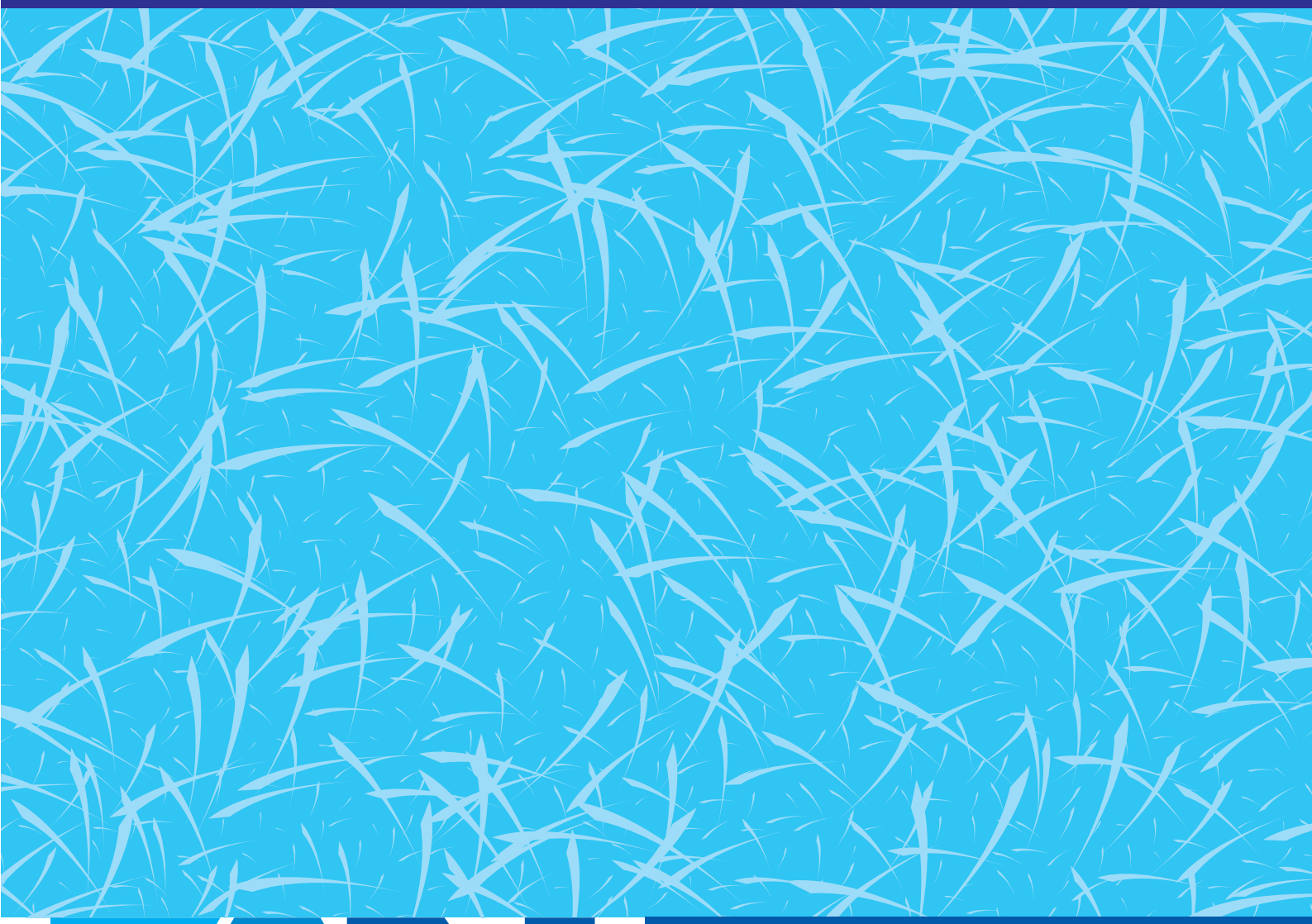
FAN

December 1998 - No. 20

FAO Aquaculture Newsletter

A farmer in North Sulawesi, Indonesia, inspects his rice paddles and fish ponds

FAO AQUACULTURE NEWSLETTER FAO AQU
FAO AQUACULTURE NEWSLETTER



FAN

FAO Aquaculture Newsletter

INLAND WATER RESOURCES AND AQUACULTURE SERVICE FISHERIES DEPARTMENT

Food and Agriculture Organization of the United Nations

Viale delle Terme di Caracalla, Rome, 00100 Italy

Tel: 39-06-57054795 Fax: 39-06-57053020.

E-mail: Ziad.Shehadeh@fao.org

The FAO Aquaculture Newsletter (FAN) is issued three times a year by the Inland Water Resources and Aquaculture Service, Fishery Resources Division, of FAO's Fisheries Department, Rome, Italy. It presents articles and views from the FAO aquaculture programme and discusses various aspects of aquaculture as seen from the perspective of both Headquarters and the field programme. Articles are contributed by FAO staff from within and outside the Fisheries Department, from FAO regional offices and field projects, by FAO consultants and, occasionally, by invitation from other sources. FAN is distributed free of charge to various institutions, scientists, planners and managers in Member Countries and has a current circulation of about 3,000 copies.

It is also available on the FAO internet Home Page:
http://www.fao.org/waicent/faoinfo/fishery/newslet/newslet.htm

Editor: *Ziad H. Shehadeh*
Editorial Board: *Jiansan Jia, Mario Pedini, Izzat Feidi*
Rohana Subasinghe, Devin M. Bartley
Layout and Production: *Sylviane Borghesi, José Luis Castilla*

Enabling Framework for Aquaculture

Few countries have appropriate legal frameworks and policies for aquaculture. Often comprehensive policies and associated legal frameworks have been overlooked because development has been seen mainly in technical terms and support has been largely focused on technical aspects of production. Also, as in many other sectors, policy-makers have often treated aquaculture in isolation from other sectors, thus ignoring important linkages, including externalities. The need to incorporate political, economic, social, environmental and legal aspects has been neglected generally, 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 be established, at all levels (international, regional, national, local and farm levels) to make it attractive to farmers, fishermen and other entrepreneurs to exploit the potential of aquaculture in a sustainable manner. Governments need to create and maintain a suitable climate for sustainable growth of the sector; they need to create an "enabling environment". Such an environment is complex. It has economic, legal, social and physical components. It should ensure *inter alia* fair access to resources; mechanisms for conflict resolution; access to information, credit and markets. This presupposes that there are functioning channels of communication with institutions and representatives of other, competing sectors of the economy.

In creating the "enabling environment" it is essential to strike a balance between the need for development/growth and the need for eco-system conservation. 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 globalisation of markets must also be taken into consideration.

The complex task at hand is to put the principles of the recently adopted Code of Conduct for Responsible Fisheries into operation; that is, to clarify how sustainability choices might work in practice; to incorporate its principles into development policies and plans; and to elaborate specific codes of responsible practice containing norms, standards and guidelines, agreed upon by all stakeholders. Given the diversity of aquaculture practices, and of the political, social and economic conditions in which they take place, as well as the different perceptions of sustainability, balanced and informed approaches are required to effectively address developmental and environmental issues at any one location. Further, the applicability of various approaches needs to be assessed carefully, particularly where there are many small-scale farmers involved, and in view of the often highly decentralised nature of the aquaculture industry.

The FAO Fisheries Department is in the process of elaborating a strategy for the promotion and implementation of the Code. A summary of the essential aspects of the strategy was presented in a joint FAO/World Bank paper entitled 'Towards Sustainable Development: A Draft Strategy of FAO and the World Bank' at the Summit of the Seas, St. John's, Newfoundland, Canada, 1 to 6 September 1997. In follow up on Resolution 4/95 of the FAO Conference, recalling Article 5 of the Code, the Organization is also developing an interregional programme, for external assistance, to help developing countries to implement the Code. The purpose of this programme would be to upgrade the fisheries capabilities of developing countries so that they would be better placed to meet their obligations under the Code. The Government of the Netherlands and the Government of Norway are providing support to some components of this strategy. It is hoped that other donors will contribute to this worthwhile programme.

Ziad H. Shehadeh
Senior Fishery Resources Officer
Fishery Resources Division

CONTENTS

This is an abbreviated version of an article contributed by the FAO Fisheries Department to the 1998 edition of the annual FAO flagship publication:
THE STATE OF FOOD AND AGRICULTURE[1]

INTEGRATING FISHERIES AND AGRICULTURE TO ENHANCE FISH PRODUCTION AND FOOD SECURITY

INTRODUCTION

There are manifold interactions between fisheries and agriculture through the common use of land and water resources and concurrent production activities to support rural village communities and supply urban areas with the needed quantity and variety of food. Such interactions extend to the institutional sphere, as fisheries and agriculture often fall within one government ministry. Improved integration between the two sectors is therefore an important means to enhance fish production and food security. The term "fisheries" is broadly defined here to include the capture of wild fish stocks from inland and marine waters, the capture of fish stocks that have been enhanced through stocking and other measures and various types of aquaculture. The most direct interactions between agriculture and fisheries occur where these two sectors compete for the same kinds of resource, especially land and water, and where measures aimed at higher agricultural production can alter natural fish habitats.

At present, the reported global capture fisheries production from freshwater ecosystems, including rivers and lakes, is about 7.5 million tonnes. Actual catches, however, are believed to be significantly higher and could be as much as double the reported statistics.[2] Except for some industrial commercial fisheries in the Great Lakes of Africa and North America, most inland capture fisheries are small-scale by nature and much of the catch is destined for local consumption. Inland fisheries activities are often undertaken by farmers during the agricultural lean season when they provide needed food and income. Thus, the significance of freshwater catches for food security far exceeds what recorded production figures alone might suggest[3]. The importance of fish, particularly in the diet of rural communities, can be judged by its contribution to total animal protein intake. In many Asian countries, over one-half of animal protein intake comes from fish, while in Africa the proportion is 17.5 percent. Moreover, recreational fisheries in inland waters are gaining more economic importance in Asia, Europe and North and South America, where they serve as valued tourist attractions.

In spite of their nutritional and economic importance and their significant future development potential, inland fisheries landings relative to outputs from other fishery production systems have been waning over the past few decade[4]. The diminished role of inland fisheries has to some extent resulted from physical and chemical changes in the aquatic environment, brought about by agricultural practices such as damming, wetland reclamation, drainage and water abstraction and transfer for irrigation. Recent experience has shown that these environmental changes are often reversible, in which case fisheries habitats can be restored without compromising agricultural production. In other cases, changes can be anticipated and planned for in a way that enhances fisheries potential beyond natural productivity. The full range of fisheries enhancement techniques – including stocking, the modification of water bodies, fertilization and the introduction of genetically improved species – can only be realized when human-induced changes are planned and implemented in an integrated manner that prevents harmful effects on fisheries resources and their habitats.

Aquaculture is one of the world's fastest-growing food-producing sectors, providing an important supplement to and substitute for stagnating yields from wild fish stocks. The importance of aquaculture for future food security was acknowledged by the 1996 World Food Summit, which agreed "to promote the development of environmentally sound and sustainable aquaculture well integrated into rural, agricultural and coastal development". Over the last decade, aquaculture production increased at an average compounded growth rate of nearly 11 percent per annum. By 1996, total annual production of cultured fish, molluscs, crustaceans and aquatic plants reached a record

34.12 million tonnes, valued at $46.5 billion. Of special importance is the fact that more than 85 percent of total aquaculture food production came from developing countries, and in particular from low-income food-deficit countries (LIFDCs). Production within this group is concentrated in Asian countries, with China being by far the largest producer.

Annual aquaculture production is projected to exceed 40 million tonnes by 2010[5]. Much of this increase is expected to come from the farming of fish and crustaceans in ponds, enhanced production in small and medium-sized water bodies and integrated fish and crustacean farming, primarily with rice but also with vegetables and other crops as well as livestock. Efficiency in the use of water (particularly freshwater) and land resources is becoming a crucial factor in sustaining high growth rates. In many areas where aquaculture has rapidly expanded over the last decade, there is growing pressure on limited land and water resources, and planning for integrated fisheries and agricultural development is therefore of the utmost importance.

THE BENEFITS OF INTEGRATION

The overall objective of integrating fisheries and agriculture is to maximize the synergistic and minimize the antagonistic interactions between the two sectors. The former are mainly derived from the recycling of nutrients arising in the course of agriculture-livestock-fish production processes, from integrated pest management and from the optimal use of water resources.

Antagonistic interactions arise from: the application of pesticides and herbicides that harm aquatic living organisms; the eutrophication of inland water bodies and near-shore coastal waters caused by nutrient runoff (after excessive or inappropriate chemical fertilizer application); soil erosion, which increases the sediment load of natural watercourses; alterations to the hydrological regimes of rivers, lakes and other natural water bodies; drainage of wetlands and swamps; and the obstruction of fish migration routes.

The benefits to be gained from maximizing and minimizing synergistic and antagonistic interactions, respectively, are examined in the next section. Following this is a discussion on how institutional constraints can be overcome at various levels to achieve a better integration of the two sectors.

Optimal nutrient use through by-product recycling

Agricultural by-products, such as manure from livestock and crop residues can serve as fertilizer and feed inputs for small-scale and commercial aquaculture. After availability of freshwater, the existence of livestock and agricultural crop production systems is the principal factor influencing aquaculture potential in countries and regions[6].

Resource scarcity is commonly the overriding incentive directing technical and institutional change towards higher levels of efficiency. Sophisticated techniques and institutional arrangements for managing resource use can be found in areas of both high and low population densities, depending on the abundance of resources. In arid areas with a low population density, for example, complex systems for the allocation of scarce freshwater resources are known to have existed for centuries[7].

