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Hunger, malnutrition and aquaculture

Hunger and malnutrition remain among the most devastating problems facing the world's poor. Tragically, a considerable portion of the global population is currently suffering from one or more forms of nutrient deficiency. This remains a continuing travesty of the recognized fundamental human rights to adequate food and to freedom from hunger and malnutrition, particularly in a world that has both the resources and knowledge to end this catastrophe.

At the Twenty-Ninth Session of the Committee on World Food Security, held in Rome in May 2003, the issue of "The role of aquaculture in improving food security at the community level" was discussed. Special attention was given to the contribution that aquaculture makes to food security, poverty reduction and improving the nutritional status of marginal and vulnerable groups, including pregnant and lactating mothers, children, the elderly and people living with HIV/AIDS. The delegates unanimously agreed that the potential of aquaculture to improve household food security and nutrition should be fully harnessed.

Aquaculture has an important role to play in this effort by providing fish and other marine and freshwater products that are rich sources of nutrients, and by providing employment opportunities and raising incomes. Fish can make a unique contribution towards improving and diversifying dietary intakes and promoting nutritional well-being, especially among vulnerable communities. Fish have a highly desirable nutrient profile, providing an excellent source of high quality animal protein that is easily digested and of high biological value. Fatty fish, in particular, are an extremely rich source of essential fatty acids, including omega-3 polyunsaturated fatty acids (PUFAs), so important for normal growth and mental development, especially during pregnancy and early childhood. Fish are also rich in vitamins and minerals (especially calcium, phosphorus, iron and selenium and, in marine products, iodine). Fish can therefore provide an important source of nutrients, particularly for those whose diets are monotonous or lacking in animal products. Increasing the availability of fish in the diet also increases palatability and leads to increased consumption of a range of foods, thereby improving overall food and nutrient intakes. The challenge is to accelerate rapidly the pace at which hunger and malnutrition are eliminated through enhancing the contribution that aquaculture makes to this goal.

The world leaders who drafted the Rome Declaration at the World Food Summit (WFS) in 1996 pledged to halve the number of hungry in the world by no later than 2015. They met again in 2002 to review the progress (World Food Summit: *five years later*) and to renew their global commitments. They resolved to accelerate the implementation of the WFS Plan of Action. They emphasized the need for nutritionally adequate and safe food and highlighted the need for attention to nutritional issues as an integral part of addressing food security.

This is not an easy goal to meet without all our help. It is clear that aquaculture can play an important role in achieving this goal. It is our responsibility and priority to address these issues through the design and implementation of aquaculture development programmes at both the national and international levels, so that we can be sure that our work in aquaculture development has maximum benefit for the poor and the nutritionally most vulnerable households.

Rohana P. Subasinghe
Chief Editor

Cover photo
Netting fish from culture-based fishery, Myanmar

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Global Reporting on Aquaculture Trends and Related Initiatives of the Fisheries Department

Background

FAO is a provider of global assessments and analyses of food and agriculture to the world community. The challenge is to respond to the increasing and more diversified demands for these services, while adapting to Members' changing needs and capacities.

The Fisheries Department (FI) reviews global aquaculture status and trends, and reports on these through periodic publications – The State of World Fisheries and Aquaculture and the Review of the State of World Aquaculture (FAO Fisheries Circular 886). These reports are intended to identify and analyze current and emerging issues that can and do have effects at the regional and national levels, and to draw them to the attention of the international community in order to raise awareness and stimulate action. FAO's information clients (its Members, the international community and the public at large) require such information in support of decision-making and policy development.

Whereas *The State of World Fisheries and Aquaculture*, which is submitted to the FAO Committee on Fisheries (COFI) every two years, has a fixed format, the contents of Circular 886 are still in flux. Efforts have been under way since 1997 to increase transparency and participation in its preparation. The quality of aquaculture statistics is being commented on and information sources are cited. Information from both FAO and non-FAO sources is used and, in some instances, professionals from outside FAO with specialized expertise in selected subject matter covered in the review have been invited to participate in preparing certain segments of the document. External participation has increased and is much more extensive and evident in all sections of Revision 2 (FAO 2003). Regional reviews of status, trends and outlook were prepared by regional organizations, national centres of excellence, or individual experts in collaboration with the Inland Water Resources and Aquaculture Service, FAO Fisheries Department (FIRI) staff. The reviews were discussed and amended by a working group consisting of those involved in their preparation.

FAO is the only source of comprehensive global aquaculture statistics, and most reviews of the state of world aquaculture, past trends and future prospects rely on FAO statistics. The statistical database on aquaculture, maintained by the Fisheries Information, Data and Statistics Unit (FIDI), is the key vehicle for monitoring and strategic analysis of global, regional and national developments in aquaculture. The database is disseminated annually in hard copy as the FAO Yearbook of Fishery Statistics: Aquaculture Production, and electronically as FISHSTAT PLUS for years from 1950 onwards. It is also available on request in CD form. The database has served as an important means of describing the characteristics and dynamics of one of the most complex and rapidly evolving international food production sectors.

FI and other FAO departments also maintain other data and information resources that are largely available on line and provide additional support to status and trends reporting (Table 1).

Available Information and Information Needs

Published FAO statistics are currently limited to production quantities and values by species and environment, plus information on production facilities. There is considerable variation in the quality of the data submitted

Table 1. Some available databases with relevance to aquaculture

SIPAM	Information System for the Promotion of Aquaculture in the Mediterranean
AAPQIS	Aquatic Animal Pathogen and Quarantine Information System
DIAS	Database on Introductions of Aquatic Species
NASO	National Aquaculture Sector Profiles (under development)
GISFISH	Known applications of GIS in aquaculture, case studies, etc. (under development, to complement *Geonetwork*)
SPECIESDAB	Species identification sheets and world catalogues
ASFA	Aquatic Sciences and Fisheries Abstracts
AQUASTAT	Information system on water and agriculture
AFRIS	Animal Feed Resources Information System
TERRASTAT	Land resource potential and constraints statistics at country and regional level
FAOLEX	Collection of national laws and regulations, as well as treaties, on food, agriculture and renewable natural resources
Geonetwork	Allows integrated use of spatial information available at FAO (under development)

to FAO by Member States, and some of the submitted data is not published because of problems of quality and completeness. FAO recognizes that many of the problems with statistical and non-statistical information on aquaculture are a reflection of the recent development of the sector as a recorded activity, its diversity and the complexity of developing approaches, as well as the limited resources of some countries, particularly least-developed countries. Aquaculture was recognized only recently (March 2001) as an independent economic activity by the United Nations Statistical Commission (and defined as such in the International Standard Industrial Classification of All Economic Activities).

In spite of many years of efforts and experiences, compilation of accurate, reliable, relevant, timely and usable aquaculture and fishery data and information remains one of the main challenges of the sector (FAO 2000). The mechanisms for collecting data and the coverage and quality of data on production from aquaculture provided by countries to FAO are constantly under review, with the aim of improving their quality and relevance to future national and global needs. Though considerable progress has been made, the database is still under development, lagging behind statistical systems for fisheries and agriculture.

Nevertheless, FIDI has made considerable progress in establishing the statistical database on aquaculture in the past 20 years. This has included:

- ☐ disaggregation of FAO's total fishery production statistics into capture fishery and aquaculture components for the period 1950-2001, and extension of the time series of aquaculture production statistics back to 1950;
- ☐ introduction of AQUASTAT NS, a new questionnaire, equivalent to the NSI form for capture fisheries statistics, to allow countries to update the time series for total aquaculture production tonnage and value for the previous seven years;
- ☐ introduction (1997) of questionnaires for collection of separate statistics for capture fisheries and aquaculture;
- ☐ upgrading of FAO Fisheries Circular No. 815: Aquaculture production statistics, to a yearbook in the year 2000 (FAO Yearbook. Fishery Statistics. Aquaculture Production) (this has improved dissemination of the statistics and increased its visibility since, as a yearbook, it is distributed to Member Governments according to country quota, whereas the Circular was not);
- ☐ dissemination of the entire aquaculture database electronically as FISHSTAT PLUS (Aquaculture). As with other FIDI databases, it is downloadable from the Internet;
- ☐ development and publication of Guidelines for the collection of structural aquaculture statistics (FAO 1997) to encourage countries to incorporate aquaculture into the World Census of Agriculture 2000;
- ☐ recognition of aquaculture (March 2001) as an independent economic activity by the United Nations Statistical Commission (and defined as such in the International Standard Industrial Classification of All Economic Activities); and

- ☐ continuing efforts, through working parties/groups and workshops to promote harmonized terms, definitions, classifications and methodologies within available resources.

However, despite this progress, more needs to be done to improve quality and meet rapidly emerging information needs.

In recent years, the demand for reliable data and information has increased considerably, driven by the need for sustainable development and for monitoring the impact of development policies, and by public demand for transparency and accountability. The rapid growth of the aquaculture sector in many countries and its increasing interaction with other sectors, particularly capture fisheries and agriculture (in terms of resources, markets and biodiversity), has also increased concern about the implications of its expansion and the risk of unsustainable development, and has underlined the need for increasing the scope of information required for decision-making. The increasing concern about environmental impact and general sustainability has wider resource implications that stimulate growing interest in assessments to measure the resource demands and environmental cost of aquaculture, and to compare these with the potential benefits it may generate.

Management perspectives are also changing. It is increasingly accepted that a wider range of issues has to be taken into account in decision-making. Thus, information on resource utilization, the environment and socio-economics plays an important part in the multifaceted research required for modern management.

The FAO Kyoto Conference on the Sustainable Contribution of Fisheries to Food Security, in its Declaration and Plan of Action (1996), stressed the need to develop standardized methods for the study of social, cultural and economic characteristics of fisheries and aquaculture and their associated activities and, in particular, practical indicators to assess the importance of such characteristics and their interaction and compatibility with management objectives. These recommendations have been reiterated by subsequent FAO and other meetings.

The lack of information and statistics on rural, small-scale aquaculture and inland fisheries has masked the important role of these sectors in rural livelihoods and nutrition and undermined the importance of the sector in the mind of policy-makers. The challenge will be to develop the institutional mechanisms and tools with which this information can be collected in a cost-effective manner.

Clearly, there is an emerging need for a better, more complex array of numerical data of reliable quality that can better measure and describe trends of the sector to ensure informed policy and governance. The multidisciplinary, intra-sectoral and inter-sectoral nature of the required information calls for integration of information and information capacities across sectors.

The increased scope of required data will probably strain national statistical systems that already suffer from inadequate resources. Therefore, besides integration of institutional and financial resources at the national level, there is also a need for partnerships between national, regional and international organizations to meet demands for data at the regional and international levels. Also, as the quality of FAO's information is closely correlated to the capacity of member countries to provide reliable and complete data, there is a need to support and/or improve national capacities for data collection and analysis and to provide tools and procedures for cost-effective data collection, processing and dissemination.

Meeting changing information needs - FAO Fisheries Department information strategy: supporting informed decisions and actions (FAO 2000)

Noting the changing information needs of its clients, the Fisheries Department (FI) has responded by formulating a strategy to help address them, and has initiated concrete actions to implement elements of this strategy.

The strategy aims at:

- ☐ developing a clear policy framework, by providing a set of principles, guidelines and procedures that will foster development and implementation of a coherent and need-driven information programme;

- ☐ enhancing efficiency in the compilation of data and information, through improved methods and tools, maintaining dynamic relations with national programmes, and filling in data and information gaps;

- ☐ improving the usefulness of data and information compiled, by integrating and harmonizing dispersed data and information compiled by the Department;

- ☐ facilitating cooperation and coordination among related programmes and organizations to maximize mutual benefits and reduce duplication of effort;

- ☐ ensuring that FI's information products reach target clients, by utilizing communication mechanisms and methods appropriate for the target audiences, compiling policy-oriented information products, and improving distribution and dissemination of fishery data and information; and

- ☐ strengthening national capacity in the compilation, analysis and utilization of accurate, reliable and timely data and information for the management and development of the aquaculture and fishery sectors.

Concrete action has been taken or is underway to implement the following elements of the strategy:

Integrating available data and information on fisheries and aquaculture

The Fisheries Global Information System (FIGIS)

The FIGIS project will integrate and harmonize dispersed data and information compiled by the Department. It will provide useful, compiled and analysed information at the global scale, available to all and subject to rigorous authentication. The intention is that it will become the internationally accepted standard on all the world's fisheries and aquaculture.

