action, Ishikawa Prefecture, in cooperation with the Fisheries Department of FAO, the Fisheries Agency of Japan, the Japan Sea-farming Association, Marino-forum 21, and others convened an International Symposium on Marine Ranching, 13-16 September, 1996, Kanazawa, Japan. This Circular is an unedited collection of the presentations of this Symposium, which have been assembled by the FAO Inland Water Resources and Aquaculture Service, Fishery Resources Division. The assistance of the Fisheries Department of Ishikawa Prefecture, and especially the work of Messrs M. Miyahara and A. Shikida, is greatly appreciated.

This circular reports on the status of marine ranching programmes throughout the world, with a special emphasis on the ongoing and planned enhancement work in Japan. The contributed papers address the variety of issues that are necessary for responsible and cost-effective marine ranching. These issues include, *inter alia,* technical concerns with producing and releasing large numbers of hatchery fish and invertebrates, habitat improvement, genetic resource management and biodiversity conservation, socio-economic evaluation, fishery management, technology transfer, criteria for success, and the multidisciplinary approach required for a successful ranching programme. The marine ranching programmes of Japan, the world leader in this type of fishery management, are extensively reviewed by Japanese experts.



FAO, 1999. *Review of the state of world fishery resources: inland fisheries.* FAO Fisheries Circular No. 942. Rome, FAO. 54 pp.

The purpose of this review is to present a broad view of the state of inland capture fisheries. The review is organized in three main parts. The first part is an overview of inland capture fisheries. Overall, the trend is for an annual average increase in inland capture of about 138,000 t. The nominal inland capture amounted to about 7.7 million tonnes in 1997. Actual inland capture is considerably greater than the amounts reported to FAO. The factor is at least two overall, but may be as high as three in some instances. There is an urgent need for better data on inland fisheries that can be interpreted in both economic and ecological terms. Although the cost of improving inland fishery data collection may be high, failure to fully account for inland capture also is costly in terms of lessened, or lost, opportunities to increase food security and other economic and social benefits from inland fishery resources.

The second part deals with trends in capture organized by continental regions, sub-regions and countries for the period 1984 to 1997. Asia produces a disproportionately large share of the global inland capture in relation to its continental land area and the water surface available there. The 14-year trends are for increases in inland capture in Asia, Africa and Latin America and for decreases in the Former USSR Region, North America and Europe while Oceania is stable.

The third part sets out major issues, of which the environment is the salient concern, and future directions of inland fisheries, mainly towards increased uses of enhancements to increase outputs. Enhancements are characterised on a global basis according to type, species and geographical distribution. Rehabilitation and mitigation of inland systems are highlighted as is the importance of recreational inland fisheries.

FAO/NACA/WHO. 1999. *Food safety issues associated with products from aquaculture.* Report of a joint FAO/NACA/WHO Study Group. WHO Technical Report Series No.883, WHO, Geneva. 55 pp.

The past decade has seen rapid expansion in aquaculture production. In the fisheries sector, as in animal production, farming is replacing hunting as the primary food production strategy. In future, farmed fish will be an even more important source of protein foods than they are today, and the safety for human consumption of products from aquaculture is of public health significance.

This is the report of a joint FAO/NACA/WHO Study Group that considered food safety issues associated with farmed finfish and crustaceans. The principal conclusion was that an integrated approach - involving close collaboration between the aquaculture, agriculture, food safety, health and education sectors - is needed to identify and control hazards associated with products from aquaculture. Food safety assurance should be included in fish farm management and form an integral part of the farm-to-table food safety continuum. Where appropriate, measures should be based on Hazard Analysis and Critical Control Point (HACCP) methods; however, difficulties in applying HACCP principles to small-scale farming systems were recognized. Food safety hazards associated with products from aquaculture differ according to region, habitat and environmental conditions, as well as methods of production and management. Lack of awareness of hazards can hinder risk assessment and the application of risk management strategies to aquaculture production, and education is therefore needed. Chemical and biological hazards that should be taken into account in public health policies concerning products from aquaculture are discussed in this report, which should be of use to policy-makers and public health officials. The report will also assist fish farmers to identify harzards and develop appropriate hazard-control strategies.