Integrated farming in China dates back to more than 2 400 years ago, when it involved a complex complementary system combining fish polyculture with poultry, livestock and crop production and the integrated use of manure, grass and other crops as feed and fertilizer[8]. Rotational farming of rice and shrimps has a long history in the intertidal zones of Bangladesh, India, Indonesia, Thailand, Viet Nam and other Asian countries[9]. Globally, integrated farming systems are receiving increasing attention. In Argentina, Brazil, Haiti, Panama and Peru, the technical feasibility of rice-fish farming is being studied. Concurrent and rotational cultivation of fish and crustaceans with rice are also attracting interest in economically advanced countries: in the United States and Spain, while the revival of rice-fish culture is being considered in Italy. Although the scientific foundations of these systems as well as their regional diversity have yet to be fully understood, there is no doubt about their high level of efficiency, particularly regarding the use of natural resources. The extent of potential efficiency gains from integrated farming systems may be gauged by a report of the Indian Council of Agricultural Research[10] citing a twelve-fold increase in economic benefits from integrated rice-fish systems combined with vegetable or fruit crops grown on the bunds, as compared with traditional rice farming.

Generally, integrated pest management (IPM) practices are recommended for rice-fish farming. The use of pest- and disease-resistant rice varieties is encouraged to minimize the use of pesticide. In rice

monoculture, the chance of pests reaching a population level that economically justifies definite control action is usually low, and the potential income to be gained by integrating fish production shifts the economic threshold to a level that is even less likely to justify pest control. From the point of view of IPM, fish culture and rice farming are complementary activities because it has been shown that fish reduce pest populations. In Indonesia, evidence from the Inter-country Programme for Integrated Pest Control in Rice in South and Southeast Asia shows that the number of pesticide applications in rice-fields can be drastically reduced through IPM. Such a reduction not only lowers costs but also eliminates an important constraint to the adoption of fish farming. With savings on pesticides and additional earnings from fish sales, increases in net income on rice-fish farms are reported to be significantly higher than on rice monoculture farms by widely varying margins of 7 to 65 percent[11].

In Viet Nam recent, experiments have demonstrated the effectiveness of carp as a means of biological control of snails, both in rice-fields and communal water reservoirs. In the Republic of Korea, researchers are focusing on the impact that indigenous fish species have on malaria vectors in rice-fields[12].

Efficient use of water resources

In economic terms, water use efficiency may be measured by the net economic benefits attained per unit of water. Fish and crustaceans are grown in artificial water bodies such as village tanks, reservoirs and channels whose primary purpose is water abstraction, storage and transport for use in agriculture and/or power generation and as drinking water. Engineering details of construction as well as seasonal water abstraction and use schedules can influence the potential of these structures for fish production. For example, rapid drawdowns in reservoirs may cause the loss of vital spawning habitat, thereby limiting fish production.

Under irrigated conditions, water losses associated with evaporation and seepage can be minimized by applying drip irrigation and by storing and transporting water in covered or underground structures. Since such measures impede fish production, however, the advantages of preventing water evaporation need to be compared with the economic and nutritional benefits derived from fish. Except for arid and semi-arid areas, water scarcity and evaporation rates may be too low to justify the cost of installing closed systems and forgoing the opportunities offered by fish production.

Apart from the production of fish, the benefits gained through enhanced fish culture in reservoirs and channels often derive also from the maintenance of water quality and the physical functions of these bodies. Stocking with grass carp, for example, controls aquatic weeds in irrigation channels, thereby facilitating water flow and reducing evaporation rates during water transport. Stocking and fish culture can also reduce human health hazards caused by mosquitoes and other insects. Moreover, fish can be used to harvest certain plankton species and aquatic weeds, and thus indirectly reduce nutrient levels, thereby minimizing the harmful effects of eutrophication.

Use of biocides

The extent to which fish are able to tolerate pesticides and herbicides, including their residues, is an acknowledged indicator of the potential human health hazards associated with the use of these products in agriculture. Significant advancements have been made in recent decades in limiting undesired harmful effects of chemicals applied for pest and weed control. In fact, the negative impact of biocides on fisheries is often caused not so much by their use but rather by their inappropriate application, which may have wide-ranging effects on fish and other aquatic organisms. Mortality is not the only negative effect; equally serious consequences of biocide misuse include changes in an organism's reproduction system, metabolism and growth patterns, in food availability and in population size and numbers, etc. If biocides are applied according to prescription, the risks for fish and fisheries can be minimized. Many governments have established lists of recommended pesticides and herbicides and have laid down regulations on imports and domestic production, while extension programmes and training of farmers in their correct use have expanded. All these measures help to reduce the risks of pest and weed control for fisheries and human health.

Eutrophication

Nutrient runoff from fertilized agricultural fields and urban and industrial sewage discharge are the two main causes of nutrient enrichment of inland waters, near-shore marine waters and semi-enclosed water bodies such as the Mediterranean and Black Seas. The fisheries potential of nutrient-poor water bodies may initially increase owing to the enhanced availability of nutrients associated with agricultural runoff and other effluent, as has most likely happened in the Mediterranean Sea, which historically has been a nutrient-poor water body.

Overloading or excessive nutrient enrichment, however, can result in eutrophication, which may severely affect the reproduction, growth and survival of fish and other aquatic organisms by creating anaerobic conditions and by causing physical damage and intoxication associated with the occurrence of harmful algal blooms. Increasingly frequent occurrences and larger sizes of harmful, sometimes toxic, algal blooms in coastal marine waters have caused substantial losses to coastal fisheries and aquaculture over the last two decades.

The contribution of agriculture to nutrient loading is often relatively small, but it is not insignificant. The introduction of sewage water treatment systems in the Austrian, German and Swiss communities and towns around Lake Constance over the past 20 years has led to a significant reduction in the lake's nutrient loading.

Alterations in hydrological systems

Many of the world's large and small river basins have undergone major human-induced changes in their hydrological regimes over the past 40 to 50 years. In some European river systems such as the Rhine, control measures were taken as far back as 100 years ago or more. The construction of dams, reservoirs, embankments, barrages and channels for purposes of water abstraction and storage, flood control, power generation and irrigation have produced large economic benefits. In some cases, these changes have also yielded large gains for fisheries in reservoirs, such as in Lake Kariba in Africa, as well as in irrigated rice-fields whose full fisheries potential still remains to be realized in many parts of the world.

In many other instances, modifications in hydrological systems have caused drastic declines in natural fish populations and dramatically reduced fish catches and incomes from fishing. In some cases where fish migration routes and spawning and nursery areas have been lost, species have become extinct. In many rivers of Europe, for example, wild stocks of salmon, sturgeon and Allis shad no longer exist.

Past experiences have greatly improved scientific knowledge regarding the short-term and long-term consequences of different designs and features of structural alterations to river basin hydrology. This expertise can now bear fruit by preserving the essential ecological features that sustain wild fish stocks and/or create optimal conditions for fish production in new reservoirs and channels. According to current ideas in the field of integrated water resources management (IWRM), ecosystems such as seasonal floodplains and coastal wetlands and estuaries are major water users that provide essential permanent and seasonal habitat for fish and serve as repositories of aquatic biodiversity[13]. Wetlands are also important fish nurseries.

Soil and groundwater salination

In general, most culture-based fisheries and aquaculture activities have no or few significant negative environmental effects and are highly complementary to agriculture. However, shrimp culture practices have been associated with reduced agricultural yields in certain localities where soil conditions allowed saline water to seep through embankments and pond bottoms into adjacent fields. In addition, excessive abstraction of groundwater for various purposes such as agriculture, domestic water supply, industrial activities and, in some cases, shrimp culture, are causing seawater intrusion into coastal aquifers. Appropriate planning and allocation of land and water resources in coastal areas can help minimize the degradation of groundwater and soil quality resulting from salination. Furthermore, there are numerous experiences of the beneficial coexistence of coastal aquaculture and agriculture; for example, the rotational systems of rice-fish or rice-shrimp culture, where advantage is taken of saltwater-resistant paddy, an abundant freshwater influx in the rainy season and the opportunity to cultivate brackishwater aquaculture species.

APPROACHES TO BETTER INTEGRATION

Human resource development and institutional strengthening are widely held to be the principal requirements for improving integration at the level of individual farms and communities, in river basin and coastal area management and at the level of sectoral and macroeconomic policies. At the farm level, attention needs to focus first on resource use efficiency and the economic incentives that influence farmers when they decide on cropping patterns and the use of water, fertilizer, pesticides and herbicides and other inputs. Next, the emphasis should be on farmers' knowledge of available production and pest management options as well as on their ability to apply these. Agriculture and aquaculture offer a large variety of cropping patterns under different climatic and soil conditions. If they have the right skills, together with access to the necessary inputs, farmers will adopt the farming or aquaculture system that is most suitable and economically advantageous for their specific situation. Extension and training are crucial for informed decision-making, and physical infrastructure, efficient input markets and credit

facilities are indispensable for the optimal development and integration of farming and aquaculture systems.

Markets for certain important natural resource inputs, such as water, and the environment's capacity to assimilate effluent are often entirely non-existent or distorted because of their common property or open access nature. The levying of use fees and/or the introduction of tradable rights have been suggested to achieve a higher level of efficiency in the use of water and other natural resources such as wild fish stocks. Resource management through such market-based instruments can entail high administrative costs because of the need to monitor individual farmers' resource use and to institute well-defined and enforceable individual user rights. Where tradable rights are applicable, they may reinforce an inequitable distribution of incomes and assets, especially where other services (e.g. for credit) are inefficient.

The alternative approaches of co-management and community-based management of common property resources have received increasing attention in recent years because of their assumed greater efficiency and prevention of undesired distributional implications. Factors that users themselves have identified as being important for successful resource management include: small group size, which facilitates the formulation, observance and monitoring of a collective agreement; social cohesion; resource characteristics that facilitate the exclusion of outsiders; and visible signs of successful collective management[14]. These factors could well apply to a number of fisheries in reservoirs and other small water bodies, where the potential for self-management, however, is not utilized because responsibility is not delegated to the local level and collective rights are not sufficiently protected. Similar favourable conditions exist in many other situations, for example for resources such as water and mangrove forests where, again, the potential for effective management has yet to be realized. In addition to the recognition of common rights, community-based and co-management need support through extension and training services and scientific assessments of resource abundance.

At the level of river basins and coastal areas, integration is aimed at managing sectoral components as parts of a functional whole, explicitly recognizing that management needs to focus on human behaviour, not physical stocks of natural resources such as fish, land or water. Integrated river basin and coastal area management employs a multi-sectoral strategic approach to the efficient allocation of scarce resources among competing uses and the minimization of unintended natural resource and environmental effects[15]. Land use planning and zoning, together with environmental impact assessment procedures, are vital tools for preventing the occurrence of antagonistic inter-sectoral interactions and for fostering synergistic and harmonious development while preserving ecosystem functionalities. The involvement of fisheries agencies in these activities therefore is absolutely essential.

The participation of all resource users and other stakeholders at an early stage is indispensable for effective land use planning and zoning, not least because of their intimate knowledge of local socio-economic conditions and the state of natural resources. At the government level, the functions of the various agencies with regulatory and development mandates need to be well coordinated. Two broad distinctions can be made in the wide range of possible institutional arrangements for integrated river basin and coastal area management:

Multi-sectoral integration. This involves coordinating the various agencies responsible for river basin and coastal management on the basis of a common policy and bringing together the various government agencies concerned as well as other stakeholders so that they can work towards common goals by following mutually agreed strategies.

Structural integration. Here, an entirely new, integrated institutional structure is created by placing management, development and policy initiatives within a single institution.

Multi-sectoral coordination tends to be preferred, since line ministries are typically highly protective of their core responsibilities and the associated power base and funding. The establishment of an organization with broad administrative responsibilities overlapping the traditional jurisdictions of line ministries as would be the case if management, policy and development functions were integrated within a single institution – is often likely to meet with resistance rather than co-operation. Integration and co-ordination should be thought of as being separate but mutually supportive[16].

However, a caveat has arisen from experiences to date. Integrated planning and institutional coordination are often difficult to achieve and can entail significant costs. The difficulties and costs relate to the often cumbersome bureaucratic structures and procedures of government agencies; the complexity of the scientific, technical and economic issues involved; and the potentially large

number of informed decisions that need to be taken. In addition to high administrative costs, the decision-making process could be protracted and may unduly slow down economic development.

Many river basin and coastal management issues can be addressed through sound sectoral management, but taking into full account the impacts of and interdependencies with other sectors and ecosystem processes[17]; the provision and enforcement of environmental legislation; the need for a transparent and consultative process of land use planning and siting; and the design of major infrastructure projects such as dams. The costs of a formal process for the preparation of a river basin or coastal area management plan are always likely to be justified in areas where intense multi-sectoral resource utilization either exists or is planned.

At the macro level, economic policies such as subsidies for production inputs and import and export duties can have profound impacts on the characteristics and level of resource use as well as on the occurrence of undesirable environmental effects. The advantages of subsidizing chemical inputs such as fertilizer and pesticides need to be weighed against the potential harm they can do to aquatic environments and to fishery resources, which provide food for fishers and fish consumers alike.

CONCLUSION

Modern advances in information and data processing technologies have dramatically increased the capacity of humans to analyse complex multiple resource-use options and to link up large numbers of people into integrated decision-making structures. At the same time, new research findings have greatly broadened the understanding of local communities' ability to co-ordinate common property resource use while maintaining their essential social and cultural attributes. Finally, governments have become more aware of sectoral and environmental inter-dependencies. Such all-round progress has created conditions favourable to the full realization of benefits resulting from the enhanced integration of fisheries and agriculture as well as their integration with the rest of the economy.

[1] This article was prepared by Rolf Willmann, Matthias Halwart and Uwe Barg. Valuable comments on earlier drafts were received from Bram Born, Richard Grainger, James Kapetsky, Gerd Marmulla and Krishen Rana.

[2] A household food consumption survey undertaken in north-eastern Thailand, for example, has revealed that fish consumption was five to six times higher than reported fish catches from the Mekong River (Mekong *Fisheries Network Newsletter*, August 1996, 2 (1)).