At the same time, an overarching inter-sectoral effort is under way by the FAO to integrate in-house data and information resources on agriculture, fisheries and forestry.

World Fisheries and Aquaculture Atlas CD-ROM

This is another integrating, multi-media tool. The atlas presents a comprehensive and global view of capture fisheries and aquaculture. It touches on all aspects of fisheries - from technology and trade to research and resources - and addresses a broad range of policy issues, such as ecosystem management, safety at sea and biotechnology. The first edition of the atlas was launched in 2001. It will be published in CD-ROM format at least every two years for distribution at the biennial meeting of the FAO COFI.

Improving Information on the Status and Trends of Capture Fisheries and Aquaculture

A strategy to improve information on status and trends was developed for capture fisheries in response to recommendations of the Working Party on Status and Trends in Fisheries of FAO's Advisory Committee on Fisheries Research, to support more effective policy-making and management, and better monitoring of environmental and ecosystem impacts. The strategy was adopted by the FAO Committee on Fisheries (COFI) in March 2003.

Plans are underway to develop a similar strategy for aquaculture, as recommended by the first session of the COFI Sub-Committee on Aquaculture (April 2002). An "Expert Consultation on Improving Global Status and Trends Reporting on Aquaculture" will be convened in Rome during October 2003, as a cooperative effort of three units of the Fisheries Department. A "Working Group of Experts on the FAO Questionnaire, FISHSTAT AQ" will meet immediately after the Consultation to review and evaluate the adequacy of the FAO statistics questionnaire for aquaculture, address existing issues and recommend practical and achievable improvements.

It is anticipated that special project proposals will be prepared to raise additional funds to expedite progress in the implementation of the strategies for improving information for status and trends reporting of capture fisheries and aquaculture, particularly the development of tools and capacity building.

Plugging Gaps in Aquaculture Statistics

Structural Statistics of Aquaculture

Besides preparation of the Guidelines for the collection of structural aquaculture statistics (see above), the statistics on production by farming structure made available by selected countries, representing a good geographical coverage by continent, have been consolidated for analysis. Annual data of aquaculture production practices for 1985-2000 for some 50 countries have been entered into

electronic format and preliminary analyses have been conducted. FI has also convened an "Expert Consultation on Land and Water Uses in Aquaculture Systems - Towards an Improved Information Basis" in October 2002, to provide advice on possible ways to improve the collection, organization, dissemination and general use of data and information on land and water use in aquaculture, and the use and interpretation of such data and information in assessing resource use efficiencies of aquaculture practices.

Information on Rural Aquaculture and Inland Fisheries

The FAO Regional Office for Asia-Pacific (RAP) carried out a survey of status and information needs of inland capture fisheries of Southeast Asia (Coates 2002), which formed the basis of an "Ad-hoc Consultation on New Approaches for the Improvement of Inland Capture Fisheries Statistics in the Mekong Basin", in collaboration with the Mekong River Commission (MRC) and the Government of Thailand (FAO-RAP, 2003). The Consultation focused on improvements to methods for the collection of inland fisheries and aquaculture statistics. In addition, there has been an initiative by RAP to seek support through a Technical Cooperation Programme (TCP) to improve data for the small-scale and rural inland fisheries sectors, including those integrated with aquaculture activities.

Improvement of National Aquaculture Data

In 2002, FAO evaluated its core statistical programme and noted that there were problems with the quality of data in many countries and regions, particularly from least-developed countries with limited resources and capacities, and that this has impact on the quality and value of FAO's databases of global statistics. Recommendations were made on means to deal with this problem. Specific problems related to aquaculture statistics will be discussed in the forthcoming "Expert Consultation on Improving Status and Trends Reporting on Aquaculture".

Development of a System to Improve the Collection of Aquaculture Data at the National Level

National statistical development is constrained by resources, and there is a need for cost effective methods of quality data collection and processing. FIDI is planning the development of a computer-based aquaculture data collection module similar in concept to an already developed system for capture fisheries (ARTFISH), a system that has been successfully tested in many countries through the Technical Cooperation Programme. The goal of this new system ("ARTFISH-AQ") will be to build data collection and processing capacity in countries that desire such assistance. It is expected that this module will include elements of statistical sample selection procedures, data collection elements and forms, and data entry and processing capabilities.

The Fisheries Department and the Organization in general will continue its efforts to improve the global information base to meet the needs of its clients within the limits of its normative programme. This will allow for steady, though perhaps slow progress. Additional resources will be needed to respond adequately to the daunting challenges at hand.

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Traditional Use of Aquatic Biodiversity in Rice-based Ecosystems

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FAO photo/M. Halwart

Rice-based ecosystems often represent a dynamic and closely linked complex of rice fields, ponds, irrigation canals, and rivers (Viet Nam)

Introduction

Aquatic resources derived from rice fields and associated environments often contribute a large share of the animal protein intake of poor households, particularly in Southeast Asia. Unfortunately, although this dietary contribution is self-evident for those working in the field, the role of aquatic resources in the food security of rural households is poorly documented because of the complexity of seasonally and spatially variable resources, environments and stakeholder activities.

This information is, however, needed by policy makers when formulating more pro-poor policies or making resource allocation decisions. Thus, awareness of the role of aquatic resources in food security and poverty alleviation of the rural poor will be required. Organizations in the field of sustainable development need to work further to integrate and mainstream agricultural biodiversity in their policies, programmes and activities in order to develop action plans for the conservation and sustainable utilization of agricultural biodiversity, especially at agro-ecosystem levels.

Given this scenario, and the timely financial support to regular programme resources received by the Government of the Netherlands through the FAO Inter-Departmental Working Group on Biodiversity, the Inland Water Resources and Aquaculture Service of the FAO Fisheries Department initiated a regional activity on the availability and use of aquatic organisms in rice-based farming in Cambodia, China, the Lao People's Democratic Republic and Viet Nam. This article highlights the initial results from activities in Cambodia and China.

Making biodiversity visible

The objectives of two studies in Xishuangbanna, Yunnan Province, China, and Kampong Thom Province, Cambodia, were to collect and document information on the living aquatic resources availability and use pattern of rice farmers. Specific attention was paid to applying participatory methods and techniques to learn about the traditional knowledge of farmers in a particular area.

FAO photo/M. Halwart

Rice-based ecosystems are often modified to enhance the production from a rich and diverse biodiversity (Viet Nam)

In both studies, aquatic species were collected by the farmers themselves using their own tools and techniques. Farmers identified the species in local language and the names were recorded. Smaller species were preserved and larger species were photographed for reference purposes. Information on all species was listed in databases, including their local and scientific names, information on sampling, special observations for collection and/or use, and, as far as possible, information on consumption.

A first analysis of the findings shows that, despite the geographically localized nature of the study areas, the rice field ecosystems have a rich aquatic biodiversity that is extensively used by the local people. The most important group, in terms of species diversity and importance for the local people, are the fishes. A total of 70 and 60 different fish species were found in the Cambodia and the China study, respectively (Table 1). Most species are consumed fresh or are fermented into fish paste. A few species are fermented, either as fillet or in smaller pieces, or dried, salted, smoked, or used for preparing fish sauce.

Fresh or processed fish are usually part of every meal and are the primary source of protein and essential fatty acids that are of key importance in brain development, particularly for sight. As far as home consumption and marketing of fish are concerned, it is estimated in the Cambodian case study that an average family of five persons consumes about one kilogram of fresh fish every day during the fishing season. The same family needs about 20 kg of fermented fish paste for the dry season. Everything caught above this amount can be sold in the market. Depending on the fishing tool employed, a farmer can catch 15 to 20 kg of fish on a good day, although the average catch during the fishing season is below 10 kg per day. The Chinese study also stressed the importance of fish and other aquatic organisms obtained from rice-based systems as part of the daily diet, in particular for the rice farming Dai minority in Xishuangbanna. Although the amount of aquatic organisms consumed has probably remained constant, it was estimated that nowadays one-fifth to one-third of this consumption is derived from capture in rice-

Table 1 . Aquatic species (number) collected and used by rural households from rice-based ecosystems during September to December 2001 at study sites in Kampong Thom, Cambodia, and Yunnan, China.

	Cambodia	China
Fish	70	60
Crustaceans	6	2
Molluscs	1	4
Amphibians	2	4
Insects	2	3
Reptiles	8	-
Aquatic Plants	13	19

FAO photo/A. Luo

Various techniques and tools are employed to capture fish and other aquatic organisms in rice-based ecosystems (China)

based farming, while only a decade ago rice-based capture supplied half of the fish needed in the diet.

In addition to fish, many species of crustaceans, molluscs, amphibians, insects, reptiles, and aquatic plants were recorded in these studies. All of these are either used directly or processed for human consumption, or used as animal feeds, bait, or for medicinal purposes.

Threats

The availability of aquatic resources is declining. Farmers in Xishuangbanna claimed that fish are becoming less and less abundant, and that the amount of aquatic organisms collected in one day nowadays is equivalent to what was collected a decade ago in one hour. Similarly, the Cambodian study points out that fish catches have greatly reduced over the past two decades. The villagers estimate that already in three years there will be not enough fish to make a living for them.

Human population increase and the consequent increased fishing pressure on aquatic resources is certainly an important factor for the decline of living aquatic resources, but a number of management reasons are claimed to be chiefly responsible: pesticide use, destruction of fish breeding grounds, and illegal fishing tools such as electro-fishing or chemical poisoning do not allow fish populations to maintain themselves. Development efforts urgently need to address these threats.

It is particularly the rural poor who are often highly dependent on the aquatic biodiversity in rice fields. They may not have access to money but in many areas they still have access to the biodiversity that supports them. A particular threat to them is the restriction of access to these fishery resources, for example when fishing grounds are sold or auctioned as fishing lots. These poor people will be hit hardest since they have no land to cultivate and completely depend on the capture of wild resources.

Impacts of study findings

At local level, the study results allow an increased understanding and appreciation by all those who are directly or indirectly involved in the studies for the rich diversity and value of aquatic resources, the local practices related to their culture and capture, and the need to work closely with farmers to develop appropriate interventions for aquaculture production. Capacity building among participating national collaborators in various informal, participatory

FAO photo/A. Luo

Fish and other aquatic organisms from rice-based ecosystems often form part of the daily main meal (China)

methods of data collection is an outcome of these studies whose value should not be underestimated.

To work against the trend of declining fishery resources, the results of the Cambodian study are being used at the village and commune level as a tool for fish inventories that will later become part of developing community-managed fisheries plans. At the national level, the results have been distributed on a CD to raise awareness among those making decisions.

Looking forward

The studies now require further analysis and follow-up, since they only cover limited areas and time spans. They should be expanded to other countries in the region. Furthermore, the findings are expected to serve as important background information for similar activities in other regions, such as West Africa and Latin America.

The initial goals of these studies, i.e., to document the availability and use of aquatic organisms in rice-based farming and to raise awareness of all stakeholders about the aquatic biodiversity in rice, have partially been achieved through the participatory process that was followed. However, further activities are planned in the form of documentation, presentation and workshops to make a larger audience aware of the results.

Studies in this integrated area of rice farming and fisheries require cooperation and exchange between the different disciplines. Close collaboration within FAO is expected to continue in the future, particularly with the Agricultural Divisions dealing with plant production and protection and with land and water use as well as the Food and Nutrition Division of the Economic and Social Department. The International Year of Rice 2004 will certainly stimulate further thoughts and discussion.

The findings of these studies will be important for forthcoming meetings such as the FAO-WARDA Workshop on Integrated Irrigation and Aquaculture to be held in Bamako, Mali, in October 2003, and for collaborative programmes with external partners, in particular for the joint project among FAO, the Department for International Development of the United Kingdom (DFID), Voluntary Services Overseas (VSO), and the Network of Aquaculture Centres in Asia-Pacific (NACA) entitled "Support to Regional Aquatic Resource Management" (STREAM).

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FAO photo/P. Balzer

Traditionally most of the fish for household consumption is caught and collected from rice fields (Cambodia)

Regional Workshop on traditional use of aquatic biodiversity held in Xishuangbanna, Yunnan, China

A regional workshop bringing together the collaborators and selected policy-makers from Cambodia, China, the Lao People's Democratic Republic and Viet Nam was held in China in October 2002. The objectives of the workshop were

- to facilitate information exchange on methodology, findings, and interpretation of results among the researchers of the participating countries; and
- to identify and define next steps with a view to further increase awareness among all stakeholders in participating countries as well as at regional and international levels

The case studies from the four countries were presented follwed by a detailed discussion on the various approaches used, the problems encountered, and the solutions that had been found. Additional presentations were given to enhance participants' understanding of the needs for professional photo documentation and the overall strategy for publication of the research findings particularly with reference to internet-based media (see section on further reading).