A summary of the findings of the Study Group was published earlier in *FAN* No. 19, August 1998, pp.3-7. News about the meeting of the group was published in *FAN* No. 17, December 1997, p.23.
The report is available from:
WHO Distribution & sales
CH-1211, Geneva 27
Switzerland
Price:SW.fr14.-
Price in developing countries: SW.fr.9.80

FAO-Fishstat Plus (v.2.19), 1999. (CD ROM)

FAO-Fishstat Plus (v.2.19) is now available from FIDI and provides access to Fishery statistics of various sorts, including:
- aquaculture production (quantities, tons) 1984-1997 and
- aquaculture production (values, thousands US$) 1984-1997

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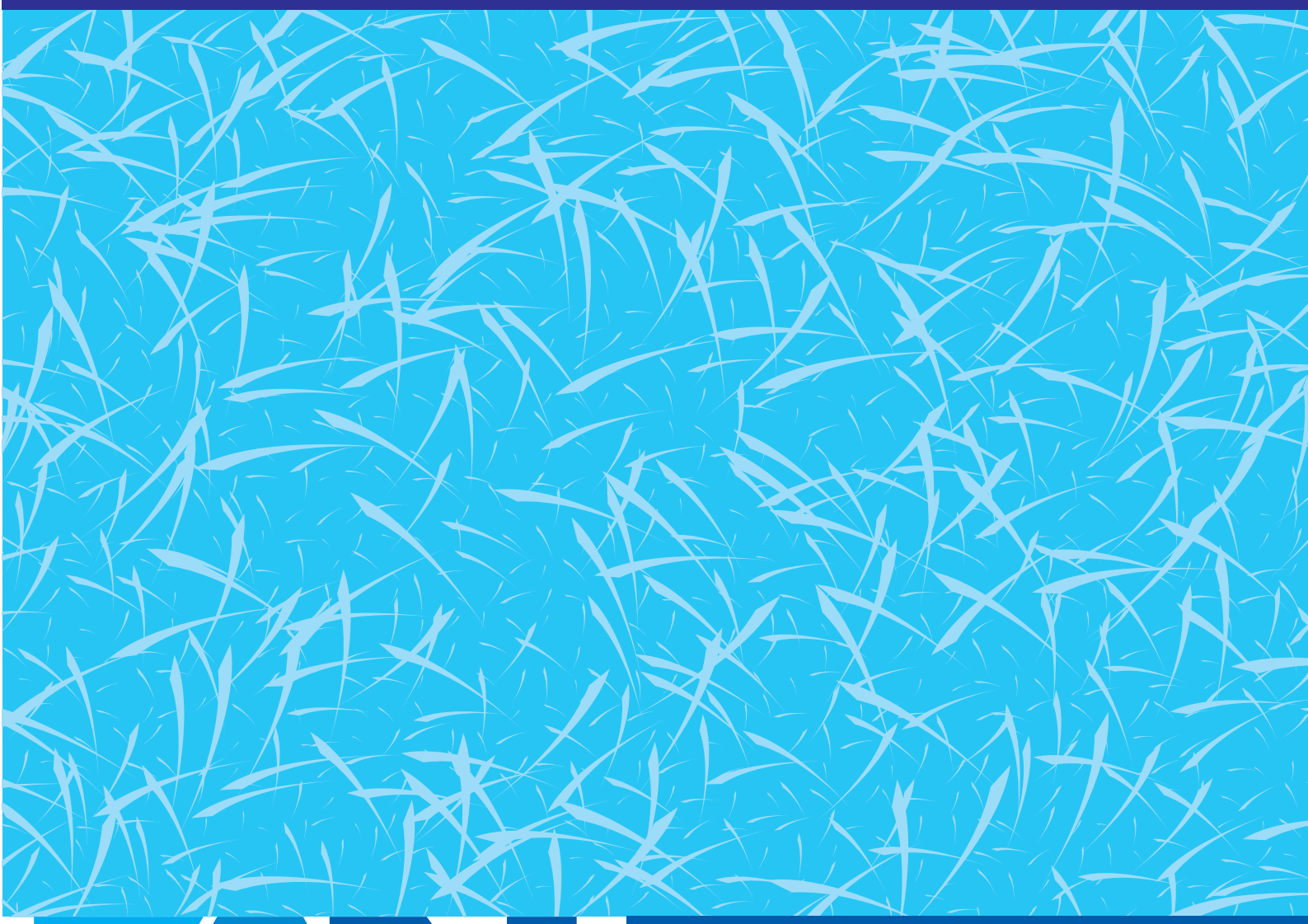
Please contact fidi-inquiries@fao.org with any questions.
This CD is free of-charge and can be ordered from the following address:
Fishery Information, Data and Statistics Unit
Food and Agriculture Organization of the United Nations
Viale delle Terme di Caracalla
00100 Rome, Italy



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FAO Aquaculture Newsletter

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