[3] The importance of inland fisheries for food security has been highlighted by Coates, D. 1995. Inland capture fisheries and enhancement: status, constraints and prospects for food security. KC/FI/TECH 82p. Contribution to the International Conference on sustainable Contribution of Fisheries to Food Security, Kyoto, Japan, 4-9 December 1995, organized by the Government of Japan, in collaboration with the Food and Agriculture Organization of the United Nations (FAO).

[4] FAO. 1997. Inland Fisheries. FAO *Technical Guidelines for Responsible Fisheries* N° 6. Rome, FAO.

[5] FAO. 1997. Review of the state of world aquaculture. *FAO Fish. Circ. 886, Rev. 2. Rome, FAO. 163p.*

[6] The development of agriculture implies that at least a minimum amount of physical and institutional infrastructure has already been developed. Kapetsky and Nath conclude that, in general, the conditions encouraging agriculture favour aquaculture development and vice versa. This fact has been used by these authors and by Aguilar-Manjarrez and Nath in their estimates of aquaculture potential in Africa and Latin America. See J.M. Kapetsky and S.S. Nath in FAO. 1997. A strategic assessment of the potential for freshwater fish farming in Latin America. COPESCAL *Technical Paper* N°. 10. Rome; and J. Aguilar-Manjarrez and S.S. Nath in FAO. 1998. A strategic reassessment of fish farming potential in Africa. *CIFA Technical Paper* N°. 32. Rome.

[7] Many examples of traditional management of water resources and other common property or common pool resources can be found in National Academy Press. 1986. *Proceedings of the Conference on Common Property Resource Management.* Washington, DC.

[8] Network of Aquaculture Centres in Asia and the Pacific (NACA). 1989. Integrated fish farming in China. *Technical Manual* N°. 7.

[9] A recent review of the trends in rice-fish farming is provided by M. Halwart. 1998. Trends in rice-fish farming. In *FAO Aquaculture Newsletter*, N° 18: 3-11.

[10] K.C. Mathur. 1996. Rainfed lowlands become remunerative through rice-fish systems. *Indian Council of Agricultural Research News*, 2(1): 1-3.

[11] See M. Halwart. 1998. *Op. Cit.*

[12] Ibid.

[13] A comprehensive discussion on this issue took place during the Expert Group Meeting on Strategic Approaches to Freshwater Management, organized by the UN Department of Economic and Social Affairs and held in Harare, Zimbabwe, 27-30 January 1998.

[14] See E. Ostrom. 1990. *Governing the commons. The evolution of institutions for collective action*. Cambridge, UK, Cambridge University Press; and J.-M. Baland and J.-P. Platteau. 1996. *Halting degradation of natural resources. Is there a role for local communities?* Published for FAO by Oxford University Press (Clarendon academic imprint), UK.

[15] Fallon Scura, L. 1994. Typological framework and strategy elements for integrated coastal fisheries management. FAO/UNDP Project INT/91/007 "Integrated Coastal Fisheries management". FI:DP/INT/91/007. Field Document 2. Rome. 23p.

[16] For this and other aspects of integration, such as conflict management and economic valuation of natural resources, see the detailed discussion in FAO. 1998. *Integrated coastal area management and agriculture, forestry and fisheries.* Edited by N. Scialabba. Rome.

[17] This has been named "enhanced sectoral management" in a recent survey of coastal management programmes. See S. Olsen, K. Lowry, J. Tobey, P. Burbridge and S. Humphrey. 1997. Survey of current purposes and methods for evaluating coastal management projects and programs funded by international donors. *Coastal Management Report N°. 2200*. Coastal Resources Center, University of Rhode Island, USA. A detailed discussion of integration aspects with respect to inland fisheries is provided in U. Barg, I.G. Dunn, T. Petr and R.L. Welcomme. 1996. Inland Fisheries. In A.K. Biswas, ed. *Water Resources Environmental planning, management and development*. New York, McGraw-Hill.

AQUACULTURE PRODUCTION IN CHINA

Krishen Rana, Maurizio Perotti,
Sara Montanaro and Anton Immink
Fisheries Information, Data and Statistics Unit

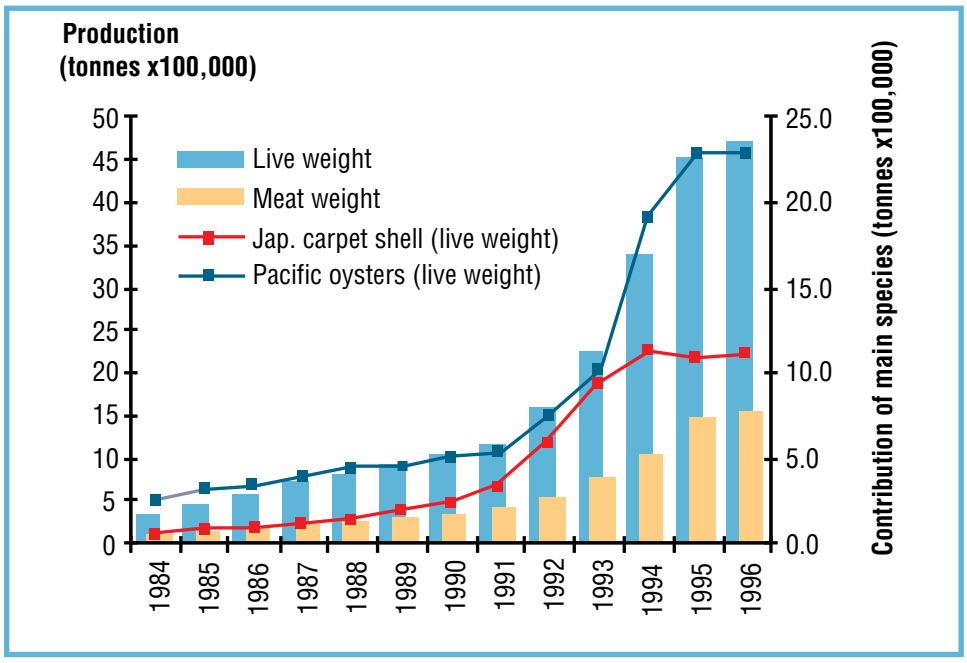
China's underestimated national aquaculture production and global contribution addressed and rectified by FAO

The Fisheries Information, Data and Statistics Unit (FIDI) of the Food and Agricultural Organization (FAO) has been systematically collecting analysing and disseminating data on global aquaculture production by weight and value (US$) since 1984. In parallel, the mechanisms for collecting data and the coverage and quality of data on production from aquaculture provided by countries to FAO have been constantly under review with the aim of improving their accuracy, quality, scope and relevance to future national and global needs as well as ensuring reporting according to international norms and standards

China continues to dominate world aquaculture production. Her share of global aquaculture (including plants) increased from 37.7% or 3.8 million tonnes in 1984 to 67.8% or 23.1 million tonnes in 1996. Therefore any changes in Chinese aquaculture development or reporting may greatly influence global fisheries production. It has recently come to light that China has been reporting production statistics of three molluscs species: the blood cockle, Japanese carpet shell, Pacific cupped oyster and unclassified marine molluscs, to FAO as shelled or shucked weight. Consequently, to date, the contribution of:

- shellfish (molluscs and crustaceans) to Chinese and global aquaculture,
- Chinese aquaculture to their national fisheries landings,
- Chinese aquaculture to global aquaculture and
- Global aquaculture to world fisheries landings have been understated. This year FAO, in consultation with the Chinese

Figure 1. Increase in reported Chinese production of the sum of three shellfish species and unclassfied molluscs resulting from converting meat to whole live weight



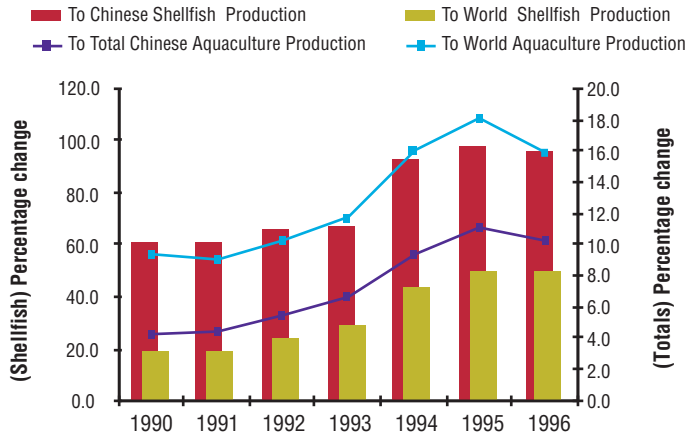
Ministry of Agriculture, adjusted Chinese and global aquaculture production statistics and reflected these in its databases, time series and subsequent analysis.

While acknowledging that meat or shucked weight may be appropriate units for expressing production, the standard practice of FAO and other international fishery organisations is to report aquatic production as "nominal catch" which is the live weight equivalent. When the production of species reported to FAO is known to be given as dry or shelled weight, appropriate conversion factors are applied to convert these to live weight equivalent to ensure international comparability. In the case of China, the FAO statistics for three shellfish species: the blood cockle, Japanese carpet shell, Pacific cupped oyster and unclassified marine molluscs, were adjusted from shucked to live weight equivalents using conversion factors of 1.35, 2.13, 6.11 and 2.13, respectively, provided by the Chinese Ministry of Agriculture.

The implication of converting reported production from meat to live weight for Chinese production between 1984 and 1996 is shown in Figure 1. During this period the total Chinese production (live weight) statistics of these shellfish increased from 347 000 tonnes to 4.70 million tonnes. Therefore previous reporting of these shellfish by FAO underestimated their production by 255 000 tonnes or 276% in 1984 and 3.16 million tonnes or by 205% in 1996. In view of the rapid increase in their production after 1990 (see Figure 1) the impact of these changes are only highlighted here for 1990 to 1996. The exponential increase between 1990 and 1996 is due to a combination of the rapid expansion rate in the culture of Japanese carpet shell and particularly the Pacific oyster (Figure 1). Between 1984 and 1996 these two species accounted for 71-85% of total shellfish production.

Following the conversion, the reported production statistics of Chinese shellfish (molluscs and crustaceans) increased from 1.32 to 2.0 million tonnes or by 52% in 1990 and from 3.49 to 6.64 million tonnes

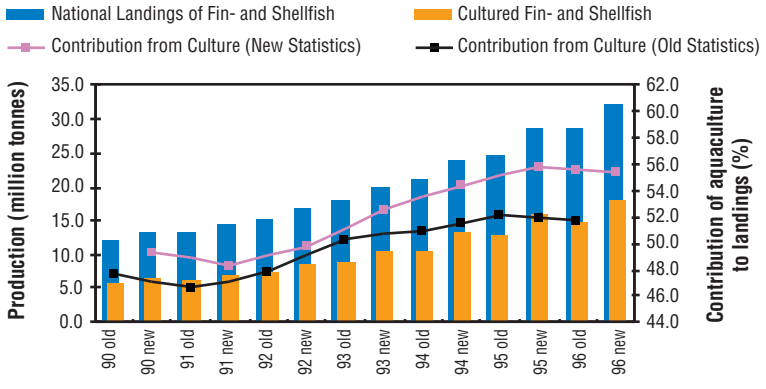
Figure 2. Increases arising from adjusting meat to live weight for three shellfish species and unclassified molluscs from culture on reported production



or by 90.5% in 1996 (Figure 2). The contribution of Chinese shellfish production to global cultured shellfish production increased by 18% in 1990 and by 49% in 1996 (Figure 2). The increase in the quantity of adjusted shellfish production also greatly changed the statistics on estimated total Chinese aquacultural output. The total reported aquaculture production, including plants, for China increased from 7.5 to 8.2 million tonnes or by 9% in 1990 and from 20.0 to 23.1 million tonnes or by 15.8% in 1996. The new higher reported production statistics also altered the contribution of cultured fin- and shell-fish to Chinese fin- and shell-fish landings (Figure 3). Between 1990 and 1996 their contribution to national fin- and shell-fish landings increased by 1.5 and 3.8%, respectively.

At the global level, the statistics on China's aquacultural contribution to world aquaculture production increased. For 1990 its contribution rose from 46.5 to 48.7%, and in 1996 from 64.5 to 67.8%. Similarly, the contribution of global cultured finfish and shell-fish to total world fin- and shell-fish fisheries increased by 0.6% in 1990 and 2.1% in 1996 to 13.3 and 21.8%, respectively. Finally, the contribution of global aquaculture production, including plants, to world aquatic production increased by 0.6% in 1990 and by 1.8%, 1996, to 16 and 26%, respectively.

Figure 3. Apparent increases in the contribution of aquaculture to Chinese national landings. The "old" and "new"on the time axis refers to values based on old and new statistics, respectively



RESOURCE USE IN AQUACULTURE AND INLAND FISHERIES

Summary report of the EIFAC symposium on water for sustainable inland fisheries and aquaculture

1. A Symposium on Water for Sustainable Inland Fisheries and Aquaculture was convened in conjunction with the Twentieth Session of the European Inland Fisheries Advisory Commission (EIFAC) in Praia do Carvoeiro, Portugal, from 23 to 26 June 1998. The Symposium was convened by Mr R. Müller (Switzerland) and chaired by Mr H. Ackefors (Sweden). The Symposium was attended by 68 participants from 23 countries.

Assessment of quantitative and qualitative characteristics of water resources

2. Ground and surface freshwater resources are finite but demand on them from various sectors and interests in society is increasing. Growing scarcity is therefore leading to competition between the various users including fisheries and is becoming a major issue in Europe and elsewhere. The intensification of use is also leading to greater pressure on water quality through pollution and eutrophication.