For the next steps, participants were asked to list their priorities and define related activities in the short, medium and long term. Among the main conclusions reached by the participants were the need for

- enhanced communication and sharing of knowledge and information among the study collaborators;
- additional activities to raise and increase awareness about aquatic biodiversity in rice-based ecosystems in the countries;
- an expansion of current efforts; and
- a broadening of the scope of the investigations.

For the first conclusion it was recommended that the FAO Inland Water Resources and Aquaculture Service facilitate enhanced communication by establishing an electronic Aquatic Biodiversity News Group which would provide a forum for exchange and learning from each other on a regular basis. Increased awareness was thought to be best achieved by national workshops assembling the various stakeholders. Another means of increasing awareness is the development of communication and extension materials at various levels including booklets, material for school children, posters, videos and TV spots. At the workshops, a prioritization of activities should take place and institutional arrangements for further studies and development efforts should be discussed and agreed upon. With regard to the expanded efforts, the group considered a longer duration of the studies necessary in order to overcome various constraints particularly the seasonality of species. An increase in the number of study sites would be important to cover a wider range of ecological conditions. This as well as the need to initiate new studies covering the nutritional contribution of aquatic biodiversity for rice farming households should be subject of discussion at the national workshops.

Aquatic Biodiversity and the International Year of Rice 2004

On 16 December 2002, the United Nations General Assembly (UNGA) declared the year 2004 the International Year of Rice (IYR).The UNGA invited the Food and Agriculture Organization of the United Nations (FAO) to act as the lead agency for the implementation of the IYR, in collaboration with partners from national, regional and international agencies; non-governmental organizations; and the private sector.

The FAO Fisheries Department contributes to the IYR through the following awareness-raising activities related to the importance of aquatic biodiversity in rice- based ecosystems:

- Background information on the use and availability of aquatic resources is provided in the Concept Paper, the guiding document of the IYR.
- Information material on aquatic biodiversity and rice –based ecosystems will be presented on the official IYR website (http://www.rice2004.com/) and linked to related issues.
- A fact sheet on aquatic biodiversity in rice fields will be made available on the Internet, as well as a hard copy in the publication folder on the IYR.
- In the framework of the IYR, several events will be held, such as national workshops on aquatic biodiversity in rice-based ecosystems in Cambodia, China, Laos and Viet Nam.
- Case studies will be conducted to generate knowledge on special aspects of rice-based production systems, such as a study on the role of aquatic biodiversity in the nutrition of rural livelihoods.

20th Session of the International Rice Commission, 23-26 July 2002

The FAO's International Rice Commission is a forum where senior policy-makers and rice specialists from rice producing countries (current membership is 61 countries) review their national rice research and development programmes. Its objective is the promotion of national and international action in matters relating to the production, conservation, distribution and consumption of rice.

The paper "Recent initiatives on the availability and use of aquatic organisms in rice-based farming" was presented covering findings from two case studies in Cambodia and China initiated by FIRI and supported by regular programme and extra budgetary funds (FAO-Netherlands Partnership Programme). The corresponding CD with results from Cambodia was presented and distributed to all participants.

The Commission made the following notes and recommendations (excerpted from the Draft Report agreed upon and approved by the delegates on 26 July 2002):

7.6 Recent initiatives on the availability and use of aquatic organisms in rice based farming

The Commission (Document IRC: 02/21E) noted that:

Rice fields are much more than rice. Studies to collect and document information on the living aquatic resources, their availability and use patterns by rice farmers have been initiated by the FAO Inland Water Resources and Aquaculture Service in Cambodia, China, Laos and Viet Nam. The aquatic biodiversity in rice was found to be rich and diverse and performs not only important ecosystem functions but also serves as the major source of protein and essential fatty acids and hence is essential for a balanced diet of rural people.

Aquatic organisms are collected from rice-based ecosystems on a daily basis in the rainy season. More than 100 aquatic species (fish, reptiles, amphibians, crustaceans, molluscs, insects and plants) were identified in farmers' own catch. However, this biodiversity is under threat from pesticide use, destruction of flooded forest habitat and illegal fishing tools. Managing resources with a more holistic view will be important. The findings of the studies have relevance for other rice growing regions of the world.

The Commission recommended that:

1. Member countries should promote the sustainable development of aquatic biodiversity in rice-based ecosystems, and policy decisions and management measures should enhance the living aquatic resource base. In areas where wild fish are depleted, rice-fish farming should be considered as a means of enhancing food security and securing sustainable rural development.
2. Attention should be given to the nutritional contribution of aquatic organisms in the diet of rural people who produce or depend on rice.

Fresh fish traders at Ho Chi Minh City fish market

Fish Marketing and Consumption in Viet Nam: What about Aquaculture Products?

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Fisheries products provide an important source of proteins, fatty acids and minerals to the daily diet of the Vietnamese population. Vietnamese people consume fisheries products mainly because of their high nutritional value, their easiness to digest and the fact that they are considered relatively cheap food stuffs. With regards to price, it is noteworthy that the average cost of the favourite fish species is US$3.4/ kg, while the price of substitutes like pork and chicken averages US$5.0/kg and that of beef, as much as US$7.3/kg. Fish sauce, which is added to a number of rice and noodle dishes, is priced around US$0.62/liter. Vietnamese people also like to eat fish because it's easy to cook, widely available, safe, and adds variety to the daily diet.

Good quality and freshness are considered the most important attributes of fisheries products according to more than one-third of the Vietnamese fish consumers. Twenty percent of the consumers see the reasonable price of fish as most important, and 18 percent cite the availability of their favourite fish species.

The study compared the various characteristics fish (e.g. price, availability, taste, healthiness and freshness) with those of its main substitutes (see Table 1). Considering the previously mentioned average prices, it is not surprising that almost half of the consumers responded that fish is cheaper. Fish scores very well on

Table 1. Comparison of fish based with its main substitutes (pork, chicken and beef) on the following attributes: price, availability, taste, health, safety, diversity and freshness.

Percentage Attribute (%)	Price	Availability	Taste	Health	Food Safety	Diversity	Freshness
Higher	28	55	55	66	44	65	46
Similar	23	36	36	26	42	26	36
Lower	49	9	9	8	14	9	18

characteristics such as taste, healthiness and product diversity, with well over half of the consumers considering these attributes higher for fish than for its substitutes.

Food safety and freshness are issues that are receiving increased consumer attention. Therefore, it is good to note that 86 percent and 82 percent of fish consumers, respectively, regard fishery products as safer and fresher than its direct substitutes. From the figures, it is also clear that fish scores poorly on the attribute of availability, with almost one-fourth of consumers noting that it is relatively less available than its substitutes.

Fish for home consumption is generally purchased at the market or from specialized fish retailers (94 percent). Respectively, 17 percent and 14 percent of the fish purchasers sometimes buy fish from middlepersons and supermarkets. The latter point of sale is rapidly gaining ground because of the rapid increase in the number of supermarkets, a trend that started in Ho Chi Minh City and is now occurring in the large cities in northern Vietnam. Nine percent of the fish purchasers sometimes buy their fishery products directly from fish farmers, while around 6 percent buy catch from fisherfolk at the beach or the landing place.

The main reasons given for where customers choose to buy their fishery products are the vicinity of the supplier, the price of the product and the good quality provided by the supplier. Fish farmers are generally selected as main suppliers because of the reasonable prices they charge (40 percent), the quality of their products (33 percent), which are often sold alive, and an already existing relationship between the farmer and the customer (16 percent).

Aquaculture products have an important share of the total fisheries products market in Viet Nam. Although 24 percent of the people never purchase aquaculture products, there are also around 7 percent who purchase primarily aquaculture products.

The average monthly household expenditure on fisheries products was estimated at around US$22. Although it was expected that wealthier households would spend relatively more on higher value aquaculture products (e.g. black tiger shrimp and freshwater prawns) no significant relationship, either positive or negative, was found between expenditure on aquaculture products and income group. Thus, hardly any relationship was found between household income and the consumption of various fish species (e.g. the consumption of tilapia, shrimp, catfish, climbing perch and snakehead fish was not related to household income).

Remarkably, the only species that are not often purchased by the lowest income groups are the carps, especially common carp and grass carp. These species are widely seen as excellent for rural poverty alleviation in Vietnam, and the fact that they are infrequently purchased by the poorer segment of the population does not mean that they are consumed less often by this sector. Poor farmers (e.g. those who grow rice and fish) already cultivate these species and thus are unlikely to purchase them. Moreover, poor people who have access to rivers, streams and lakes probably catch carp themselves. Because common carp is a bit more expensive than bighead carp, Indian major carps, tilapia, and most other freshwater and marine finfish, it is less often purchased by the poorest segment of the population.

Almost all fisheries products are available on the market in sufficient quantities. The only species that is considered relatively scarce is snakehead fish. Twenty percent of the consumers of this species reported that it was unavailable or scarce during part of the year. This indicates that opportunities exist for the cultivation of snakehead, taking in consideration that, when marketed, more than 80 percent of this fish is sold for over US$1.20/kg. In contrast, over 70 percent of the carp (bighead, grass, common and Indian major carps) is sold at lower prices.

The demand for freshwater aquaculture and fisheries products is on the rise in Vietnam (Table 2). More than 35 percent of consumers reported an increase in their consumption of freshwater products between 2000 and 2001, while only 13 percent consumed less freshwater fish in 2001 than in the previous year. At the same time, the consumption of marine fisheries products saw a similar trend, 44 percent of the people reporting an increase in consumption from 2000 to 2001.

Table 2. Change (percent) in household fisheries products consumption between 2000 and 2001.

Product	Increase	No Change	Decrease	No Idea
Fresh and live	52	33	9	6
Frozen	17	40	11	32
Canned	13	38	9	40
Instant (noodles, soups etc.)	13	40	10	37

The majority of the fish-consuming people increased their consumption of fresh and live fisheries products, while 17 percent increased their consumption of frozen products over the period 2000-2001.

Aquaculturists and Product Marketing

Vietnamese aquaculturists generally sell their products to middlepersons or wholesalers (72 percent). However, 16 percent sell directly to consumers, 13 percent to retailers and around 10 percent to processing companies. The main marketing problems they encounter are low and unstable prices, lack of marketing/price information and the limited number of buyers at the local level.

Aquaculturists see a role for the government in providing them with better marketing opportunities through:

- ☐ Enabling policy development,
- ☐ Increasing access to price and market information,
- ☐ Introducing contract farming practices, and
- ☐ Establishing wholesale markets.

Aquaculturists' solutions to become more effective in their own marketing activities can be largely summarized as follows:

- ☐ Search actively for market and price information,
- ☐ Get good quality fingerlings,
- ☐ Deliver products of the right sizes and good quality, and
- ☐ Establish good relationships with customers.

However, it is clear that many aquaculturists have no idea of how to improve the marketing of their products.

As more than 90 percent of the aquaculturists intend to establish or maintain a long-term relationship with their customers and input suppliers, it is obvious that they see clear benefits in such a relationship. In this respect, it should be noted that many of them already exchange some marketing information with their customers and suppliers. Moreover, around one-third of the aquaculturists are involved in joint grading of the products with their customers and/or have (oral) agreements with one or more customers to buy their produce. The main reasons aquaculturists get involved in long-term relationships with specific customers/buyers are:

- ☐ To improve their interdependency relationship,
- ☐ To increase access to market information,
- ☐ To reduce costs (related to the search for customers, negotiation, transaction, time and labour), and

Display of fish at the night wholesale market in Ho Chi Minh City

- ☐ To increase access to technical and product requirements information.

Almost 80 percent of the aquaculturists have never had problems with non-acceptance of their product and/or price discounts demanded by customers as a result of not providing the products as earlier agreed upon. However, some 6 percent frequently encounter rejections or price discounts as a result of smaller size of fish, lower quality, lower quantity or late delivery of the products offered to their customers.

A shop specialized in selling fish products in Ho Chi Minh City

What can Aquaculturists Learn from the Above?

