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Inland Water Resources and Aquaculture Service, Fisheries Department, Food and Agriculture Organization of the United Nations, Viale delle Terme di Caracalla, Rome, 00100 Italy
Tel: 39-6-52254795 Fax: 39-6-52253020. E-mail: Ziad.Shehadeh@fao.org

Fish fry market in Bangladesh

CONTENTS

PARADIGM SHIFT: CHANGES IN DEVELOPMENTAL STRATEGIES

Fisheries and aquacultural projects in southern Africa have experienced a period of transformation during the 1990s. In previous decades, typical fisheries project activities included: training change agents in ***proven*** *improved technologies; developing government infrastructure to assist in the diffusion of these technologies; and providing logistic support to carry the message to the intended beneficiaries. Rural communities were awash with governmental and non-governmental agents representing a broad spectrum of enterprises, offering rural dwellers a shopping list of innovations.*

However, long-term adoption rates often were less than anticipated. Purported ***proven*** *technologies did not take into consideration stakeholders' priorities. Recommended management practices did not fit beneficiaries' needs, such issues as cropping strategies, harvest schedules and input requirements frequently did not take into account the limitations of the whole family economy. Moreover, the prerequisite expanded government infrastructure required to provide these services put increased strain on already over-taxed government finances. Transport and message delivery systems, established with donor funds, exceeded by far provisions made in agency budgets.*

Nonetheless, the justification for enhanced output from aquatic resources remained valid. Rampant malnutrition and expanding food insecurity made high-quality fish harvests more and more important.

With the advent of the 90s and the imposition of structural adjustment into many national programmes, the typical project approach required a major overhaul. Donor dollars were in rapid decline. Many countries were faced with trade deficits and inflation. Governments could no longer afford to provide the full array of agricultural services to farm families. Only modest extension support, at best, could be provided to rural communities. Rapidly downsizing agencies meant fewer and fewer agents were available to meet the demands of an ever-increasing population.

Furthermore, in southern Africa the droughts of the early 90s put heightened stress on agricultural systems and already limited water resources. Farming families did not have the luxury of squandering meager water supplies; multiple use and re-use were necessities. Water became an ever-important political commodity, with individuals and communities competing for diminishing resources.

Within this context, the FAO-executed ALCOM Programme experienced a similar metamorphosis. From its origins in the late 1980s as a Swedish-funded aquacultural project (Aquaculture for Local Community Development), ALCOM evolved into a smallholder aquatic resource management programme in the mid-1990s, operating with joint Belgian and Swedish support.

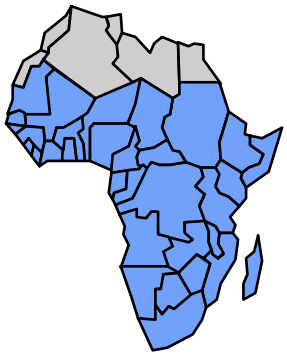
ALCOM's approach to technology transfer acknowledged the difficulties in extending rigid "packages" of ***proven*** *technologies. Potential adopters must have the latitude to form basic knowledge into actions that fit their specific circumstances. Hence, the key to adoption is to identify technological guidelines suitable for a wide range of beneficiaries, each with their own priorities. To do this, one must have a good understanding of farmers' socio-economic environment, identifying common denominators which facilitate adoption. In fact, the diffusion/adoption process is not so much one of addressing technical issues; it is much more one of addressing human issues.*

When technological guidelines have been identified that complement farm operations, the dilemma remains: how to transfer these messages to beneficiaries with shrinking extension services. While formal governmental information channels impart knowledge on general agricultural production to rural communities, these conduits are less available for specialized technologies inherent in water control and fisheries production. Informal information networks provide a more sustainable circuit of feedforward and feedback, where farmers themselves and traditional community organizations form essential links in the information chain. Identification of these informal mediums requires, again, considerable awareness of the social dynamics of the communities, comprehending how the people and their resources mesh.

For southern African farmers, adoption of fisheries and aquacultural activities happens when these provide synergy with other agricultural and water management endeavors. Water to sustain life takes precedence. If this same resource can be used to produce a high-value food, there is a higher probability the production technologies will be adopted. As a nonconsumptive water use, the inclusion of fisheries and aquacultural activities in diversified farming systems makes sense and fits well with smallholder's priorities.

John F. Moehl,Jr.
ALCOM Programme Coordinator

AQUACULTURE IN SUB-SAHARAN AFRICA: SITUATION AND OUTLOOK[1]



Mario Pedini[2] and Z. Shehadeh[3]
[2]Senior Adviser (Aquaculture Development)
[3]Senior Fishery Resources Officer (Aquaculture)
Fishery Resources Division

[1] Based on the first author's contribution to Fisheries and Aquaculture in Sub-Saharan Africa: situation and outlook in 1996. *FAO Fisheries Circular.* No. 922. Rome, FAO. 1996. 44p.