3. It was concluded that inland fisheries planners and administrators need to participate pro-actively in fora at all levels concerned with the allocation of water and management of living aquatic resources. Such participation is necessary to:

a) ensure that water is assigned for the maintenance of aquatic ecosystems and living organisms. Such allocation should include criteria for water use, including quantity, quality and timing which should be established on the basis of scientific evidence;

b) ensure that the aquaculture sector is not penalized by unrealistic requirements for effluent quality. It was recognized that for its part the aquaculture sector would need to be responsible in its approach to improving the quality of its discharges;

c) limit the potential damage resulting from introductions and transfers of exotic fish, and other animals and plants within the inland waters of Europe; and

d) promote awareness and knowledge of the social, economic and environmental significance of inland fisheries and aquaculture among decision-makers and stakeholders at all levels.

Water requirements of inland aquaculture systems

4. Aquaculture was established originally in regions where water resources were readily available but supplies are now becoming a limiting factor in some areas due to population increase, industrialization, environmental concerns and other factors. Several fish farms have had to convert from production to nature conservation or recreational areas. Other intensive fish farms are also having problems in the disposal of their effluents. Despite these difficulties, the need for fish as healthy food is increasing, and efforts are being made in many countries to increase the proportion of fish in the diet. However, given current circumstances, studies and trend analyses indicate that some conventional aquaculture systems need to evolve and adapt to changing social, economic and environmental conditions in many European countries.

5. Aquaculture must be accepted and legally recognized as a legitimate user of water.

6. The availability of freshwater resources for aquaculture production will continue to decrease in the future but new methods and production systems are available for the more efficient use and protection of those water resources that remain. While there is little need to introduce these into many countries at present, medium-and long-term planning of aquaculture development should consider their potential for the future. Research and development of new types of water efficient fish production systems should get priority in formulating R&D programmes.

7. The possibility of integrating aquaculture into irrigation systems should be considered as an option for improved efficiency of water use. However a flexible approach is suggested which uses all types of habitat created by existing agronomic practices, the hydrological cycle and the features of the landscape. The principle of integration may also be applied on a wider scale, and more active collaboration among the various water users, planners and administrators is necessary. Collaboration between countries in which water shortage already exists and where such problems are anticipated in the future should also be promoted in order to exchange information and execute joint projects.

Water requirements for inland fisheries

8. Fisheries scientists have an acceptable level of knowledge on the theoretical water quantity and quality requirements for fish for many aquatic ecosystems. Increasing pressures on water resources, coupled with a heightened public demand for truly sustainable development, means there are now key cross-disciplinary considerations related to the need to manage the environment as a whole. There is an increasing need for a better understanding of the different demands placed on the aquatic system and how these demands relate to one another. There is also a need for improved communication and acceptance of how the requirements of one user will modify and compromise those of another.

9. Water resources are generally under pressure under existing demand regimes. There is significant scope for reducing demand and managing impacts in order to comply with new environmental awareness. Given current levels of demand it will not always be possible to protect the environment fully, but the appraisal process must be carried out so as to balance priorities and apply mitigation measures.

10. Current knowledge is sufficient for technical interventions to mitigate continuing damage by other users or to rehabilitate impacted systems. Public incapacity to improve the aquatic system lies more in the sphere of policy making and allocation among different user groups. The new need is for political processes that will facilitate compromise by stakeholders and favour integrated resource management.

11. Fishery scientists should continue to build understanding of the impacts of hydrological change on fish communities. Robust environmental appraisal processes must be

carried out to properly balance resource priorities, guide decisions on allocation and on any mitigation measures that may be necessary.

12. It is important that concepts of social and economic value and use are developed for inland fisheries so that fisheries interests can be properly represented in the allocation debate. Collaboration with local stakeholders and with other groups expressing public concern for the environment should be sought in order to influence planners and politicians.

13. Stocking of new species in stressed systems may provide alternative fishery resources but potential risks to the wider environment should be carefully considered and the appropriate guidelines respected.

Water resources issues and conflicts

14. Increasing demand for aquatic resources by a diverse array of user groups has resulted in environmental degradation, loss of habitat and conflict between various stakeholder groups. The mechanisms for assessing the impact of various activities are reasonably well established but overcoming the problems is still complex. This is because mechanisms for resolving conflicts within fisheries and between fisheries and other users are only now being developed. The key problem to be addressed is the promotion of sustainable use of water resources at an optimal level of exploitation, acceptable to all users whilst maintaining the potential to meet the needs and expectations of future generations.

15. If aquatic resources are to be exploited on a sustainable basis in the future, concerted effort is needed to resolve the conflicts between user groups. Where possible, this must be based on available scientific evidence, close liaison between user groups, full cost-benefit analysis and transparency in the decision-making process. If this is to be successful it must involve cross education of all user groups, recognition of stakeholder participation and needs, and be implemented at the local community level. It is recommended that aquatic resource planning and management tools such as the river basin management plans being developed by the European Union member countries be used to facilitate the process of integrated water resource management.

16. The proper representation of fisheries requires improved long-term trend analysis, and assessment of economic and social value of fisheries and associated externalities. It is recommended that priority be given to developing and promoting economic evaluation of inland fisheries and marketing of its products. There is also the need for robust methods for prioritizing demands for aquatic resources, which balance human requirements against the protection of the environment and biodiversity.

Strategic planning of water resources

17. World food production has to be increased over the next three decades to satisfy the additional demands of a world population, which is expected to grow to about eight thousand million by 2025. It is not anticipated that substantial increases in supply can be obtained from oceanic fisheries. Therefore, any future growth in fish protein supply will have to come from aquaculture and enhancement of wild fisheries. In view of the problems of water supply caused by growing demand existing aquaculture production using conventional methods is likely to be endangered. Those responsible for the inland fisheries and aquaculture sectors in Europe and elsewhere must take part in the wider discussions and decisions concerning future water resources allocation and water quality management.

18. It was concluded that:

a) EIFAC member countries should be aware of a growing demand for fish in the near future that cannot be filled by catches from the sea or from natural inland waters;

b) against the background of growing world population future demand for fish will have to be satisfied through aquaculture and fish stock enhancement;

c) therefore those responsible for decisions on ground and surface water allocation and management at all administrative and technical levels must make adequate water available for aquaculture and for maintenance of quantity and timing of stream flows;

d) greater efforts in the development of more efficient purification systems are needed to protect ground and surface water from unacceptable pollution deriving from urban and industrial drainage systems; and

e) there should be a comparable emphasis on river and lake rehabilitation and improvement to maintain and enhance valuable recreational, commercial and subsistence fisheries.

CONCLUSIONS AND RECOMMENDATIONS

19. The participants at the Symposium on Water for Sustainable Inland Fisheries and Aquaculture proposed the following recommendations for adoption by the Twentieth Session of EIFAC:

a) Authorities and those in charge of fisheries and aquaculture development must seek collaboration with other agencies and other sectors of society in order to improve coordination of resource management.

b) It is vital that governments empower fisheries and aquaculture authorities to promote actively the interests of inland fisheries and aquaculture, as well as adequately participate in resource management decision-making.

c) Authorities in charge of fisheries and aquaculture need enhanced capacity to implement policies and regulations related to management of living and physical aquatic resources. Greater resources must be made available to these authorities. It is realized that in many cases these authorities lack manpower and financial and information resources to be able to participate actively in intersectoral negotiations and policy-making. There is a need for research and development to fill key information gaps.

d) There is a need for management strategies for water resources in general that incorporate the needs of inland fisheries and aquaculture. Those responsible for water allocation should consult with fisheries and aquaculture authorities. Authorities responsible for fisheries, aquaculture and water resource planning should collaborate to formulate appropriate strategies, identify options for their implementation and identify key stakeholders who should participate in this process. These strategies must encompass a range of aspects including social, economic and recreational considerations, biodiversity and the wider aquatic environment.

e) In view of river basin management plans which have to be prepared for a deadline of December 1999 in the EU member states, authorities representing inland fisheries and aquaculture management must identify groups responsible for the production of these plans and ensure that the needs of inland fisheries and aquaculture are adequately represented in the plans.

f) Key government departments must recognize that inland fisheries have economic, social, biological and other values. For inland fisheries and aquaculture to be properly represented in the allocation of resources there is a need for improved economic and social evaluation of fisheries, aquaculture and associated aspects. It is recommended that priority is given to developing and promoting economic and social evaluation of inland fisheries, aquaculture production, fishing communities, fish populations and aquatic environments in general.

The report of the EIFAC Symposium on Water for Sustainable Inland Fisheries and Aquaculture will be published in:
Report of the Twentieth Session of the European Inland Fishery Advisory Commission, Praia do Carvoiero, Portugal, 23 - June - 1 July 1998, as FAO Fisheries Report No. 580 (FIPL/R580), and is available on the Home Page of the FAO Fisheries Department:
http://www.fao.org/WAICENT/FAOINFO/FISHERY/body/eifac/1998rep1.htm

***FOR FURTHER INFORMATION, PLEASE CONTACT*:**
Dr Heiner Naeve, *Secretary of EIFAC*
e.mail: heiner.naeve@fao.org, or
Mr Uwe Barg, *Technical Secretary of the Symposium*
e.mail: uwe.barg@fao.org

IMPACTS OF INTRODUCTIONS ON THE CONSERVATION AND SUSTAINABLE USE OF AQUATIC BIODIVERSITY

Devin Bartley[1] and Christine V. Casal[2]

[1]Fishery Resources Division
[2]Biodiversity and Genetic Resources Programme
ICLARM, Manila, Philippines

The following was presented by D. Bartley at Session 4 of the International Conference on Sustainable Use of Aquatic Biodiversity: Data, Tools and Collaboration[1]. ACP-EU Fisheries Research Initiative, 3 – 5 September, 1998, Lisbon Portugal. The article will also be distributed on CD ROM along with the other contributions from the meeting through the ACP-EU Fisheries Research Initiative. The assistance of ICLARM and the other organizers is gratefully acknowledged.

Alien species[2] are receiving international attention in fora such as the Convention on Biological Diversity and the FAO Code of Conduct for Responsible Fisheries. While much of the recent attention has focused on the adverse impacts, not all alien species are bad. As in agriculture and ornamental horticulture, alien aquatic species have contributed to an improvement of the human condition in many areas. The production of the African cichlid tilapia is much higher in Asia (>700,000 mt in 1996) than in most areas of Africa (39,245 mt); introduced salmonids in Chile support a thriving aquaculture industry that is responsible for approximately 20% of the world's farmed salmon. The practice of using species outside of their natural range to increase production or profitability can be expected to continue. The issue is not to ban alien species, or to abandon regulation of their movement, but rather, as stated in international codes of practice (ICES 1995) and the Convention on Biological Diversity, to assess the risks and benefits associated with their use and then, if appropriate, develop and implement a plan for their responsible use.

Risk assessment will require information from a number of sources on a number of areas such as the biology, ecology, and genetics of the alien species. The information will need to be readily available and understandable to those performing the risk assessment and to policy makers. Risk assessment must also include benefit assessment; an accurate accounting of the benefits derived from exotic species is essential. This note details information from two databases that stemmed from collaborative efforts of the European Community, ICLARM and FAO – FishBase (Froese and Pauley 1997) and DIAS (Database on Introductions of Aquatic Species) (Welcomme 1988; Bartley *et al*. 1997). The records in the databases came from questionnaires distributed internationally, from the literature, and from personal communications. The purpose of the paper is to examine what type of information is needed to make reasonable risk assessments and to use the databases to examine the impacts of alien species.

Impacts

Impacts of introduced species will fall into two broad categories – i) ecological, which includes biological and genetic effects and ii) socio-economic (Table 1). However, these two categories are not independent and socio-economic changes brought about by alien species can in turn cause more ecological changes. Thus, a reduction in native species may be from direct interaction with an exotic species, or it may result from increased fishing pressure or changes in land use brought about by the presence of a newly established species.

FishBase is a relational database that allows comparisons of multiple data-sets. Links of the Introductions module to the FAO Fishery Statistics (FAO 1998) module revealed that the contribution introduced fishes make to total fish production is about 17% (Figure 1).

Table 1. Some potential adverse effects of alien aquatic species

EFFECT	MECHANISM - BIOLOGICAL	MECHANISM - SOCIAL
Reduction or elimination of aquatic species	Competition, hybridization, predation/herbivory, disease transmission	Change in fishing pressure and access to resources; treatment measures to enhance introduced species
Change in terrestrial fauna	Change in abundance of preferred prey	Fish farms providing more food for birds and animals or killing predatory birds
Change in fishery management	Change in stock composition	Successful introductions lead to other introductions
Alteration in habitat	Burrowing, sediment mobilization, removal of vegetation	Change in land use, e.g. creation of fish farms
Socioeconomic impacts	Change in species abundance or distribution leading to changes in fishing or consumption practices	Change in access rights,land tenure; financial liability for damages through national and interntional legislation

Table 2. Effects of introduced fishes on ecological and (socioeconomic) environments, by reason for the introduction. Data represents number of records from FishBase

	REASON					
IMPACT	FISHING	AQUACULTURE	ORNAMENTAL	BIO-CONTROL	UNKNOWN	OTHER
ADVERSE	36 (2)	78 (8)	17 (5)	23 (9)	13 (0)	40 (12)
BENEFICIAL	16 (87)	52 (283)	11 (42)	11 (19)	3 (10)	6 (15)
UNKNOWN	28 (16)	76 (49)	9 (9)	8 (2)		21 (3)
BLANK	196 (299)	949 (815)	169 (150)	106 (122)	459	283 (328)

Impacts may depend on the objective of the introduction. Analyses of the database reveals that aquaculture development was the most often cited reason for fish introductions, and that government organizations were responsible for more introductions than any other group. Table 2 presents information that most of the ecological effects of introduced species reported were negative; however, the socio-economic impacts were reported to be more often beneficial and there were more positive socio-economic benefits reported than negative ecological impacts.