First of all, aquaculturists should capitalize on those attributes of fish that are considered its strengths as compared to its substitutes e.g. healthiness, price and diversity. This means that they will have to continue to produce a variety of healthy products for a reasonable price, and that fish should be promoted as such among the public. Secondly, aquaculturists should focus on further improvements on those attributes of fish that can be considered weaknesses e.g. its availability and freshness. One can think, for instance, about keeping products fresh for a longer period by keeping them alive, or by trying to limit the period needed for transport and marketing to a minimum. The latter could take place through logistical fine-tuning of harvesting, transport and marketing with their customers/buyers.

In view of the fact that most fish is purchased at the market (from retailers), and that the number of supermarkets is increasing rapidly, aquaculturists should think about how to address this changing market environment. Supermarkets generally demand a stable supply of good quality products of a certain (often rather high) quantity. For individual aquaculturists, the demands of large retailers such as supermarkets are difficult to meet. Therefore, it is promising that aquaculturists generally intend to have a long lasting and strong relationship with their partners in the aquaculture product chain (customers and input suppliers). Via such a relationship they try to perform better in terms of delivering higher quality products and getting around the general lack of market information. As a result, aquaculturists get the information needed to respond properly to the demands of the final consumers.

As aquaculture products are consumed by all income groups, it is important that the current availability of a wide variety of products (catfish, shrimp, prawns, carp, tilapia, perch, gourami, grouper, cobia etc.) is maintained or further extended. Given its scarcity on the market during some times of the year, snakehead is one species with market potential.

In view of the fact that many consumers have increased their consumption of fresh and live fish, and the recent and rapidly growing trend of eating sashimi, it is important that aquaculturists take note of the changing demands of consumers. Coordination and collaboration in the aquaculture product marketing chain, which includes aquaculturists, middlepersons, processors and retailers, provide good opportunities to respond to changing consumer demands.

Acknowledgements

The data for this article were derived from the MTF/VIE/025/MSC "Fisheries Marketing and Credit in Vietnam" research project databases. This joint FAO, Ministry of Fisheries of Vietnam and DANIDA Fisheries Sector Programme Support sponsored, nation-wide project interviewed more than 650 consumers and over 300 aquaculture farmers in 12 provinces. The author acknowledges the important contributions of Ms Nguyen Viet Ha, Mr Nguyen Viet Dang, Mr Nhan Ngia and Ms Phuong Mai to the above study.

Latin America Regional TCP Project on Shrimp Health Management Ends

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The FAO Regional Technical Cooperation Programme (TCP) Project on "Health Management in Shrimp Aquaculture in Latin America" ended successfully. The final field activity of the project, the third and final regional workshop on postlarval health, was held in Guayaquil, Ecuador in May 2003. The National Coordinators (NCs) from 13 regional countries finalized the regional hatchery technical standards for producing better health Penaeus vannamei postlarvae. Fourteen regional countries: Belize, Brazil, Colombia, Costa Rica, Cuba, Ecuador, El-Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru and Venezuela participated in the project, which began in 2001. At the inception workshop of the project, held in August 2001, representatives of each country (NCs) responded to a questionnaire on shrimp maturation and hatchery practices in their countries. The questionnaire covered a number of aspects of production, concentrating on maturation and hatchery types, sizes, species, management, physical and chemical treatments and disinfection procedures, health management, production and quality assessment methods, transportation methods, and problems encountered. This information, and the knowledge gained through a series of workshops and consultations held during the past two years that were attended by NCs, experts and industry representatives, provided the basis for the regional hatchery technical guidelines, which will be published late this year.

Aquaculture in Latin America

Total reported aquaculture production within the Latin American and Caribbean Region has increased over 714-fold by weight, from 1 221 metric tonnes (mt) in 1970 (0.03 percent of total global production) to 871 874 mt in 2000 (representing 1.9 percent of total global production). The annual percentage growth of the sector within the region has decreased from 34.4 percent per year (period 1970-1980) and 23.3 percent per year (period 1980-1990), to 14.2 percent per year (period 1990-2000), with the sector displaying an overall growth of 24.5 percent per year during the period 1970-2000. The total number of reported cultured species within the region has increased dramatically, from eight in 1970 to 46 in 2000. The main cultivated species groups in 2000 included finfish (624 thousand metric tonnes (tmt) or 71.6 percent), crustaceans (153 tmt or 17.6 percent), molluscs (60 tmt or 6.9 percent), aquatic plants (34 tmt or 3.8 percent) and amphibians (772 mt or 0.09 percent). The top ten cultured species by weight within the region in 2000 were Atlantic salmon (166 897 mt or 19.1 percent), whiteleg shrimp (139 264 mt or 16.0 percent), rainbow trout (97 479 mt or 11.2 percent), coho salmon (93 419 mt or 10.7 percent), tilapia (85 246 mt or 9.8 percent), common carp (62 241 mt or 7.1 percent), Gracilaria seaweed (33 642 mt or 3.8 percent), silver carp (30 000 mt or 3.4 percent), Chilean mussel (Mytilus chilensis) (23 477 mt or 2.7 percent) and the Peruvian calico scallop (Argopectin purpuratus) (21 295 mt or 2.4 percent) (FAO, 2003).

By value, aquaculture production within the region has increased over eight-fold, from US$337 million in 1984 to US$2.98 thousand million in 2000 (representing 5.3 percent of the total global aquaculture production by value).

The main species groups by value in 2000 were finfish (US$1.89 billion or 63.4 percent), crustaceans (US$0.94 billion or 31.5 percent) and molluscs (US$128 million or 4.3 percent). The top country producers by value within the region in 2000 included Chile (US$1.27 billion or 42.5 percent), Brazil (US$617 million or 20.7 percent), Ecuador (US$324 million or 10.8 percent), Colombia (US$258 million or 8.6 percent), Mexico (US$181 million or 7.0 percent), Honduras (US$59 million or 2.0 percent), Cuba (US$47 million or 1.6 percent), Venezuela (US$43 million or 1.1 percent). Costa Rica (US$33 million or 1.4 percent) and Peru (US$ 28 million or 0.9 percent) (FAO, 2003).

Shrimp Culture in the Region

The shrimp farming industry in Latin America has emerged as one of the major foreign exchange earners in the region. However, disease has become a major constraint; especially since the outbreak of white spot disease (WSD), shrimp production has decreased significantly in many countries and farmers are facing serious difficulties in continuing production. The resulting economic losses and their impacts are now significantly affecting national economies and the livelihoods of poorer sectors. For example, the shrimp exports from Ecuador in December 1999 fell to below 1985 levels.

Initially, shrimp producers relied almost entirely upon the capture of wild postlarvae (PL) in the estuaries and coastal areas where these are found naturally. Seasonal and annual variations in the catch of PL, however, led to the development of hatcheries where shrimp PL production could be undertaken in a more controlled manner. These hatcheries used wild broodstock that were caught and supplied by fishermen.

The fluctuations in catches of both wild PL and broodstock as a result of the El Niño phenomenon had a major impact on the development of hatcheries. In years when wild seed was abundant, low prices for PL and a general perception that wild seed was stronger meant that many hatcheries encountered financial difficulties. In years when wild seed was scarce, on the other hand, hatchery-produced seed could be sold at a premium. Despite this, many hatcheries experienced problems due to the unpredictability of the market situation.

National coordinators from 13 countries in Latin America who participated in the final workshop in Guayaquil, Ecuador

Shrimp Health Problems

In recent years, disease, or more specifically, shrimp health concerns, led to a revival of interest in hatchery-produced postlarvae. Shrimp from certain countries were widely believed to be less sensitive to taura syndrome virus (TSV) than those from other areas, and this led to a lucrative trade in broodstock, nauplii and postlarvae. Unfortunately, the arrival of the white spot syndrome virus (WSSV) in the region in the late 1990s exposed the local hatchery operators to the possibility that the disease might be spread by such transfers if they were not accomplished using appropriate controls and regulation.

At the same time, several producers had been experimenting with the breeding of survivors of TSV outbreaks in an attempt to develop lines of shrimp with greater resistance to the virus. The WSSV epidemic and the risk of vertical transmission accelerated this and led to a greater interest in genetics and breeding and a recognition that the dependence on wild sources of shrimp represented a significant disease risk. Hatchery operators reviewed their operations and focused on improving the biosecurity and health management of their production systems.

The simplest way to solve the PL quality problem is to change from the use of PL derived from captured broodstock to PL derived from domesticated stocks. However, this practice requires considerable research effort and field-testing, and is still in its infancy. At least we can try to ensure biosecurity in ponds through appropriate screening of PL for important pathogens prior to stocking. The procedures for screening PL for important pathogens (currently predominantly the WSSV) are known; however, some training, capacity

building and upgrading of hatcheries and diagnostic centres are necessary.

Currently, there are little or no harmonized (technical) standards on hatchery production of PL. It is imperative that such technical standards are developed, validated, standardized and agreed upon by the hatchery producers, both nationally and internationally.

Most countries in Latin America have begun domestication and genetic selection programmes using pond-reared broodstock in maturation systems. This has been done in an attempt to stabilize predictability and to improve the disease resistance and growth rate of their shrimp stocks. Initial efforts used broodstock from a variety of countries around the region in order to ensure a wide genetic variability in the stocks, but subsequent closure of most borders to import of live shrimp has curtailed this activity.

Most countries in the region are concentrating on the production of specific pathogen tolerant (SPT) shrimp, selecting the best surviving (but not necessarily disease-free) animals from pond on-growing facilities and on-growing them further in various facilities before transfer to maturation systems. Specific pathogen free (SPF) shrimp (shrimp certified free from a specified serious disease or diseases and held throughout their lives in closed systems) have also been used, but with less frequency. Where used, these animals have generally been brought in from isolated breeding centres in the United States.

FAO Assistance

In November 1999, an FAO Expert Workshop was held in Cebu, Philippines, where 14 shrimp-producing countries, including five from Latin America, attended. The workshop discussed the strategies for controlling shrimp disease problems globally and recommended future activities. These ideas were further discussed at the APEC/NACA/FAO/SEMERNAP Expert Workshop on Trans-boundary Aquatic Animal Pathogen Transfer and the Development of Harmonized Standards on Aquaculture Health Management, which was held in Puerto Vallarta, Jalisco, Mexico, from 24th-28th July 2000. Consensus has been built that the above ideas should be incorporated into an FAO Regional Technical Cooperation Project aimed at assisting member countries, particularly those in Latin America.

In early 2001, the Government of Ecuador made a formal request to FAO for technical assistance to combat serious shrimp disease problems in Ecuador. FAO, in consultation and agreement with the other shrimp-producing countries in the Americas, decided to prepare a Regional TCP Project to provide technical assistance to the shrimp health problem in the region. The development objectives of the project were to secure and increase the income of the shrimp farmers in Latin America by improving national income, food security status and rural livelihoods by minimizing outbreaks of disease in shrimp aquaculture. The project attempted to achieve this objective through:

- ☐ Developing a programme for improving health, sanitary status and quality of hatchery-produced shrimp PL, in particular, by compiling hatchery technical standards for producing better health Penaeus vannamei PL;
- ☐ Improving farmer capacity in disease control and health management in shrimp aquaculture; and
- ☐ Developing and establishing an information system on aquatic animal health, with a view to providing vital information required during the movement of live aquatic animals, with special reference to reducing transboundary pathogen movement.

The project field activities included four regional workshops on shrimp health and two regional laboratory training workshops on shrimp disease diagnostics. The regional hatchery technical standards are being finalized for printing, and the Latin American Chapter of the FAO Aquatic Animal Pathogen and Quarantine Information System (AAPQIS) will soon be fully functional and available to the public. It is hoped that the regional technical standards will help regional hatchery operators to improve their management practices and the regional governments to develop the policy and regulatory measures necessary to improve the overall quality of the PL produced, thus improving regional shrimp production and maintaining sectoral sustainability.

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Promoting Sustainable Aquaculture Development in the Small Island Developing States of the Lesser Antilles

A summary of the Subregional Workshop to Promote Sustainable Aquaculture Development in the Small Island Developing States of the Lesser Antilles, held in Vieux Fort, Saint Lucia, 4–7 November 2002

Samia Sarkis, Bermuda Biological Station for Research

Suspended pearl nets of calico scallop (Argopecten gibbus) *in Bermuda*

For more information on this initiative, please contact Randolph Walters (e-mail: randolph.walters@fao.org), Fisheries Officer, Subregional Office for the Caribbean. The workshop proceedings will be published shortly as FAO Fisheries Report No. 704.