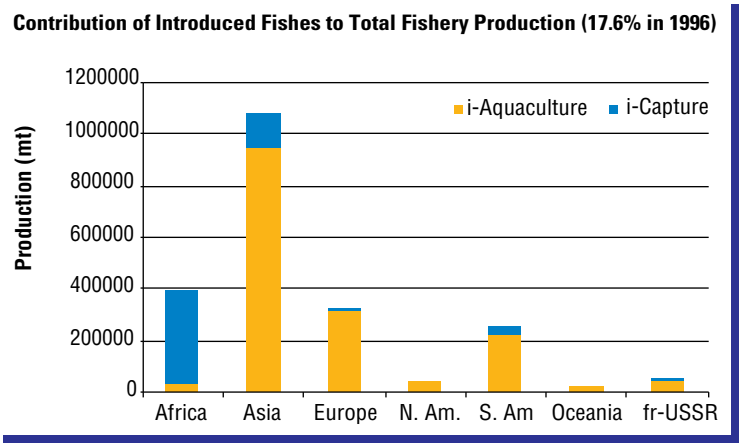


Table 3 presents some popular conceptions regarding impacts of alien species and how the databases can provide information to support or refute the generalizations. The purpose of challenging the broad generalizations is not to replace one generalization with another, but to provide some estimate of their validity.

The way forward

There are limitations to the present databases that must be born in mind when analyzing the data. Many of the data are from questionnaires distributed internationally and therefore may not be an accurate sample of species introduced or the actual impact of the introduction. Introductions that made a big impact would probably be preferentially reported, whereas introductions that did not work or produced only minor impact may be forgotten. In addition, the data-sets only report on the first introduction across national borders, subsequent introductions and movements of aquatic species within a country are not included.

FishBase, as the name implies, covers only fishes; DIAS includes other taxa, but is not a relational database. Efforts to include other taxa in FishBase, or a similar relational database are needed.

An accurate assessment of the impact of an alien species will only be possible if an accurate assessment of the "pre-introduction" ecological and socio-economic environments already exists. Unfortunately, in many areas of the world and especially in many inland areas of developing countries, this information is lacking. Chinese carp were introduced into barrier lakes in coastal Mozambique to establish aquaculture and a fishery with little or no knowledge of the species existing in this unusual habitat nor of the level of fishing activity the lakes already supported.

The Convention on Biological Diversity calls on Members to prepare and maintain a registry of alien species. The format of FishBase and DIAS may provide suitable models. The databases mentioned here focus on the species. This is understandable and effective for many purposes. However, in assessing risk from the movement of species from one area into another, a key factor is the receiving environment. National registries would be able to focus on more than the first introduction and could contain information on the environment that the alien has "invaded".

The amount of information necessary to predict accurately the impacts of alien species is extensive. Collaboration and sharing of information will be essential in order to take full advantage of the potential of alien species, while protecting aquatic biodiversity for present and future generations.

[1] Editor's note: editorial changes have been made to the original document.

[2] Other terms in use are introduced species and exotic species; all terms refer to species moved across international borders.

Catfish production in Thailand is based on the hybrid between the introduced African and the Thai catfish. Will hybrids affect native gene pools?

Table 3. Some popular conceptions regarding alien species

STATEMENT	INFORMATION FROM DATABASE	POSSIBLE BIASES IN DATA	REFERENCES
Most introductions fail	Where establishment was assessed, 65% of the introductions lead to established populations	Data from questionnaires, i.e. biased reporting	Moyle and Light 1996
Top carnivores are the most dangerous	Herbivores and carnivores were reported to cause negative impacts in >60% of the cases where impact was assessed, whereas the figure for omnivores was 81%	Small sample size of carnivore introductions	Moyle and Light 1996
r-selectd species[1] most likely to establish	Establishment success negatively correlated with max. size	Larger fish subsequently removed by fishing or other factors after establishment; larger fish take longer to establish noticeable populations	Pullin *et al*. 1997
Diverse environment hinders alien establishment	Data-set cannot address the issue		Moyle and Light 1996
Disturbed environment helps alien establishment	Data-set cannot address the issue		Moyle and Light 1996
Genome size inversely related to invasive ability	DNA content and chromosome number were not related to establishment success		Baker and Stebbins 1965

[1] species with high fecundity, short generation time, early age at maturity and usually small size.

REFERENCES

Baker, H.G. and G.L. Stebbins. 1965. The Genetics of Colonizing Species. Academic Press.

Bartley, D.M., L. Garibaldi, and R.L. Welcomme. 1997. Introductions of aquatic organisms: a global perspective and database. Presented to the American Fisheries Society Symposium: Impacts, threats and control of introduced species in coastal waters, Monterey, California, 28 August, 1997.

FAO. 1998. FAO FishStat PC. Fishery Information, Data and Statistics Unit. Food and Agriculture Organization of the United Nations, Rome, Italy.

Froese. R. and D. Pauley, Editors. 1997. FishBase 97. Concepts, design, and data sources. ICLARM, Manila, Philippines. 256p.

ICES. 1995. ICES Code of Practice on the Introductions and Transfers of Marine Organisms. International Council for the Exploration of the Sea, Copenhagen, Denmark. 5p.

Moyle, P.B. and T.L. Light. 1996. Biological invasions of freshwater: empirical rules and assembly theory. Biological Conservation 78: 149 – 161.

Pullin, R.S.V., M.L. Palomares, C.V. Casal, M.M. Dey and D. Pauly. 1997. Environmental impacts of tilapia. ICLARM Contribution No. 1350.

Welcomme, R. L. 1988. International Introductions of Inland Aquatic Species. FAO Fisheries Technical Paper No. 294. Food and Agriculture Organization of the United Nations, Rome, Italy. 318pp.

Introduced Atlantic salmon and rainbow trout have made Chile the world's second leading producer of farmed salmon behind Norway; but the effect on native fauna is largely unknown.

Black bass introduced from North America along with local red breasted bream are sold along the roadside in Zimbabwe.

THE DATABASE ON INTRODUCTIONS OF AQUATIC SPECIES (DIAS): THE WEB SITE

L. Garibaldi[1] and D.M. Bartley[2]

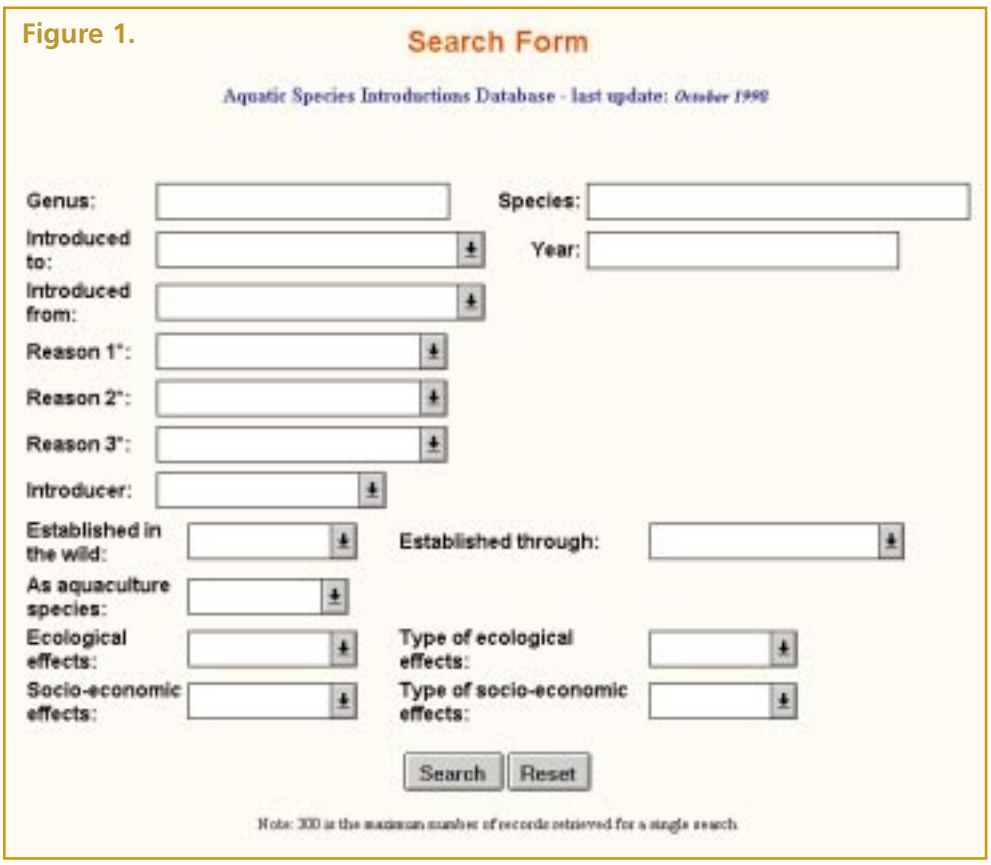
[1]Consultant, FAO Fisheries Department
[2]Fishery Resources Division

The Database on Introductions of Aquatic Species (DIAS) is the name recently given to the database begun by Dr. Robin Welcomme in the early 80's on a pioneering Amiga computer to store records of aquatic introductions. It was used as the main source for an FAO Technical Paper (Welcomme, 1988) which has served as a standard reference in the field of inland aquatic introductions. In 1991 the responsibility of the database passed to Dr. Devin Bartley who promoted a further collection of data by means of questionnaires to national experts. Exchange and updating of data was subsequently set up between DIAS and FishBase, ICLARM's database on fish, supported by the European Union and FAO. An MS-Access application was then created to better manage and query the database and an analysis of the existing data was carried out and presented to an international congress (Bartley, Garibaldi and Welcomme, in press). In 1997, a Web site, hosted in the FAO Fisheries homepage (where it can be accessed selecting "Databases and Statistics" and then DIAS under "On-line Databases", or directly at http://www.fao.org/waicent/faoinfo/fishery/statist/fisoft/dias/index.htm), was created to allow interested people outside FAO to consult the database. "Highlights" pages were prepared to provide basic information to the public on this increasingly important topic.

In September 1998, the DIAS site was revised to include comments received by the users, add new pages and improve the interface. The data set has been updated to include new records from recently published reviews on introductions (i.e., Coad, 1996, on Southwest Asia; De Moor and Bruton, 1996, on southern Africa; Moreau and Costa-Pierce, 1997, on carps in Africa; Bergot and Vigneux, 1997, on French speaking countries; Lever, 1996, global) and other papers on recent introductions accessed through a search of the Aquatic Sciences and Fisheries Abstracts (ASFA). The database now contains about 3150 records of introductions of aquatic species from one country to another, excluding movements of species within the same country. Parasites are not included and introductions from ballast water and ship-fouling organisms are considered only when the introduction of an alien organism has had or could have significant effect on fisheries and aquaculture, or when the introduction could seriously affect the environment. The database is still growing and is probably incomplete, especially in the areas of marine organisms, ornamental fishes, and those organisms not used for fisheries and aquaculture. Users aware of introductions not already included in the database are kindly requested to send the new information through the Input Form provided in the Web site. This information is first checked and validated and then inserted in the next DIAS update.

The home page of the DIAS Web site is organized into two frames. The main frame on the left side contains, apart from brief explanatory texts and a list of related Web sites, the icons to open the **Search Form, Input Form, Statistics** and **Glossary** pages. The Search Form (Figure 1) allows to query the database by scientific name, country (where the species was introduced or source of the species), year, reason of introduction, introducer, establishment in the wild, use in aquaculture, ecological and socio-economic effects. Each field can be searched alone or in combination with others. The Input Form, as mentioned earlier, has been created to allow users to contribute to the coverage and precision of the database by providing new introduction records or corrections of the existing ones. The Input Form includes the same fields of the Search Form, an additional field for further comments on the introduction, and fields for personal data on the sender. Two other icons lead to the Statistics pages, regularly updated to include new data, and the Glossary page, which provides explanations of some technical terms.

Figure 1.



The smaller frame on the right side of the home page is titled **Highlights on Introduction**. It includes, in a modular format that allows easy addition of new items, links to other pages where some basic information on introductions is made available. In formatting this information, a simple and direct style has been used, including maps, charts and tables, adequate to the medium used (the World Wide Web), in order to catch the attention of an audience broader than that of the specialists.

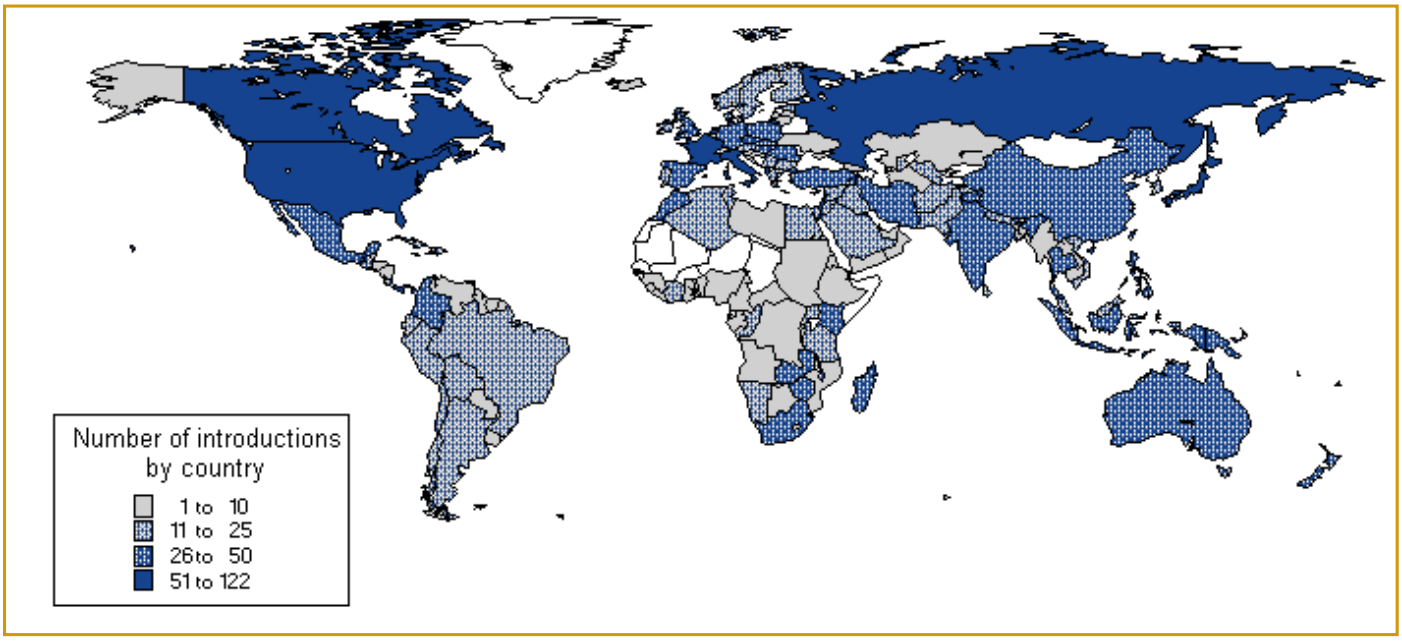


Figure 2 - Number of introductions by country

Under **Controversy**, information is provided on the **Positive effects** and **Negative effects** of Nile perch (*Lates niloticus*) introduction into Lake Victoria. Under the former, data on catch statistics of Nile perch point out the positive effects of the introduction, while in the latter an extract from a scientific paper stresses the serious negative environmental effects produced. Obviously, much more detailed information is available in the literature on this extensively studied matter; over 50 papers have been published on this topic only in the last 10 years (ASFA, 1996, 1998).