Background

Efforts to promote aquaculture development among the Small Island Developing States of the Lesser Antilles were initiated in the early 1980s. In 1993, following a review of the industry, the Italian-funded FAO-AQUILA II project on "Support to Regional Aquaculture Activities in Latin America and the Caribbean" (GCP/RLA/102/ITA) recognized the different potentials for developing aquaculture in the region. Subsequently, in cooperation with the Caribbean Community (CARICOM) Secretariat, a project on "Caribbean Aquaculture Development" (CARAD) aimed at institutional strengthening and increasing cooperation among regional institutions was formulated, but unfortunately, this was never funded.

At a special FAO Ministerial Conference on Agriculture in Small Island Developing States (SIDS) held in 1999, the participating countries expressed their commitment to pursue efforts to achieve food security and to implement development policies and programmes that would secure the sustainability of the agriculture, forestry and fisheries sectors in SIDS. Specific to aquaculture, the Ministerial Conference recognized the need to collaborate with the international and scientific communities in both the public and private sectors to:

- ☐ Introduce or strengthen aquaculture and inland fisheries, where feasible and appropriate;
- ☐ Ensure that aquaculture practices are compatible with their ecosystems; and
- ☐ Establish networks to facilitate exchange of technical information.

In response to the importance given to aquaculture and the apparent lack of capacity at the national level in the SIDS of the Lesser Antilles, FAO took the initiative to organize a subregional workshop on the "Promotion of Sustainable Aquaculture Development in the

Jean Claude Dao, IFREMER

Experimental raft with floating cages for red drum (Sciaenops ocellatus) culture in Martinique

Small Island Developing States of the Lesser Antilles". Fifteen participants from seven regional countries, four regional institutions and the FAO attended the workshop. The countries represented included Antigua and Barbuda, Barbados, Grenada, Saint Vincent and the Grenadines, Saint Kitts and Nevis, Saint Lucia, and Trinidad and Tobago.

Each of the representatives attending the workshop presented an update on the status of aquaculture in his/her respective country. A number of very interesting case studies were presented by aquaculture experts from Martinique, the US Virgin Islands and Bermuda. FAO also provided background information on issues such as potential marketing opportunities for aquaculture products from the Lesser Antilles and on aquaculture policy development.

Main Conclusions and Recommendations of the Workshop

The workshop participants noted the results of the many previous attempts to develop aquaculture in the Subregion. They also identified the following steps that should be taken to facilitate the development of sustainable aquaculture in the SIDS of the Lesser Antilles:

1) Incorporate aquaculture into national development plans and strategies.
2) Formalize an aquaculture development policy (including environmental policy and fiscal incentives).
3) Develop the legal framework for aquaculture.
4) Establish small-scale pilot projects for technology transfer and evaluation.
5) Conduct economic feasibility studies and marketing analyses for aquaculture proposals.
6) Allocate resources (including government commitments) for aquaculture.
7) Strengthen aquaculture-related institutions (including monitoring and regulatory systems, capacity building and research).
8) Develop and disseminate appropriate technologies.
9) Identify reliable sources of inputs and create access to them (e.g. broodstock, fingerlings, feed and equipment).
10) Establish administrative procedures for the smooth evaluation and approval of projects.
11) Develop Code(s) of Best Practice (thorough private-public partnerships).
12) Attract private sector involvement and investment.

The participants recommended that these steps should be prioritized for each country, depending on the country's stage of aquaculture development. They also recommended that a concerted effort should be made to raise awareness of the opportunities for sustainable aquaculture development among potential aquaculture stakeholders, decision-makers and natural resource managers in the Lesser Antilles.

Follow-up Activities

Based on the common priority-needs identified at the workshop, an FAO Technical Cooperation Programme (TCP) project proposal for the region is currently being considered.

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Green water tank tilapia culture in the US Virgin Islands

Promotion of Sustainable Commercial Aquaculture in Africa Continues

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In early October 2002, more than 35 aquaculture sector stakeholders (including aquaculturists, hatchery managers and feed processors), representatives of the banking sector and public-sector fisheries and aquaculture policy-makers from Malawi and Zambia came together in Lusaka, Zambia for a bi-national workshop on the promotion of sustainable commercial aquaculture in Zambia and Malawi. This workshop was supported by FAO under the programme theme "Sustainable Commercial Aquaculture Development in Sub-Saharan Africa". It was part of the follow-up activities after the Technical Consultation on Legal Frameworks and Economic Policy Instruments for Sustainable Commercial Aquaculture in Africa South of the Sahara, which took place in Arusha, the United Republic of Tanzania in December 2001, and aimed:

- ☐ to share the main outcomes of the Arusha Consultation,
- ☐ to review the role of commercial aquaculture development in achieving food security, alleviating poverty and supporting economic growth in the two countries,
- ☐ to identify policy measures that will support the creation of an enabling environment for commercial aquaculture development, and
- ☐ to discuss opportunities and constraints in commercial aquaculture in both countries.

Overviews of the aquaculture situation in both countries were presented by staff of the national Departments of Fisheries. In addition, working papers were presented by FAO on:

- ☐ Sustainable commercial aquaculture: concept, benefits, pitfalls and conditions for development and major constraints in sub-Saharan Africa;
- ☐ Markets and trade of commercially farmed fish and shrimp in sub-Saharan Africa;
- ☐ General policy framework;
- ☐ Legal frameworks; and
- ☐ Mitigating strategies to major constraints.

An additional presentation was given on the outcomes of the South African Aquaculture Conference, and the Barclays Bank of Zambia provided an introduction to those aquaculturists interested in obtaining credit from the bank. The presentations served as background information and assisted in making the plenary and group discussions as effective as possible, considering the limited time available for the workshop.

The review of the main subjects covered under the different agenda items and the major conclusions and recommendations made by the workshop point the way forward in the development of sustainable commercial aquaculture in Zambia and Malawi.

The Workshop concluded that:

1 There is still much unrealized potential for economically viable and sustainable commercial aquaculture in Zambia and Malawi. However, commercial aquaculture is developing at a very slow pace in these two countries. Nonetheless, there is still growing interest that needs support.

2 There is a need in Zambia and Malawi to speed up the development of policies, strategies, strategic plans, legal, regulatory and institutional frameworks in order to regulate, facilitate and enable commercial aquaculture to take off and expand.

3 The major constraints to commercial aquaculture development in Zambia and Malawi are:

☐ The quasi-complete inaccessibility to funding and to loans. Inaccessibility to funding and loans arises from:

- lack of information on the part of potential investors in commercial aquaculture on the funding mechanisms;

- lack of knowledge on the part of potential borrowers on how to prepare convincing business plans when seeking loans;

- the perception by lending institutions that aquaculture ventures bear a high risk of failure;

- lack of experience by local lending institutions on aquaculture and allied industries as economically and financially viable activities;

- lack of government policies encouraging funding and financial institutions to support infant industries such as aquaculture and allied industries just as they do in some other agricultural subsectors;

- the prohibitively exorbitant interest rates charged to potential borrowers. In addition to macro-economic factors, these high interest rates are especially a result of the lack of adequate collateral and equity by loan applicants.

☐ The lack of clear enabling policies, strategies, plans and legal, regulatory and institutional frameworks for aquaculture development in general.

☐ Shortage of skilled manpower.

4. Donor and government focus in aquaculture has traditionally been in the small-holder sector. Consequently, commercial aquaculture has felt left out and is equally in need of support.

The Workshop recommended to each of the Governments of Zambia and Malawi:

☐ To speed up the preparation of clear national policies, strategies, plans and legal, regulatory and institutional frameworks for commercial aquaculture development and, while preparing aquaculture subsector development policies and strategies, to give due attention to defining financial incentives and promotional instruments to use in order to encourage investment, especially by the private sector, in commercial aquaculture and to ensure full participation of all stakeholders, including those from allied industries (feed manufacturing, hatcheries, processing and marketing, etc.) in the process;

☐ To support start-up aquaculture and allied industries such as private hatcheries and feed mills in their pilot stage with clear and simple regulations, as well as by fiscal incentives such as tax exemptions, tax holidays, exemptions of import duty on machinery and other necessary inputs like basic feed ingredients;

☐ To define deliberate, clear policies to guide financing institutions on the borrowing and lending for start-up industries such as commercial aquaculture;

☐ To facilitate the establishment of models of economic and financial feasibility of commercial aquaculture ventures and allied industries. These models would allow financial institutions to objectively evaluate investment proposals in aquaculture and allied industries.

☐ To facilitate borrowers for commercial operations to access loans by looking into the possibilities of using loan guaranties and special interest rates;

- ☐ To promote and support research on, and preservation of, indigenous species, and to strengthen the research-extension farmer linkages in order to ensure a proper and effective dissemination of research findings;

- ☐ To consistently look for means of organizing study tours and for attendance at international meetings and conferences by government officers, extensionists and the private sector in commercial aquaculture and allied industries, to other countries in the region with the aim of exchanging experiences and allowing them to better serve the aquaculture sector development;

- ☐ To create awareness and appreciation of aquaculture products in order to increase consumer demand at the local and national levels;

- ☐ To designate ADZs (Aquaculture Development Zones) and EPZs (Economic Preferential Zones) with fast track mechanisms in place for investors.

The workshop requested FAO to provide support to the Governments of Zambia and Malawi in their promotion of sustainable commercial aquaculture in specific fields such as:

- ☐ Documenting the sources of financing and existing funding mechanisms for commercial aquaculture in the region;

- ☐ Strengthening national-level commercial fish farmers' associations and the strengthening of their lobby force and linkages of existing regional networks of commercial fish farmers;

- ☐ Creating awareness among non-governmental organizations (NGOs), possible donor agencies, funding institutions and investors on the role of commercial aquaculture in supporting economic growth, with the aim of seeking the extension and increase of their assistance and support to the subsector; and

- ☐ Continuing to regularly monitor, review and analyse what has been done in terms of commercial aquaculture development in Africa and elsewhere, with the aim of extracting and disseminating success stories of aquaculture investment, including policy development and implementation, and financial and economic successes and failures.

For more information on this workshop or other FAO activities under the "Sustainable commercial aquaculture development in Sub-Sahara Africa" theme please contact the Fishery Policy and Planning Division (FIPP): Nathanael Hishamunda, (Nathanael.hishamunda@fao.org) or Raymon van Anrooy, (Raymon.vananrooy@fao.org)

The Honorable Minister addressing the workshop at the opening

Some participants of the workshop, including the Honourable Minister for Agriculture and Cooperatives of Zambia,Mr Mundia F. Sikatana (front row, third from the left).

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Sustainable Development of Aquaculture and Aquatic Resources

The first Sub-Committee on Aquaculture (SCA) recommended that FAO assist members to create an enabling environment for the promotion of sustainable aquaculture development and management and to establish a framework for sustainable rural aquaculture development. The effective communication of the issues that relate to the poor and their dependence upon aquatic resources to policy and decision-making mechanisms is critical to these two recommendations of the SCA. This is a central theme of the STREAM initiative of the Network of Aquaculture Centres in Asia-Pacific (NACA), and to which FAO headquarters and the Regional Office (RAPI) have recently provided Technical Cooperation Programme (TCP) assistance. This is a joint effort supported by donors such as the Australian Agency for International Development (AusAID) and the Department for International Development of the United Kingdom (DFID) and partnered with an international nongovernmental organization - volunteer service overseas (VSO). Its goal is to improve the understanding of how the livelihoods of the poor depend upon aquatic resources and to assist in communicating the issues that relate to this into decision-making fora at the national and regional levels.

FAO/RAPI and IUCN Join Hands to Study Living Aquatic Resources, Rice Agriculture and their Impacts on People's Livelihoods

Fish and other aquatic products are staple resources for many populations of the Asia-Pacific Region. Set against increasing population pressure and intensifying agricultural development, the inland fisheries upon which so many people were once dependent appear to be increasingly under threat. Actually, the lack of a clear understanding of these resources prevents us from really saying what the future of these resources is. We do know that more and more people are fishing in inland waters, that these people are reporting that their catches are declining, and that the size of the fish they are taking is getting smaller. Importantly, the decisions made about these resources are often based on assumptions about the status of the resource that are not always correct, and all too frequently, the number of people dependent upon inland fisheries resources is assumed to be insignificant. Recently, improved information emerging from some of the largest inland fisheries in Asia, those of the Mekong River Basin, is now showing that far more people than was previously thought depend on fisheries as a coping strategy or simply as an important source of good quality nutrition.

To improve our understanding of the resource issues relating to inland fisheries and the poverty and nutrition-related impacts on the livelihoods of people dependent upon these resources, the fisheries group of the Regional Office (RAPI) and the World Conservation Union (IUCN) have undertaken a joint initiative to investigate the relationships between living aquatic resources, rice agriculture and the livelihoods of the people who manage these systems. This assessment is a contribution to the global initiative the "Dialogue on Water, Food and the Environment" and is intended to address the concern that the ecological and livelihood functions and values of rice fields and adjoining wetlands are not fully appreciated in development planning. The assessment undertook participatory activities to assess the local availability and use of aquatic resources, their importance in local livelihoods, and the over-all health and nutrition of the villagers.

The results of these activities illustrate that a broad diversity of aquatic plants and animals (almost 200 species) are frequently used by villagers, and that fish and other aquatic animals make up the main animal protein source in peoples' diets. Local health and nutritional conditions, however, are quite poor, and evidence of malnutrition (underweight,

stunting and wasting) was observed in a significant number of people from all three villages. Typical diets are insufficient in terms of quantity and quality, and are especially low in protein and fats.

These findings indicate that strategies for rural development, food security and poverty alleviation in these areas need to give special attention to aquatic resource management to ensure the health and well being of rural people. Integrated management of freshwater and wetland resources is necessary to increase rice production while maintaining the viability and productivity of the aquatic resources upon which rural livelihoods depend.

A Joint Mission Reviewed the Status of Aquaculture and Inland Fisheries in Myanmar

A joint mission to review the status of aquaculture and inland fisheries of Myanmar was undertaken by a team comprising members from NACA, FAO Regional Office Asia and the Pacific, the Australian Center for International Agricultural Research (ACIAR), the Department of Fisheries (DOF) Thailand and DOF Myanmar. There are repeated references to the crucial importance of fish and fish products in the nutrition of the Myanmar people. The mission team report concluded that while it is certainly recognized that fish is second only to rice in the diet of Myanmar, there is little information available on the patterns of consumption, interregional differences, availability and types of fish consumed. In this respect, Myanmar is similar to many of the Southeast Asian countries, where emphasis is paid to rice production as a crucial element of food security, with little or no recognition of the fish component that gives the rice-based diet much of its nutritional value outside of calories and crude protein. The size and scale of activities and opportunities within the inland fisheries and aquaculture sector varies from very small-scale to large-scale commercial operations.

Myanmar has a coastline of nearly 3 000 km, a continental shelf of 228 000 km2 and an exclusive economic zone (EEZ) of 486 000 km2. Inland freshwater bodies cover 8.1 million ha of which 1.3 million ha are permanent, the remainder seasonally inundated floodplains. Fisheries are the fourth most important source of export earnings, valued at US$218 million in 2001. Marine capture fisheries is reported

Fish sellers in Nyaung Schwe, Shan State, Myanmar. Fish is the principle source of animal protein and still mostly obtained from inland fisheries

to produce 932 090 metric tonnes (mt), freshwater capture fisheries 235 530 mt (DOF estimates of leasable, open and floodplain waters) and aquaculture 115 870 mt. It is uncertain whether marine or freshwater capture fisheries still have expansion potential, although recent reviews have suggested that the inland fisheries potential of Myanmar is far greater than the 235 000 mt reported (possibly as much as 600 000-900 000 mt based on revised estimates from the Mekong system). This is partly due to the non-inclusion of fisheries production for household use and the production that is derived from rice fields and their associated streams and channels. Statistics are also focussed on fish production and not on the range of other aquatic products that are also routinely consumed in rural households. The leasable inland fisheries may also be benefiting from the effects of interventions aimed at enhancing production, which also gives encouraging potential for increased contribution for the inland fisheries sector in supporting the livelihoods and food security of the people of Myanmar.

The report of the scoping mission was particularly timely, since so little is known about this crucial food security sector of Myanmar. The report developed from the NACA/ACIAR/FAO mission will contribute greatly to the improved coverage of the inland fishery and aquaculture sectors of Myanmar's economy. The report of the mission will soon be available on both the

RAP Web site (http://www.fao.org.th/) and the NACA Web site (www.enaca.org).

Encouraging Farmers to Associate

As aquaculture continues to develop at a rapid pace in the Asia Region (at a growth rate exceeding that of other parts of the agriculture sector), the need to control the quality of the production and the methods of production increases. Much of Asia's aquaculture is still operated as family businesses, giving rise to a huge number of independent operations within any given part of the sector. While this gives Asia's aquaculture much of its diversity and economic robustness, it is becoming evident that it also presents a great challenge in terms of how to ensure quality products that are healthy, safe and that can be exported. At the same time, some countries in Asia are increasingly challenged by the environmental

Grandfather and grandson in the highlands of Viet Nam catching small common carp from their fish pond

impacts of intensification of small livestock, and some forms of aquaculture are also competing for water resources.

Delivering messages about best practices and proper management techniques is an impossible task if the message must be delivered to farms individually. The grouping of farms or farmers in order to provide appropriate advice is one way to make the task more manageable. Associations (whatever the type) of farmers also offer the opportunity to introduce certification and licensing systems. These are essential steps if quality is to be controlled to a standard that will enable farmers' products to be acceptable to export markets.

The question remains as to how to start the process of encouraging or enabling aqua-farmers' association. Many aquaculture operations may not even be at a scale that is considered large enough to warrant licensing, and farmers themselves are wary of licensing and certification systems, due to the fear of taxation and other unknown costs and control. Offering incentives to farmers to associate is probably more effective than trying to legislate or drive farmers together. Such incentives are various, but might include:

- ☐ A higher market price (for improved quality);
- ☐ Access to markets (traceable products, producers group selling to supermarkets, branding);
- ☐ Improved access to extension and private sector information services;
- ☐ Opportunity to access and manage micro-credit/ government loans; and
- ☐ Control of effluents/environmental impacts.

Transboundary Movement of Aquatic Species

Recent years have seen the introduction and movement of a wide range of alien aquatic species around the region, as well as the transboundary movement of native species. The lack of effective controls at the national level and a tendency to "try out" new species are leading to an increased risk that the movement of aquatic species and their diseases could have serious impacts on established aquaculture industries. The escape of some alien species into the wild is another potential risk that is difficult to evaluate, but this could impact wild fisheries and the people who depend upon them. As part of a collaborative FAO/NACA/Mekong River Commission (MRC)/ IUCN/Asian Institute of Technology (AIT) initiative to raise awareness and to promote good practice in the transboundary movement of aquatic animals, a workshop on the "Use of International Mechanisms for the Control and

Responsible Use of Alien Species in Aquatic Ecosystems" will be held in late 2003. The output of the workshop, a synthesis of the various international mechanisms, will be produced in the form of an awareness/ information brochure (to be translated into local languages for dissemination in the region), an outline for the development of best practice guidelines, recommendations on practical follow-up actions and a list of responsible individuals and offices in participating countries, intended to serve as a basis for a future collaboration on alien species in the region.

Rohu cultured in a family fish pond in Myanmar

Asia Regional Donor Consultation

The lack of sensitization of policy-makers to the role and opportunities of aquatic resource management and aquaculture is not necessarily a result of inadequate information but rather of inadequate channelling of the information to the right decision-makers, in a form that is useful to them. There are currently few opportunities for dialogue and mutual learning, and efforts to inform policy-makers of the important role of aquaculture and aquatic resource management are sometimes poorly coordinated. As a result, awareness among policy-makers is low, and this is reflected in the lack of donor intervention in the subsector. Therefore, a Regional Donor Consultation was convened on "the Role of Aquaculture and Living Aquatic Resources: Priorities for Support and Networking" to discuss with donors the role that aquaculture and aquatic resources management play in rural and coastal livelihoods and the regional development requirements for this subsector.

The consultation was convened by the FAO Regional Office Asia and the Pacific, with collaboration from several regional institutions with competence in aquaculture and fisheries: the MRC, WorldFish Center, the SouthEast Asian Fisheries Development Center (SEAFDEC) and NACA.

Each of the organizations promoting aquaculture and aquatic resources management presented an overview of its aims, perceived role in the development process and main activities. Four major themes emerged from these presentations. Ten donor agencies were represented and outlined their guiding policies, main approaches and services. All the donors presenting are supporting the fisheries sector through initiatives such as knowledge dissemination, community-based coastal resources management or marine fisheries. Donors agreed that small-scale fisheries and aquaculture are valuable tools for poverty alleviation and rural development and are prepared to fund these activities provided that proposals can be shown to meet the donors' policy goals.

A pressing need was identified for aquatic resource management and aquaculture to become part of the global discourse on poverty alleviation and to demonstrate that aquaculture and aquatic resources management play a significant role. A number of practical and immediate actions can be taken to make aquaculture and aquatic resources management a larger part of the discourse on rural development and poverty alleviation. Donors are constrained by their own national policies and the policies and priorities of the countries with which they wish to engage. It was also stated that donors often talk to national planners and staff at the various Ministries of Agriculture, which may not always be aware of the importance of the fisheries sector. To assist, regional institutions offeredto analyze the range of sectoral strategy papers the various donors are using (trends on development support, inclusion of current issues) and draw up a common document that would be provided to donors. This would include recommendations regarding adaptation and/or revision to current regional and national needs. Additionally, the regional institutions could assess project impact against selected poverty indicators, possibly in the manner of an overall review. The meeting agreed that follow-up consultations between the regional institutions and donors would be fruitful if held at least once every two years.

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Gender and Aquaculture Development in the Africa Region

It is well acknowledged that African women are key players in the region's agricultural sector, and that their participation is critical to achieving food security and economic well being. In many traditional agricultural enterprises, roles can be well defined along gender lines. However, most aquaculture systems are non-traditional and gender delineations less well documented.

A large percentage of both market-orientated and non-market-orientated aquaculture systems in the region rely heavily, if not exclusively, on family labour. Although this labour may be somewhat segregated along gender lines, with men at times doing construction and women marketing, aquaculture is typically a family affair. All family members contribute to pond management and harvesting, including children.

A case in point is the small-scale commercial fish farm of Mr and Mrs Awa in Yemssoa, Cameroon. Mrs Awa (photo) shares aquaculture management responsibilities equally with her husband and is the focal point for the majority of pond operations. Over the past few years, this family has developed a multi-pond complex with approximately a third of a hectare in catfish and tilapia production. Aquaculture is progressively replacing cocoa, the traditional cash crop, as the prime income earner.

Another example is Mr and Mrs Lucien Awoa, who began fish farming in 1998 with the construction of a 100 m2 pond in the small town of Komo, in the Arrondissement of Obala. Their initial intent was to produce fish to feed the family, and they were fairly content with this goal until a new project on market aquaculture came to town in 2001. Since finding that access to markets can open new opportunities for income generation, the Awoas have built three additional ponds (230, 300 and 350 m2) and increased their gross yield to 5 000-6 000 kg/ha. Aquaculture is currently earning the family some fcfa 800 000 per year, a 40 percent increase over pre-aquaculture cash income.

Family-run units are often administratively attributed to the man of the household, as customary ownership and benefits can have gender exclusiveness. Thus, census data citing women fish farmers are limited to woman-headed households and do not take into consideration the management responsibilities where women are raising fish as part of a mixed-sex family entity.

Begun in March 2003, an FAO Technical Cooperation Programme project "Strengthening the Organizational Capacity of Fish Farmer Groups" (TCP/GHA/2904) is reviewing gender roles in aquaculture in Ghana. Through contributions from FAO's Gender and Development Service (SDWW), this project will determine how paying more attention to gender issues of can strengthen group coherence. It will also address gender as it relates to marketing and communications channels.

A Strategic Framework for Aquaculture Development in Cameroon

Aquaculture development in the Africa Region has gone through a series of highs and lows over the past four decades. It has alternately been cited as a panacea for fish supply or accused of having grossly substandard performance and being a waste of public resources. These cycles lead to a waxing and waning of attention to aquaculture. Often the progress made during a "high" period was completely undone during a "low" period. In the aggregate, the tangible results are few and the subsector remains noticeably under-productive.

Many of the mediocre results obtained to date can be attributed, in hindsight, to inappropriate approaches to aquaculture development. In the 1970s and 1980s, government was seen as the engine driving aquaculture. Government stations and hatcheries were perceived as indispensable hubs of extension support and input (seed and feed) supply. These donor-driven efforts produced scores of aquaculture extensionists who scoured the countryside on project-provided transport promoting fish farming – often expounding production "packages" that were totally inappropriate to local conditions and needs.