Another item under "Highlights" deals with the **Importance for aquaculture**, and shows that aquaculture is the main reason of introduction in 38.7% of the database records and that almost 10% of the world production from aquaculture derives from introduced species (Garibaldi, 1996). Under **Environmental risks** the abstract of a paper (Bartley and Minchin, 1996) on the use of the precautionary approach on introductions stresses the need to use a code of practice when planning new introductions to minimize possible negative effects on the environment. Finally, a new item has been added under "Highlights" during the recent revision of the DIAS site. This includes four world maps which provide, at a glance, information on the number of introductions by country and introductions for aquaculture purposes (Figures 2 and 4), a chronological record of the spread of *Cyprinus carpio* from its native range (China, Japan, Central Asia; Welcomme, 1988) to almost the entire world (Figure 3), and the countries where the tilapia species *Oreochromis mossambicus* and *O. niloticus* have been introduced (Figure 5).

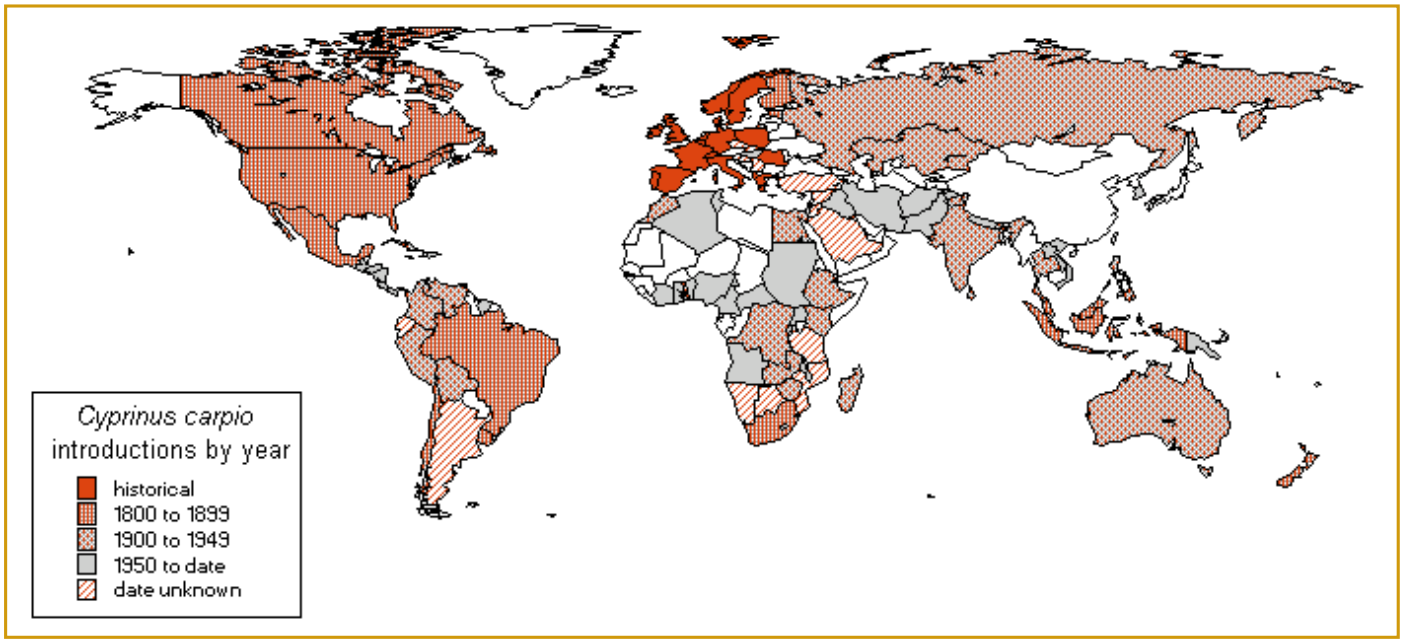


Figure 3 - *Cyprinus carpio* introductions by year

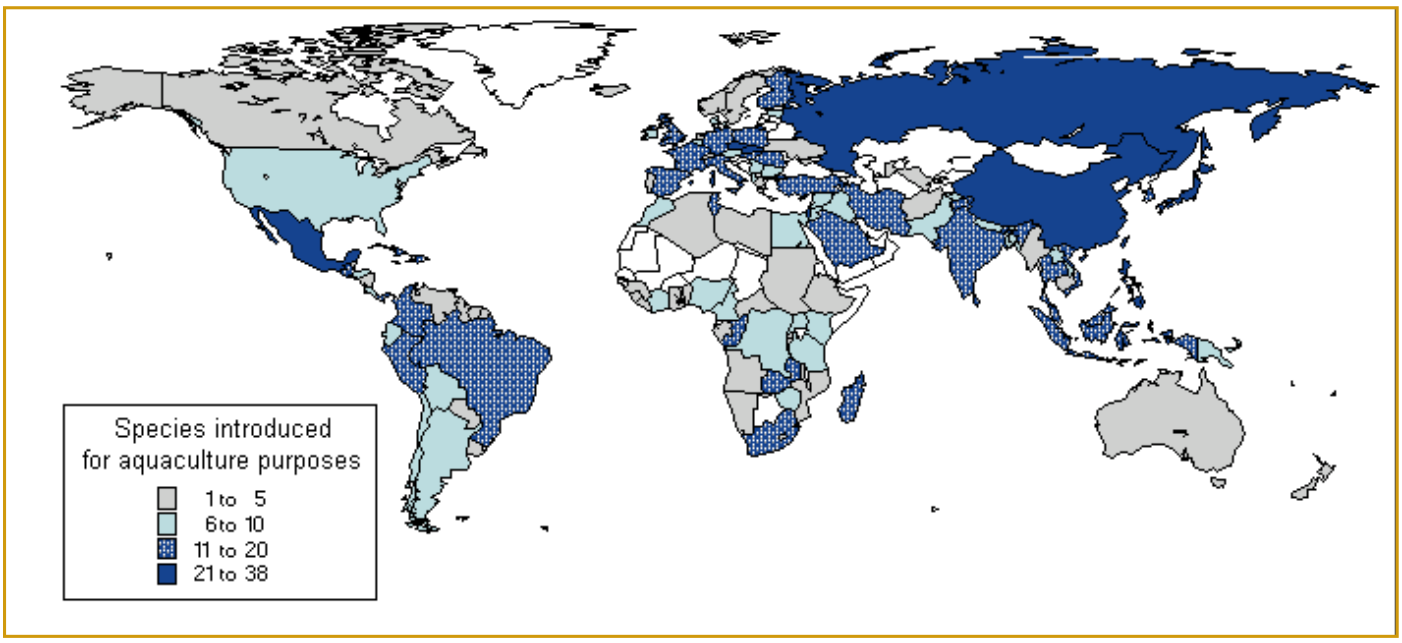


Figure 4 - Species introduced for aquaculture purposes

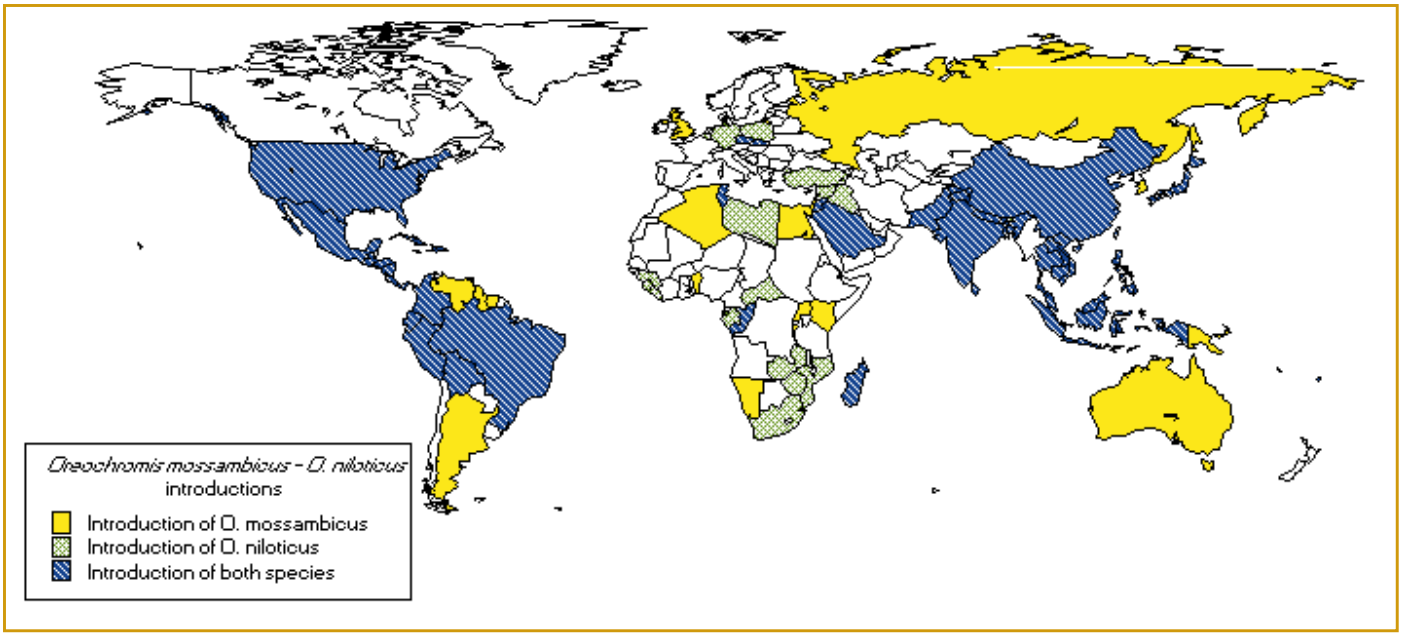


Figure 5 - *Oreochromis mossambicus* and *O. niloticus* introductions

ACKNOWLEDGEMENTS

The Authors are indebted to Mr. Marco Tusa, FAO World Agriculture Information Centre (WAICENT) Group, for his technical assistance in preparing the database in a format searchable on the Web and the set up of the Search and Input Forms; Mr. Andrea Vietri, WAICENT Group, for his support; and Mr. Francisco Perez Trejo, WAICENT Responsible, for his supervision. The Authors also wish to thank all the users who have kindly contributed new information to the database.

REFERENCES

Aquatic Sciences and Fisheries Abstracts (ASFA), 1996. Scientific Abstracts 1988-1996. Cambridge Scientific Abstracts, CD-ROM published by Silverplatter International.

Aquatic Sciences and Fisheries Abstracts (ASFA), 1998. Scientific Abstracts 1997- June 1998. Cambridge Scientific Abstracts, CD-ROM published by Silverplatter International.

Bartley, D.M., L. Garibaldi and R.L. Welcomme, (in press). Introductions of aquatic animal species: a global perspective and database. Presented at the American Fishery Society Symposium, Monterey, California, August 1997.

Bartley, D.M. and D. Minchin, 1996. Precautionary approach to the introduction and transfer of aquatic species. *In*: Precautionary approach to fisheries. Part 2: scientific papers, FAO, Prepared for the Technical Consultation on the Precautionary Approach to Capture Fisheries (including Species Introductions), Lysekil, Sweden, 6-13 June 1995. *FAO Technical Paper*, N° 350/2, Rome, FAO, 159-189 p.

Bergot, F. and E. Vigneux (coord.), 1997. Les introductions d'espèces dans les milieux aquatiques continentaux en métropole. *Bull. Fr. Pêche Piscic.*, N° 344-345, 518 p.

Coad, B.W.,1996. Exotic and transplanted fishes in Southwest Asia. *Publ. Espec. Inst. Esp. Oceanogr.*, N°. 21, 81-106 p.

De Moor, I.J. and M.N. Bruton, 1996. Alien and translocated aquatic animals in southern Africa (excluding Zimbabwe and Mozambique) - revised checklist and analysis of distribution on a catchment basis. *Ann. Cape Prov. Mus. (Nat. Hist.)*, vol. 19, part 6, 305-344 p.

Garibaldi, L., 1996. List of animal species used in aquaculture. *FAO Fish. Circ.*, N° 914, Rome, FAO, 38 p.

Lever, C., 1996. Naturalized fishes of the world. Academic Press, 304 p.

Moreau, J. and B. Costa-Pierce, 1997. Introduction and present status of exotic carp in Africa. *Aquacult. Res.*, N°. 28, 717-732 p.

Welcomme, R.L., 1988. International introductions of inland aquatic species. FAO *Fish. Tech. Pap.*, N° 294, Rome, FAO, 318 p.

Ziad H. Shehadeh
Fishery Resouces Division

Collaborative Activities with NACA

Regional Programme on "Sustainable Aquaculture for Rural Development" (SARDev)

It has become very clear from various fora that "Sustainable Aquaculture for Rural Development" with focus on (i) poverty alleviation, (ii) food security, (iii) environmental and natural resources management, and (iv) advancement of women is an appropriate, relevant and timely theme for regional co-operation. Developmental research on rural aquaculture was identified as a priority theme for regional co-operation by the 1996 FAO-NACA Survey and Analysis of Aquaculture Development Research Priorities and Capacities in Asia. It was envisaged that the recommendations of the study and associated workshop would form the basis of specific regional and sub-regional follow-up programmes. Accordingly, project concepts were prepared for this purpose by the workshop.

The development of a Programme on "Sustainable Aquaculture for Rural Development" (SARDev) was approved by the Governing Council of NACA (Hanoi, December 1997), based on a concept prepared by a regional consultation of experts and lead centres convened by NACA. NACA's Technical Advisory Committee, at its 5th Meeting, held in India in June 1998, reviewed the programme concept, clarified its objectives and outputs and the implementation mechanism, and recommended to the Secretariat a plan of action to develop the proposal. In addition, the FAO Asia- Pacific Fishery Commission (APFIC), in its twenty-sixth Session (Beijing, September 1998), agreed that small-scale rural aquaculture was an effective vehicle for rural development and established an ad hoc Working Group of Experts on Rural Aquaculture to address issues and advise the Commission in this field.

In view of these developments, the Network of Aquaculture Centres in Asia-Pacific (NACA) and FAO have agreed to collaborate on the establishment of the Regional Programme on Sustainable Aquaculture for Rural Development (SARDev Programme) for the Asia-Pacific region and have signed a Letter of Agreement for that purpose. FAO will play a catalytic role, by assisting in planning and project formulation, in the context of its Regular Programme activities in this field. The organization will also continue to cooperate with the programme, once established, by means of specific joint activities in areas of mutual interest.

The objectives of the programme would be to:

i) promote the development and utilization of sustainable aquaculture technology and management systems that are appropriate for target rural communities through applied and adaptive research, manpower training and information exchange;

ii) develop the capacities of farmers and women in poor rural communities to adapt and apply technologies and management systems aimed to produce more food, generate more income and manage the environment and production resources in a sustainable manner; and

iii) strengthen the capabilities of regional, national and local institutions including farmers and women's groups involved in technology development, training, information dissemination and utilization.

NACA and FAO will convene a planning workshop, tentatively scheduled for 29-31 March 1999, in Chiang Mai, Thailand. The workshop will:

i) collate national information relevant to the above 3 purposes including past, ongoing and planned activities on rural aquaculture, needs and priorities;

ii) discuss the experience of other organizations in rural aquaculture development;

iii) define the Programme scope;

iv) define more precisely the objectives, outputs, targets and activities of the Programme; and

v) identify possible 'catalytic' project components that can facilitate the development of the Regional Programme.

Participants will include experts from a number of countries in Asia-Pacific , plus experts from FAO-RAPA, FAO-Rome, and NACA, and from regional and international organizations with active programmes in small-scale rural aquaculture. They will encompass expertise in rural aquaculture technologies, extension, rural development, information transmission, and gender issues in development.

The conclusions reached at the workshop will provide guidelines for the joint NACA-FAO project formulation mission, to be fielded shortly after the workshop.

Conference on Aquaculture in the Third Millenium

The Conference is organized by the Network of Aquaculture Centres in Asia-Pacific (NACA), in cooperation with FAO, and hosted by the Thai Government. It will be held on 20-25 February 2 000 and will be preceded by an inaugural ceremony on 20 February 2 000.

Objectives and outputs

The Conference is global in scope, with reviews of regional and global trends and perspectives, and aims to envision the state of aquaculture in the next century. It will work to attain a consensus on perspectives and future trends in aquaculture, and develop strategies to address emerging opportunities and constraints, including a plan of action for regional and inter-regional cooperation. The recommendations of the Conference will provide governments with guidelines for aquaculture development planning in the next century.

Participation

Governments, NGOs, farmer organizations, industrial houses, R & D institutions, investment agencies, development assistance organizations, societies, and other support institutions will be participating. The organizers expect some 500-600 participants to the Conference and triple this number to take part in or visit the Aquaculture Trade Fair 2000 which will be held simultaneously.

Programme

The programme of the Conference was finalized at the Second Steering Committee meeting held at the NACA headquarters on 21-23 January 1999. It was described by the Steering Committee Chairman, Dr T V R Pillay, as "proactive and forward looking". [Dr Pillay was chief organizer of the first global technical conference on aquaculture, (organized by FAO and the Govemment of Japan), held in Kyoto, Japan in 1976.]

The programme of the Conference will consist of the following sessions:

Global and Regional Overviews

The Conference programme starts with three keynote addresses: (i) a review of the global development in aquaculture since the Kyoto Conference in 1976, (ii) a look at global prospects beyond 2 000, and (iii) a presentation of the issues and challenges facing Asian aquaculture. This will be immediately followed by the presentation of aquaculture development status and trends in other regions including Africa, Latin America, North America, Europe (East and West), the Near East and the Pacific Community.

Policy and Technology

Two parallel sessions will follow the global and regional reviews:

(1) Policy and planning for sustainable aquaculture, which will consist of discussion groups on (i) increasing the contribution of aquaculture to food security and poverty alleviation, (ii) addressing social issues, (iii) integrating aquaculture into rural and coastal development, (iv) involving stakeholders in aquaculture policy-making, planning and management, (v) promoting sustainable aquaculture with economic incentives, and (vi) creating the information base for aquaculture policy making, planning and management, and (vii) establishing legal, institutional and regulatory frameworks for aquaculture development and management.

(2) Technologies for sustainable aquaculture , which will consist of discussion groups on (i) aquaculture systems and species, (ii) genetics and broodstock and seed improvement, (iii) health management and disease control, (1v) nutrition and feeding, (v) culture based fisheries and enhancement, and (vi) systems approach to aquaculture management.

Two other discussion sessions will focus on:

Aquaculture Products Quality, Safety, Marketing and Trade, and

Aquaculture Development Financing and Institutional Support

Five important issues will be covered in separate special sessions or by special lectures and discusdons:

Special Sessions and Topics

- environment and community-based management issues in aquaculture,
- 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 of the Conference will consist of summary presentations of the syntheses and recommendations of the different group discussions, and the workshop conclusions and recommendations, all to be presented in plenary.

Conference organization

A Programme Committee is being appointed by the Steering Committee to assist in the technical organization of the Conference while the Government of Thailand will form a national organizing committee to take care of logistics .

Keynote speakers, session chairpersons, special lecturers, resource persons, and panel discussants are being invited in line with Conference structure. Technical review papers on topics relevant to the various conference session themes are welcome.

NACA will conduct a regional planning workshop for Asia in September 1999, and the Secretariat of the Pacific Community is formulating an aquaculture development strategy for the Pacific Community which will also be presented at the Conference. FAO will hold regional exercises to develop the review of status and trends in regions other than Asia and the Pacific. A synthesis of all these reviews (including that of Asia and the Pacific) will be carried out in a workshop to be held in Bangkok in October, 1999. This global synthesis will be brought into the Conference to provide the global overview.

Plenary lectures will precede group discussion sessions. The group discussion sessions will be based on a resource paper, a panel discussion, and a general discussion. Panel discussants will debate the different aspects of the topic, and the general or open discussion will serve to clarify and suggest resolutions on important issues. Panel discussants will thus be expected to present more specialized papers of a strategic rather than technical orientation.

Contributed technical and experience papers are expected to provide scientific background and support to the topics under discussion. Authors will be requested to highlight the main points of their papers during the general discussion. As in the Kyoto conference, the summaries of the technical papers will also be part of the proceedings while the full papers will be in the technical publication of the Conference.

For more information, contact:

J. Jia (FAO/FIRI)
e-mail: **jiansan.jia@fao.org**
Fax: 0039-06-57053020, or

The Secretary General,
Conference on Aquaculture in the Third Millenium
e-mail: **NACA@fisheries.go.th**
Fax: 0066-2-561-1727

Collaborative activities with ICLARM

Study on the Production, Accessibility and Consumption Patterns of Aquaculture Products

The FAO Fisheries Department and International Center for Living Aquatic Resources Management (ICLARM) have signed a Letter of Agreement for a collaborative macro-analysis of the production, accessibility and consumption patterns of major farmed freshwater fish in five Asian countries (Bangladesh, China, India, Philippines and Thailand). The study will be carried out during the period 1 December 1998 - 31 December 1999. Focal points for the study are Dr. Madan Dey (ICLARM), Dr. Erhard Ruckes (Fish Utilization and Marketing Service, FAO) and Dr. Ziad Shehadeh (Inland Water Resources and aquaculture Service, FAO). The study will be carried out in collaboration with professional colleagues in the five target countries and will be co-ordinated by the study leader, Dr. M. Dey.

The tentative scope of the study consists of the following components:

1. Sector overview - production levels & production trends. Contribution of aquaculture to national fish and protein production and supplies. Trends. Prevalent farm size; farm ownership/tenure (family-based; private-commercial; state-owned; collective; etc.) and estimated contribution to national aquaculture production. Prevalent production systems and main cultured species. Mode of operation (stand-alone/ part of farming system). Objective (subsistence/ market-oriented).

2. Development Policies - macro-economic policies as they may influence markets and access. Export earnings vs. products for local consumption. Land ownership/tenure security. Incentives & disincentives.

3. Demand Characteristics - protein consumption: fish vs. other protein sources. Freshwater fish vs. marine fish. Consumption/demand by income group; changes in consumption by income group over last 20 years. Consumption by aquaculture producers vs. non-producers. Cultural preferences and geographic differences. Trends. Elasticities of demand (price and income elasticities, cross price elasticities).

4. Marketing - (a) overview of marketing practices. Market structure and channels (rural, urban, export). Marketing margins. Credit. Insurance schemes in aquaculture. Ownership structure (private/co-operative/municipal/state, etc.). Short section on retail developments. (b) Obstacles to access: deficiencies in market access which may be due to low volume, lack of buyers, inadequate infrastructure and marketing facilities; economic factors such as weakness of competitive position and lack of bargaining power in price formation, financial constraints, consumer attitudes. (c) Impact of changes in production centres and methods of production - shift of production to peri-urban areas near major consumption centres. Effects of growing intensification of production on fish prices. Impact of increased industrialization of production (i.e. shift to large-scale industrial producers).

5. Socio-economics - purchasing power(rural vs. urban consumers) . Trends. Price levels of different species (cultured & captured, high value and low value) vs. other protein sources. Role of women in fish production, and fish trade.

6. Conclusions and recommendations - consumption and access implications (for aquaculture products) of noted trends, policy measures, production, disposable income, marketing, etc. Analysis of future domestic market potential in view of existing and evolving consumption patterns and marketing development, and measures required to realize the potential. Specific actions by specific actors/sectors. Possible role of government.

A first draft of the study report is expected March 2 000. The two organizations are considering convening a workshop on the study theme following completion of the final report of the study.

Farmer-Proven Integrated Agriculture/ Aquaculture: A Technology Information Kit

FAO, ICLARM and the International Institute for Rural Reconstruction (IIRR) are collaborating on revising and updating an information kit on farm-proven integrated agriculture-aquaculture farming technologies prepared in 1992 by IIRR and ICLARM but which was given only limited circulation at the time . The document will be revised based on review of the organization and contents of the 1992 document by a number of selected experts in the field, who will advise, among other things, on potential additions to the document . The document is intended for use in education and extension and to increase the awareness of policy makers and planners about opportunities for, and benefits of certain farming practices that integrate agriculture and aquaculture.. The revised document will be published by the end of 1999 or early in the year 2 000.

Technical Report on Integrated Rice-Fish Farming

In a related development, the FAO Regional Office for Asia and the Pacific (FAO-RAP) has recently signed an agreement with ICLARM for the preparation of a Technical Report on Integrated Rice-Fish Farming. The report will review the status of rice-fish farming globally, with emphasis on Asia-Pacific region, technologies in practice, socio-economic impacts (on income, food security, rural development etc.), research need to be undertaken and institutional support needed for popularization of the farming system.

EIFAC symposium on fisheries and society: social, economic and cultural perspectives of inland fisheries

The European Inland Fisheries Advisory Commission (EIFAC) will hold a Symposium on Fisheries and Society in connection with its 21st session in Hungary in June 2000.

Rationale

The value of inland fisheries to the people of Europe needs to be clearly re-stated. The Symposium will assess the contribution of the fisheries and aquaculture sector to providing food, employment and recreation together with cultural values in such fields as ethnology, ecology and bio-diversity. With a multiplicity of social, technical, environmental and political pressures affecting inland fisheries at the present time, there is an urgent need for greater understanding, recognition and communication of the value of fish and fisheries. The principal aim of the Symposium will be to make a broad assessment of the state of inland fisheries in Europe at the end of the 2nd millennium and to set down the essential steps to be taken for developments into the 21st century.

Themes

The symposium will examine social, economic and cultural aspects of inland fisheries, in accordance with the following themes:

- Sectoral and fishery evaluation
- Economic aspects and trends
- Social and cultural aspects and trends
- Interactions between recreational fisheries, commercial fisheries and aquaculture
- Interactions with other sectors
- The future of inland fisheries over the next decade.

Information Topics

It is anticipated that information will be presented on the following topics:

- Assessment of fisheries systems
- Valuation of social, economic and cultural components
- Harmonisation amongst users
- Socio-economic principles of management
- Legislation and enforcement
- New trends in education and promotion
- Future demands on the fisheries sector
- User participation in fisheries management
- Sectoral and policy assessment

Call for Papers

Contributions are invited within any of these broad headings. It is suggested that the majority will relate to experiences within countries, both reviewing past and present and predicting future opportunities. Inter-active discussion during the Symposium will lead to a major statement embracing the entire concept of the inland fisheries of Europe. Anyone wishing to present a paper or poster display should submit a title by 31 March 1999 to the Secretary of EIFAC, Fishery Resources Division, FAO, Via delle Terme di Caracalla, 00100 Rome, Italy, e-mail heiner.naeve@fao.org, fax (+39) 065705 3020.