In the 1990s, many African countries faced serious political-economic challenges, and downsizing became a common remedy to economic shortfalls. Structural adjustment programmes reshaped the agricultural sector, and many national aquaculture programmes nearly vanished in the process. Dedicated government aquaculture extension services and the related myriad of hatcheries and stations became too expensive to maintain and thus, many fish farmers found themselves with no external support and either abandoned aquaculture or found ways to "go it alone".

Cameroon has an aquaculture history typical of the region and has suffered many of the political-economic debacles that have visited much of the African Continent. In addition to the prevailing shift in government role from

Mrs Awa, a small-scale commercial farmer in Yemssoa, Cameroon

Cameroonian fish farmer learning to adjust to new ways without government

that of a producer to that of a facilitator, Cameroon has experienced many of the other common phenomena, including urbanization, resource deterioration, balance of trade deficit and unemployment. Within this evolving economic environment, aquaculture is again identified as a subsector with significant under-utilized potential to tackle these challenges. Yet, acknowledging the irregular path of aquaculture development, government requested assistance in developing a strategic framework to guide the future expansion of the subsector.

In response to this request, an interagency aquaculture team was assembled (see photo) representing the technical and research ministries, as well as international research and development organizations. This team spent ten days meeting with stakeholders and elaborating the structure of the strategic framework. This framework is intended as a scaffold upon which a thorough development strategy can be built. It identifies the key elements of the strategy and describes how each should be addressed. Major points include:

- ☐ Prioritization of aquaculture zones;
- ☐ Definition of target groups;
- ☐ Presentation of a workable model for aquaculture outreach;

Team visiting a fish farmer in Central Province in Cameroon

- ☐ Delimitation of the roles of the public and private sectors;
- ☐ Differentiation between support to commercial and non-commercial producers;
- ☐ Identification of mechanisms for the production and distribution of production inputs, including feed, seed and capital;
- ☐ Structure of research, training and education;
- ☐ Formation of producer groups; and
- ☐ Preparation of regulations and control measures, including means of monitoring.

Pilot Aquaculture Activities in the Forest Zone of Guinea

With support from the FAO Technical Cooperation Programme through TCP/GUI/0066, the Government of Guinea has developed pilot aquaculture activities in the Forest Zone. This area is one of the few parts of the country, and the region as a whole, where there has not been a relatively long history of aquaculture promotion. Within the context of the Special Programme for Food Security (SPFS), the aim of this project is to establish a core of farmers who are growing fish in an economically profitable and socially sustainable way with the intent of becoming self-sufficient aquaculturists, independent of long-term government support.

Project activities focused on three districts: Seredou, Yomou and Lola. In each district, the objective was to establish a group of ten fish farmers and to provide them with appropriate training in pond construction and management such that average yields at the end of the project would be 1 500 kg/ha/yr. Farmers in each district received close technical backing from an Aquaculture Assistant, a resident from the district who received specialized training from the project and served in the role of extensionist. Assistants filled the gap created by the lack of a government aquaculture outreach programme. However, from the onset, their positions were considered as catalytic – ending once the prerequisite core of aquaculturists was functioning as a coherent and independent farmer group.

By the end of the project, 31 farmers in the three-district area were raising fish in 36 ponds with an average yield of 3 400 kg/ha/yr. The ponds were constructed by the farmers themselves, relying solely on locally available inputs and family resources. An evaluation at the completion of TCP support concluded that:

- ☐ Ninety percent of the participating farmers had satisfactorily learned appropriate techniques for pond construction, fertilization, feeding fish and harvesting.
- ☐ Nineteen of the participants had further refined their skills and had demonstrated abilities in pond site selection, fingerling handling and transport, and integrated aquaculture.
- ☐ Eight of the participants had proven themselves able to undertake farmer-to-farmer extension, assisting neighbours in becoming fish farmers.
- ☐ Three solid fish farmer groups (one in each district) had been established.

Strategic Framework development team (left to right): R. Brummett, Senior Aquaculture Researcher (ICLARM/World Fish); S. Yong-Sulem, hatchery operator; M. Halwart, FAO/FIRI; N. Hishamunda, FAO/FIPP; V. Pouomogne, Senior Aquaculture Researcher (IRAD); J. Kouam, National Aquaculture Chief of Service

Opportunities for Aquaculture Development in Nigeria

Left to right: Madeleine Zogbe, Aquaculture Assistant; M.K. Souare, FAO Programme Officer, Ari Toubo Ibrahim, FAO Representative, Macky Dia, National Project Coordinator; Thea Mermoz, Aquaculture Assistant

Nigeria has become one of the largest importers of fish in the developing world, importing some 600 000 metric tonnes (mt) annually. To solve the country's high demand for fish, Nigerians must turn to their under-utilized inland waters for improved fish production and aquaculture. There is a growing awareness of aquaculture in Nigeria, with more than 100 private commercial fish farms currently in production. In addition to these producers, government efforts have included major investment in the infrastructure of some 40 public farms and hatcheries, but most of these are not operating at present. Aquaculture expansion, moreover, has been a slow process, as private-sector fish farmers have faced major constraints, including lack of seed and quality feed.

As in much of Africa, the most commonly cultured species include catfish (*Clarias garipinus*, the imported *C. lazera*, and *Heterobranchus sp*.), tilapia and carp. Many fish farms focus on catfish, as they can have a market value of two to three times that of tilapia. Some farms located in cooler areas are raising carp, as a variety of carp have been introduced in Nigeria, including bighead, silver, grass and common carps.

Fish feeds have been cited as a major constraint to aquaculture development. The animal feed industry in Nigeria produces some 3.5 million mt of animal feeds each year, with most of this going for chicken production. As a result, chicken feeds cost less than half the price of locally produced aquafeeds. Because of the sometimes recurrent feed supply problem, several of the intensive catfish producers import extruded floating feeds from Europe. Although these imported feeds cost more than twice the price of local aquafeeds, they can be more reliable in terms of quality and availability.

Left to right: Aquaculture and Inland Fisheries Project staff, Messrs Miller, Asala and Atanda

Although fish farms presently cover an estimated 60 000 ha of the country and produce some 25 000 to 30 000 mt of fish per year, this equals less than 0.5 mt/ha/yr. If aquaculture is to fulfil its expectations, yields must significantly increase. While some existing fish farms produce their own feeds, and the feed industry reports supplying some 25 000 mt of fish feed per year, feed quality and availability remain critical issues for farmers targeting higher yields. When combined with problematic seed supply, the overall input delivery system must be rehabilitated if aquaculture is to make a significant contribution to the Nigerian marketplace.

In part, this rehabilitation is to be accomplished through the "Aquaculture and Inland Fisheries Project" that is currently being launched. This $6.9 million project is funded by the Nigerian Government and is part of the Special Programme for Food Security. This important intervention seeks to assist 50 private fish farms and hatcheries to increase their capacity for improved management and greater production. Alleviating the major constraints of availability of inputs, including fish seed and quality fish feeds, is also among the project's objectives. Additionally, the project will conduct stock assessments for up to 43 small to medium-size lakes and reservoirs in the country for enhancements, including the possible stocking of fish for increased catch.

Petr, T. & D.B. Swar, eds. 2002. *Cold water fisheries in the trans-Himalayan countries*. FAO Fisheries Technical Paper No. 431. Rome, FAO. 364 pp.

The Trans-Himalayan region encompasses a number of countries situated in the midland and highland areas of the Himalayas, Karakoram, and in a broad sense, also in Hindu Kush and Pamir. The mountains are characterized by a very low level of human development, with full exploitation or overexploitation of the natural resources. Fisheries play an important role in providing food and income to the mountain people. The Symposium on Cold Water Fishes of the Trans-Himalayan Region, held 10-13 July 2001 in Kathmandu, Nepal, was attended by 70 participants from ten countries. In 32 presentations, it reviewed information, experiences, ideas and findings related to fish and fisheries in the region, paying special attention to fish species distribution, fishing intensity, socio-economic conditions and livelihoods of fisher communities, as well as to the impact of environmental degradation, conservation measures and aquaculture technologies for indigenous and exotic cold water fish.

FAO/DVWK. 2002. *Fish passes – design, dimensions and monitoring.* Rome, FAO. 119 pp.

Fish passes are of increasing importance for the restoration of free passage for fish and other aquatic species in rivers, as such devices are often the only way to make it possible for aquatic fauna to pass obstacles that block their up-river journey. Fish passes thus become key elements for the ecological improvement of running waters, and their efficient functioning is a prerequisite for the restoration of free passage in rivers. These guidelines first refer to the underlying ecological basics and discuss the general requirements that must be understood for sensible application of the complex interdisciplinary matters. These general considerations are followed by technical recommendations and advice for the design and evaluation of fish passes, as well as by proposals for choosing their hydraulic dimensions correctly and testing their functioning.

Jia, J. & Chen, J. 2001. *Sea farming and sea ranching in China.* FAO Fisheries Technical Paper No. 418. Rome, FAO. 71 pp.

The various sea farming and sea ranching practices used in the People's Republic of China are reviewed, based on published and unpublished information, statistical data and field experiences. The development of marine fisheries during the past 50 years is described. Following their decline caused by overfishing and the ecological degradation of the coastal environment, emphasis was shifted from marine capture fisheries to aquaculture-based operations, including farming and ranching of marine organisms in both inshore and offshore areas. The biology and culture of major representatives of five species groups (seaweed, molluscs, crustaceans, echinoderms and fish), involving a total of 67 different species, are presented, together with detailed production statistics. The eight sea farming and ranching systems currently used in China are presented. Several aspects related to marine resources management for sea farming and ranching are discussed, such as legislation, research on genetics and biodiversity, health management and marine habitat rehabilitation. Monitoring and evaluation according to biological, environmental and socio-economic standards are briefly considered.

New, M.B. 2002. *Farming freshwater prawns*. A manual for the culture of the giant river prawn (*Macrobrachium rosenbergii*). FAO Fisheries Technical Paper No. 428. Rome, FAO. 212 pp.

The original manual on freshwater prawn farming was published in English, French and Spanish by FAO and translated by others into Farsi, Hindi and Vietnamese. In the two decades since that manual was written, many technical and practical advances have been made in the rearing of freshwater prawns. A new manual has therefore been prepared, which will be issued in each of the FAO official languages. This manual provides information on the farming of *Macrobrachium rosenbergii*. Many of the techniques described are also applicable to other species of freshwater prawn that are being cultured. The manual is not a scientific text, but is intended to be a practical guide to in-hatchery and on-farm management. The target audience is therefore principally farmers and extension workers. However, it is also hoped that, like the previous manual on this topic, it will be useful to lecturers and students alike in universities and other institutes that provide training in aquaculture.

Arthur, J.R. & Ahmed, A.T.A. 2002. *Checklist of the parasites of fishes of Bangladesh.* FAO Fisheries Technical Paper No. 369/1. Rome, FAO. 77 pp.

This checklist summarizes information on the parasites of Bangladeshi fishes contained in the world literature dating from the earliest known records in the early 1900s to the end of 2000. Information is presented in the form of parasite-host and host-parasite lists. Included are 147 named species of parasites. Also included are many records of parasites not identified to species level. The Parasite-Host List is organized on a taxonomic basis and provides information for each parasite species and the Host-Parasite List is organized according to the taxonomy of the hosts. Both lists are accompanied by remarks and footnotes, as warranted, giving specific information on points of systematics, nomenclature, possible misidentifications, introductions, pathogenicity etc. Citations are included for all references and a supplementary list of references contains other literature on Bangladeshi fish parasites. Parasite and host indices are included. Parasites have been reported from only 85 of the 528 species of marine and freshwater fish occurring in the waters of Bangladesh.

FAO. 2003. *Review of the state of world aquaculture. FAO Fisheries Circular* No. 886, Rev. 2. FAO, Rome, 95 pp.

This document is the second revision of Fisheries Circular 886 – Review of the state of world aquaculture. Taking into consideration various reviews and analyses of aquaculture production, development and management published by FAO over the past few years, the format of the present version of the Circular deviates slightly from that of the previous revision. It includes a global review of aquaculture production and production trends, brief regional production profiles based on national aquaculture statistics received from FAO member countries up to 2000, an outlook for aquaculture development (major issues, opportunities and challenges) and a section discussing issues of current importance to global aquaculture development and management. The latter includes inland fisheries and aquaculture: a synergy for sustainable foodfish production, the role of aquaculture in rural development, recent technological innovations in aquaculture, and producer associations' and farmer societies' contribution to aquaculture development. Future revisions will address more issues of interest for sustainable development and management of aquaculture, where appropriate.