Papers will be accepted in English or French, the official languages of EIFAC, but no interpretation will be provided. An abstract, not to exceed 150 words, of the proposed contribution should be submitted, preferably by e-mail, by 31 August 1999. The Steering Committee will review all abstracts in relation to the objectives and themes of the Symposium and the authors will be informed of the outcome by 1 December 1999. Successful authors must submit a draft manuscript not later than 1 March 2000.

The Convener of the Symposium is Dr Matti Sipponen (Finland), fax (+358-14) 443 7335.
The Chairman is Dr Karoly Pinter (Hungary), fax (+36-1) 301 4781.

The twenty-sixth session of the Asia-Pacific Fishery Commission

The Asia-Pacific Fishery Commission (APFIC) held its Twenty-sixth Session and a Symposium on Fish Utilization in the Asia-Pacific Region from 24 to 30 September 1998 at the Beijing Continental Grand Hotel, Beijing, People's Republic of China. The Session was attended by the representatives of sixteen Members of the Commission and observers from the Southeast Asian Fisheries Development Center (SEAFDEC). The Commission, inter alia, identified emerging issues in fisheries and aquaculture in the region and agreed to establish three *Ad Hoc* working groups:

a) *Ad hoc* Working Group of Experts in Food Safety;

b) *Ad hoc* Working Group of Experts in Capture Fishery Data Collection; and

c) *Ad hoc* Working Group of Experts in Rural Aquaculture.

The deliberations on aquaculture are reported in the following verbatim excerpts from the report of the session:

- The Commission noted that aquaculture had developed rapidly during the past decade with eight out of the top ten global producers located in Asia. The general impression was that the potential for further growth and development of aquaculture is good and that increased production could reduce the shortfall created by the decrease in supply from capture fisheries. The Commission fully agreed that the strategic issue for aquaculture development is sustainability. Sustainability in aquaculture could be achieved only by resolving the issues of immediate concern that included improved resource use and input supply, strengthening of the aquaculture information system, improved health management of cultivable species, accelerated research and improved training. In addition, there were requirements for extension services, integration of rural aquaculture with the agriculture and livestock sectors, improved quality and safety of aquaculture products; integrated planning for aquaculture development and promotion of small-scale aquaculture for rural food security.

- Several Members were of the view that the future role of APFIC should include the promotion of technical cooperation amongst countries in the region in the acceleration of sustainable aquaculture development. A number of examples of the positive impacts of appropriate technology transfer from one country to another were cited, including those for converting wastelands for aquaculture, cage culture and fish disease control through proper farm management, and small-scale backyard hatcheries for fish and shrimp.

- The Commission agreed that good extension work played an essential role in sustainable aquaculture development and noted that several Members were still in need of assistance in the strengthening of their aquaculture extension systems. The technologies for breeding, fry/fingerling rearing and grow-out were available; however, what was lacking was the effective transfer of these technologies from research laboratories to the farmers. It was pointed out that technical cooperation among the Members could help in transferring successful extension experience from one country to another.

- The Commission agreed that small-scale rural aquaculture should be considered as an effective vehicle for rural development by making a sustainable contribution to rural food security through the production of fish for food and the generation of employment and income. It was pointed out that the major constraints, such as lack of seed and extension services, had to be dealt with.

- Several Members suggested that, for landlocked countries and countries whose capture fisheries were overexploited, special emphasis should be given to the development of aquaculture. It was also pointed out that some cold water species (Tor putitora (Mahseer) and Tor tor) in the Himalayan range are overexploited and are in danger of extinction. It was suggested that special efforts be made for artificial breeding and culturing of these species.

- The Commission agreed that the measures for assurance of quality and safety of aquaculture products should be applied not only to products for export but also to products for local consumption. In this connection, however, special care should be taken in integrating aquaculture with livestock rearing (for example, integrating fish culture with pig rearing).

- Some Members underlined that aquaculture might cause some pollution and negative ecological impact and suggested that, to minimize this impact, aquaculture farm design and operation should be standardized. It was also pointed out that the introduction of exotic species for culture may create an undesirable impact on local ecosystems. Consequently, such introductions should be carried out with extreme care and following the international rules, regulations and procedures related to the transfer of live animals and quarantine guidelines.

DOMESTICATING AQUACULTURE SPECIES
A WORLD AQUACULTURE SOCIETY WORKSHOP

28 - 29 April 1999

Co-sponsored by Chesapeake Scientific and the Food and Agriculture Organization of the UN, the World Aquaculture Society presents a new format of technical programme. This two-day workshop will provide hands-on instruction to farmers on how to decide on appropriate domestication/breed improvement strategies and is designed to specifically address the needs of farmers, including those in developing nations.

Convenor: *Bonnie Brown* (Virginia Commonwealth University, USA)

Instructors: *Jim Parsons* (Blue Lakes Trout, USA)
John Benzie (Australian Institute of Marine Science, AUSTRALIA)

Topics will include selection protocols and theories, quantitative genetic overview, molecular assisted strategies, steps to domesticate local (wild) aquatic animals/plants, and case histories tailored to the atendees. There is no charge for attending this workshop; however, space is limited to 24 participants so be sure to include the application below with your conference registration.

PLEASE CONSIDER MY APPLICATION TO ATTEND THE DOMESTICATION WORKSHOP ON 28-29 APRIL DURING THE WORLD AQUACULTURE '99 CONFERENCE IN SYDNEY.

Name _____

Address _____

Phone _____ **Fax** _____ **e.mail** _____

List species you are interested in improving: _____

_____

Relation to the aquacultre industry: _____

Send completed application form as soon as possible to:
World Aquaculture '99
Conference Manager
21710 Seventh Place West, Bothell, WA 98021.

For other information please contact:
Bonnie Brown, Tel: 1 804 828 1562,
Fax: 1 804 828 0503, e-mail: blbrown@atlas.vcu.edu
or
Devin Bartley, Tel: 39 06 5705 4376,
Fax: 39 06 5705 3020, e-mail: devin.bartley@fao.org

Note:
space is limited in the workshop and applicants are encouraged to send forms in early to ensure participation. There is no fee for the workshop other than normal WAS registration.

Ziad H. Shehadeh
Fishery Resources Division

European Inland Fisheries Commission. 1998. Report of the Symposium on Water for Sustainable Inland Fisheries and Aquaculture. *FAO Fisheries Report* N°. 580, Suppl. Rome, FAO. 56p.

The document reports on the main discussions, conclusions and recommendations of the Symposium, which was held in Praia do Carvoeiro, Portugal on 23-26 June 1998, in concomitance with the Twentieth Session of the European Inland Fisheries Commission (EIFAC). (The main conclusions and recommendations of the Symposium are summarized elsewhere in this newsletter.) The report also incorporates abstracts of the contributions sumitted to the Symposium and the full addresses of participants.

Coche, A.G. 1998. Supporting aquaculture development in Africa: Research Network on Integration of Aquaculture and irrigation. *CIFA Occasional Paper* N°.23. Accra, FAO. 141p.

This is the report of a mission fielded in October-November 1997 to visit Ghana, Burkina Faso, Mali, Zambia and Zimbabwe, previously identified as potential contributors to a research network on the integration of aquaculture and irrigation, including fishery enhancement in small water bodies. Available resources for aquaculture and irrigation research, as well as the development status of these two sub-sectors, were identified and evaluated. Interest and willingness to participate in the network were ascertained.

The main findings were the following:

- In general, resources are very limited except for infrastructure in Ghana and Zambia, where human resources are also expected to improve in the near future.
- Government resources to support aquaculture development are rather limited, particularly in Burkina Faso, Mali and Zimbabwe. Although some private initiatives exist in Mali and Ghana, they are particularly developed in Zambia. This contributes to make Zambia one of the main aquaculture producers in Sub-Saharan Africa.
- Currently, most SWB (small water bodies) fishery enhancement activities are private initiatives, either at village level, in Mali and Ghana, or at farm level, in Zambia and Zimbabwe.
- Guidelines are now being finalized by ALCOM for the rapid evaluation of SWB fishery potential and for community-based enhancement/management of SWB fish resources in southern African countries.
- Several types of integration of aquaculture and irrigation have been tried in Mali and Ghana

on a relatively small scale. The Zambia SPFS (Special Programme on Food Security) is actively carrying out trials on small-scale fish farming integration in wetland areas.

- Large scale schemes with surface irrigation and full or partial water control are particularly developed in Mali, but also in Zambia and Zimbabwe, where more than 20 000 ha are available.

- The largest irrigation potential exists in Ghana. Good potential is also present in Mali and Zambia. The SPFS is well ahead in Zambia and has been initiated in the field in Burkina Faso. In Mali, Ghana and Zimbabwe, it is still in the preparatory phase.

The recommendations of the mission were as follows:

- National institutions to become involved in the African Research Network for the Integration of Aquaculture and Irrigation have been identified as follows:

Burkina Faso:	Institut de Développement Rural
Mali:	Institut d'Economie Rurale
Ghana:	Water Research Institute
Zambia:	Mount Makulu Regional Research Centre

- In Zimbabwe, the ALCOM Programme should take overall responsibility, both at regional SADC level and at national level, in cooperation with the Department of national Parks and Wildlife Management and AGRITEX.

- The new network should collaborate closely with existing networks, in particular ARID, FARMESA and SADC/FANR networks.

- Future actions should include the preparation of national syntheses and the organization of a seminar of irrigation and aquaculture specialists, to discuss the organization and research priorities of the network.

Johnson, G. and L. Verheust. 1998. Naming, typing, correcting and linking of the DCW inland water coverage for Africa. *ALCOM Working Paper* N°. 19. Harare. 27p.

This paper accompanies the digital dataset of inland water in Africa, extracted from the Digital Chart of the World. It describes the data and materials which were used, methods employed, results achieved and the lessons learnt from the exercise. The creation of the dataset was done in the framework of the FAO Fisheries activity "Spatial modeling for the assessment and management of inland fisheries". It was funded by the Inland Water Resources and Aquaculture Service, FAO, Rome, and executed by ALCOM in the context of work on a SADC Water Resource database.

Inland water polygons from the Digital Chart of the World for Africa were named, typed and corrected, then linked to two different water body databases. The output of the exercise is a corrected water body polygon file with two new identifiers which can be linked to a database file with names, types, comments and identifiers for the water bodies in the FAO Lakes and Rivers Fisheries database and the ALCOM Surface Water Body database. The dataset allows easy extraction of selected polygons from the master dataset.

For more information, or to obtain the latest digital watershed data, readers should contact ALCOM at:

MAILING ADDRESS:

Telephone: **P.O. Box 3730 Harare, Zimbabwe**
FAX: **263-4-792782**
E-Mail: **ALCOM@harare.iafrica.com**

HOMEPAGE:
http://www.zamnet.zm./zamnet/alcom/alcom.htm

Van der Mheen-Sluijer, J. 1998. Fish and water in Rural Communities. ALCOM Working Paper N°. 21. Harare. 112p.

The paper describes a tool which was developed to provide guidelines for assessing the role of ponds and small water bodies in rural communities in Africa. It examines, on the one hand, the resources households allocate to fish farming and/or fishing and, on the other, it shows how to analyze the importance of the outputs produced: fish as a source of animal protein and income, and stored water. It also explores the role of fishponds and small water bodies for households not engaged in fish farming or fishing. The paper gives a detailed description of the development of the questionnaires for each target group (fish farmer, fisher, non-fish farmer and non-fisher), and how the results can be analyzed using SPSS/PC+. It also includes a brief overview of which statistical procedures can be used for the kind of data generated by such a study.

Since the paper gives a detailed description of the most important steps involved in such a study, it can be used for the capacity building of local institutions that may implement similar studies in their country. And since it clearly spells out the procedures involved and their rationale, other users can make informed decisions on how to adapt the interview schedules and spreadsheets for monitoring or evaluating the importance of fish and water in their own environment.

For more information, or to obtain the disk containing the three questionnaires, the codebook and spreadsheets for data analysis, contact ALCOM at the address provided for the preceding publication.

Nilsson, H. 1998. Information channels in fish farming extension, Eastern Province, Zambia, and Manica Province, Mozambique. *ALCOM Field Document* N°. 41. Harare.

The document reports on the results of a study on information channels in fish farming extension, which was carried out in 1996. The aim was to assess the effectiveness of the various agents and sources of information involved. Alternative agents of information were also investigated.

Government extension agents were perceived by farmers as the source of highest quality information. In some instances, this was confirmed by the study. Farmer-to-farmer extension was often of reasonable quality despite the negative perceptions of the farmers. However, fellow farmers did not transfer information on subjects like pond construction and feeding practices as well as other sources of information. On the other hand, fellow farmers were the most accessible extension agent and were used by many respondents for day-to-day exchange of information.

Farmer clubs and informal and social get-togethers among farmers were identified as potential fora for information exchange. Constraints and drawbacks faced by government agents and village–based extension agents were identified.

Wetengere, K. and H. van Herwaarden. 1998. Development of semi-intensive fish farming in Morogoro Region, Tanzania. *ALCOM Working Paper* N°. 22. Harare.

The report presents the results of the pilot project "Development of semi-intensive aquaculture for small scale farmers", that was executed by ALCOM in collaboration with the Fisheries Division of he Ministry of Natural Resources and Tourism in Mongoro region, Tanzania. The project started in 1993 with a duration of 3 years. The objective of the pilot project was to develop suitable semi-intensive fish farming techniques and extension packages for small-scale farmers and to incorporate these into the rural extension system.

The report describes the region, the extension approach used, and the various extension methods tested during the project. It analyses the results and proposes recommendations for the development of aquaculture in Tanzania.