Valerio (middle) in Haiti with Mr A.B. Monizi (left) and Mr J.P. Dimanche (right) during a project backstopping mission

In October 2003, Mr Valerio Crespi joined the Inland Water Resources and Aquaculture Service (FIRI) as Fisheries Resources Officer (Information Systems). Mr Crespi is a biological sciences graduate of the University of Rome "La Sapienza" (Italy). He also possesses experience in inland water resources, marine biology, small-scale fisheries and aquaculture. He spent three years at the Institut Française de Recherche pour l'Exploitation de la Mer (IFREMER) in Sète, France.

As a database consultant to FAO, he worked in the Mediterranean regional project "FAO-Copemed" in 1999 and established a database on the French Mediterranean (Gulf of Lions) small-scale fishery. Then he went on to finalize the Inventory of Artisanal Fishery Communities in the Western and Central Mediterranean. The regional database "ArtFiMed" and several versions of CD-ROMs are also to his credit.

After completing three years at FAO headquarters as a database consultant to the FAO Fisheries Global Information System project (FAO-FIGIS) compiling and integrating information on aquatic resources and their exploitation, he joined FIRI with technical responsabilities for assisting the Service in the development of specialized and integrated database systems and applications for inland fisheries and aquaculture. Valerio will not only assist in maintaining and updating the information systems at FIRI, but will also disseminate information to the outside world. Mr Crespi can be contacted by telephone at +39-06-57055617 or by e-mail at valerio.crespi@fao.org.

The African Water Resource Database

Development of the African Water Resource Database (AWRD) is a work in progress being carried out under the guidance of the Inland Water Resources and Aquaculture Service (FIRI) of FAO. The beneficiaries of the AWRD will mainly consist of people working with global and regional analysis on water and inland aquatic resource management and planning, including researchers and project managers in national, sub-national and international institutions. The first version of the AWRD will be made available in late 2003 as an FAO technical publication and a set of CD-ROM data disks.

Introduction

The African Water Resource Database (AWRD) is a Geographical Information System (GIS) analytical framework supporting natural resource planning with a specific focus on inland fisheries and integrated water resource management. The objective of the AWRD is to provide water and natural resource managers with tools that foster the sustainable use of water resources as a means of promoting the responsible management of inland aquatic resources and increasing food security.

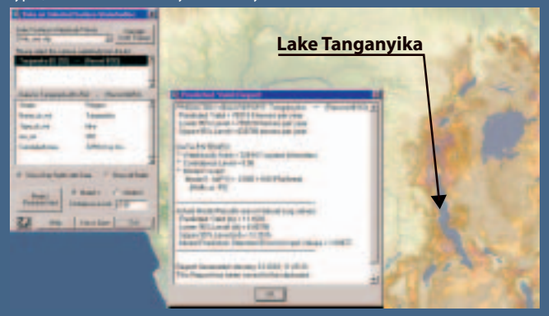
Methods

The AWRD is an enhancement of the work contained in the FAO's Aquaculture for Local Community Development Programme's Water Resource Database (WRD) of southern Africa. This work has been extended to cover continental Africa and the island states. Geographic data within the WRD were reformatted into ESRI's GIS shapefile format and the interface was reprogrammed to run from ESRI's ArcView GIS software. Currently, there are over seventy-five datasets populating the AWRD data archive. The core data layers include: various depictions of surface water bodies; multiple watershed models; aquatic species; rivers; political boundaries; population density; soils; satellite imagery; and many other physiographic and climatological data types. In general, the source scale of these data support analyses from 1:1,000,000 to 1:5,000,000 for vector data, and a nominal resolution of 1 to 5 kilometers for raster data.

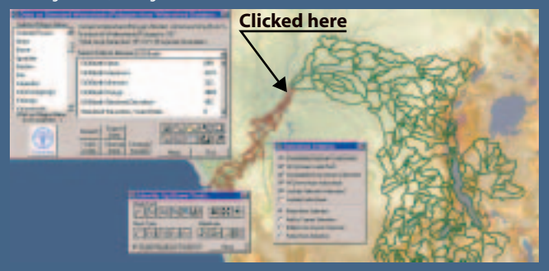
Results

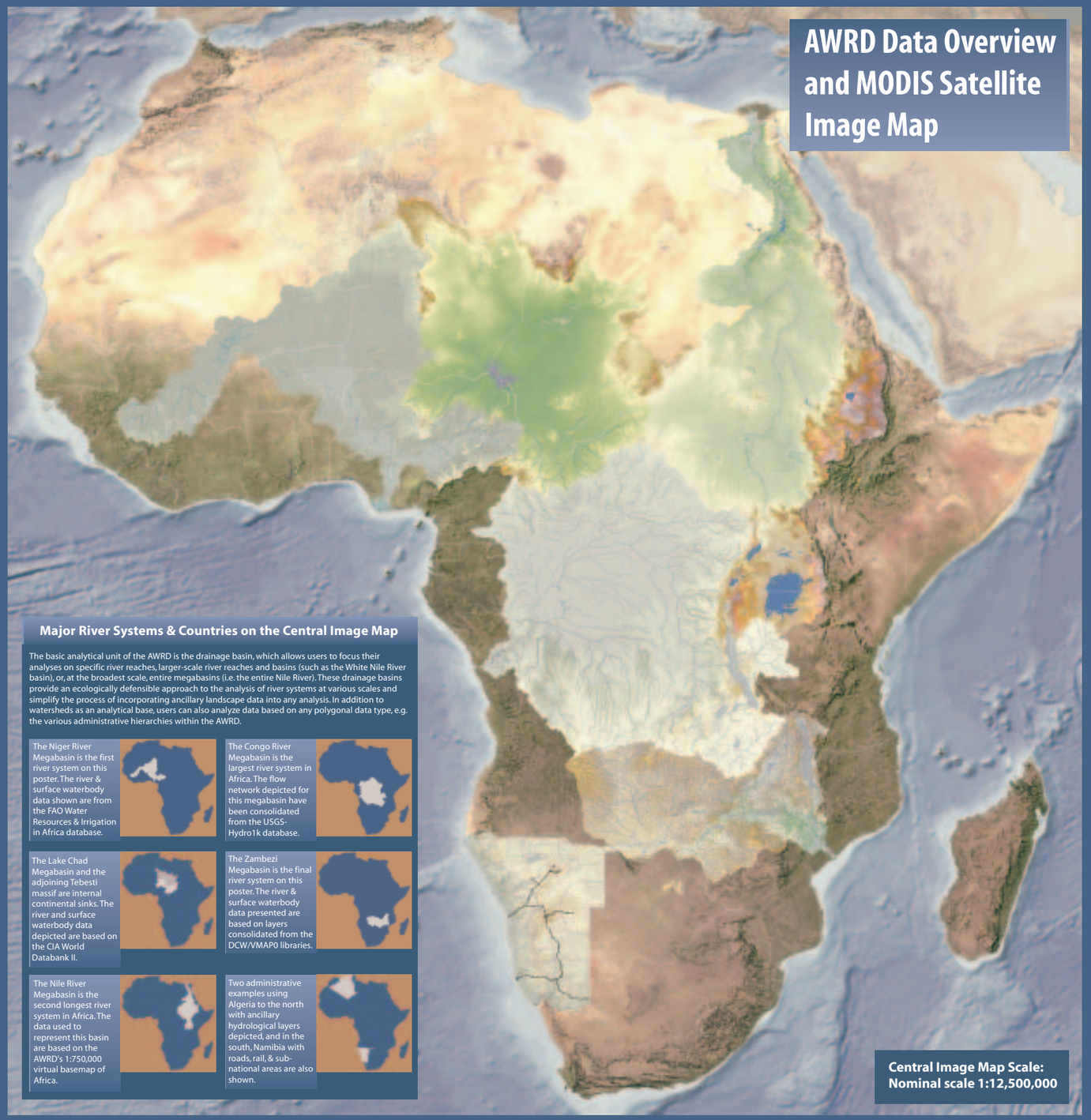
To display and analyze the datasets compiled, the AWRD contains an assortment of new custom-designed applications and tools, organized into six analytical modules. The four primary modules of the AWRD interface are presented below.

The Surface Waterbodies (SWB) Module is designed to give users of the AWRD quick and easy access to data on surface waterbodies in Africa. In addition, the SWB module provides users with the ability to predict potential SWB yields based on two possible models. The module is designed to work with both polygon and point feature types, and there are currently ten SWB layers resident within the AWRD archive.



The Watershed Statistics Module and related analytical tools represent perhaps the most comprehensive and intensive programming development undertaken regarding the interface of the AWRD. This module offers a wide variety of tools specifically designed to analyze and visualize watersheds. These tools take advantage of the hydrologic relationships between watersheds and use these relationships to identify which watersheds are upstream, which are downstream, and which make up the overall flow regime and/or megabasin.





Major River Systems & Countries on the Central Image Map

The basic analytical unit of the AWRD is the drainage basin, which allows users to focus their analyses on specific river reaches, larger-scale river reaches and basins (such as the White Nile River basin), or, at the broadest scale, entire megabasins (i.e. the entire Nile River). These drainage basins provide an ecologically defensible approach to the analysis of river systems at various scales and simplify the process of incorporating ancillary landscape data into any analysis. In addition to watersheds as an analytical base, users can also analyze data based on any polygonal data type, e.g. the various administrative hierarchies within the AWRD.

The Niger River Megabasin is the first river system on this poster. The river & surface waterbody data shown are from the FAO Water Resources & Irrigation in Africa database.

The Congo River Megabasin is the largest river system in Africa. The flow network depicted for this megabasin have been consolidated from the USGS-Hydro1k database.

The Lake Chad Megabasin and the adjoining Tebesti massif are internal continental sinks. The river and surface waterbody data depicted are based on the CIA World Databank II.

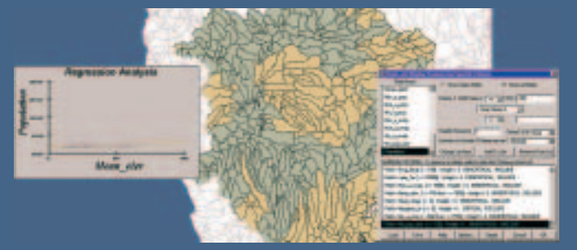
The Zambezi Megabasin is the final river system on this poster. The river & surface waterbody data presented are based on layers consolidated from the DCW/VMAP0 libraries.

The Nile River Megabasin is the second longest river system in Africa. The data used to represent this basin are based on the AWRD's 1:750,000 virtual basemap of Africa.

Two administrative examples using Algeria to the north with ancillary hydrological layers depicted, and in the south, Namibia with roads, rail, & sub-national areas are also shown.

The Aquatic Species Module provides users with the ability to spatially represent and visualize the distributions of aquatic species, identify all species within a particular area, and to potentially access a large amount of descriptive information on those species via the internet. Thematically, this module provides users with species locations from the reference database, distribution maps based on a watershed model, and broader containment maps from an administrative data layer.

The Data Classification and Statistical Analysis Module has four main analytical components which allow users to: generate summary statistics for any set of records; calculate a range of twelve probability distributions; classify and rank features according to a wide variety of simple and complex query functions; and provides a powerful method for analyzing relationships between data via linear regressions.



The AWRD also contains an HTML based **Metadata Documentation Module** meeting international standards, and a **User and Customization Module** that contains several additional statistical, data visualization, and spatial referencing tools which enhance the overall analytic and data output capabilities of the AWRD.

Conclusion

The AWRD is a GIS based analytical platform that allows users to visualize and analyze the complex hydrological and ecological relationships within, specific river reaches, larger-scale river basins, or entire megabasins. The AWRD builds on an established body of work, and strategies are currently being developed to promote research, education, training and decision-making, using the AWRD. There are over seventy-five data layers currently compiled in the AWRD data archive and great efforts were taken to make this data viewable and comparable. The AWRD includes three full continental-scale watershed models based on different minimum resolutions, and while users can analyze river systems based on a drainage basin approach, they can also choose to analyze additional models, feature data types, and ancillary data. Enhancements currently envisioned for the AWRD include: a river systems network module; a water demand and irrigation analyzer; a run-off and flood predictor; a basemap viewer and output module, and the eventual global expansion of relevant data layers.

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Food and Agriculture Organization of the United Nations