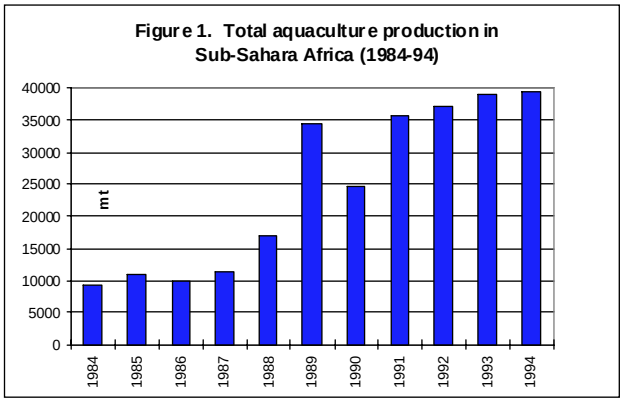
PRODUCTION

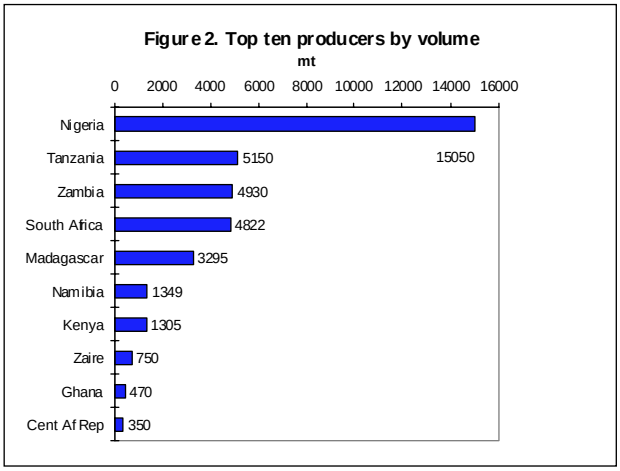
Status

Aquaculture has not been a traditional practice in Africa and remains a new form of food and income generation, in spite of various efforts since the fifties. In 1994, Sub-Saharan Africa contributed less than 0.2% to world aquaculture production.

FAO has aquaculture production records for 37 countries for the period 1984-1994. Although in a global context of aquaculture development, Africa is the least advanced of all continents, aquaculture has developed well since the beginning of the 1990's. Regional production was estimated at 9,179 mt in 1984, rising to 39,364 mt in 1994 (Figure 1). Excluding the production of seaweeds and ascidians, aquaculture production in 1984 and 1994 amounted to 9,174 and 32,764 mt respectively. However, aquaculture statistics in Africa are not very reliable for two reasons: the relatively low economic importance of the sub-sector, and the lack of financial resources at institutional level to monitor developments and rural production.

The recent development of the sub-sector, under a prevailing poor development environment in the region, has not been homogeneous and only a few countries have registered significant increases in production. Of the 37 countries for which 1994 production records are available, only 5 countries (Nigeria, Zambia, South Africa, Madagascar and Kenya) produced more than 1 000 mt, while another 13 countries reported production ranging from 100 to 1 000 mt (Figure 2).





In the period for which data have been collected, some countries made significant progress: Nigeria doubled its production; Zambia had a steady and much faster growth with a fifteen fold increase in production, due to the development of rural aquaculture based on tilapia-pond farming; South Africa increased production 13 fold, mainly through mariculture, although the rate of growth slowed down considerably after 1990; Madagascar showed a 17 fold increase in production, with very rapid development of carp culture in rural areas of the highlands and, recently, with the development of shrimp culture. These developments were catalyzed by two FAO-Government projects which mobilized the private sector. In Kenya, growth of aquaculture has been steady with a six fold increase based on carp, trout, tilapia and shrimps, and involving both rural and more commercial sectors.

Main Species

Species group data for finfish in 1994 show that the tilapias are the most important in terms of tonnage with some 13,300 mt in 1994 (Figure 3), followed by the catfishes (nearly 7,300 mt), and cyprinids (nearly 4,200 mt), with production of common carp rising rapidly.

For other groups, molluscs are currently more important than crustaceans in terms of tonnage, with a consistent increase in production from 37 mt in 1984 to 3,304 mt in 1994. In this group, which includes ten species, mussels are the most important, with 2,710 mt produced in South Africa in 1994. Oysters are cultivated in four countries. South Africa is the most important producer.

Some countries have also started shrimp culture. The group includes nine species of which four are freshwater. The main species is the tiger shrimp, *Penaeus monodon,* farmed in Madagascar, Seychelles, South Africa and Mozambique.

A recent development is the farming of *Euchema*, an important source of revenue for the coastal communities of Zanzibar. Another country involved in seaweed farming is Namibia, where *Gracilaria* is being grown. Seaweed production started to grow rapidly from 1989, stabilizing between 6,000 and 7,000 mt from 1990 to 1994.

Figure 3. Top species by production volume

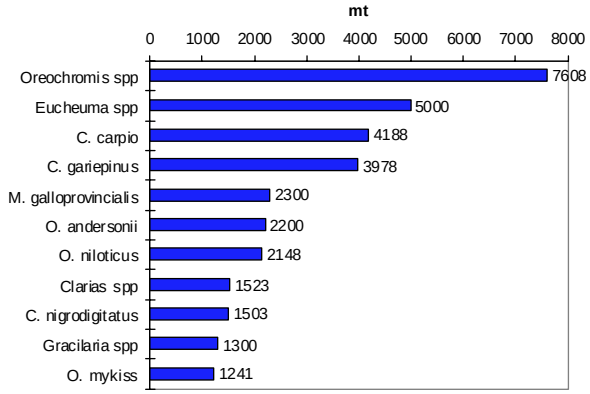
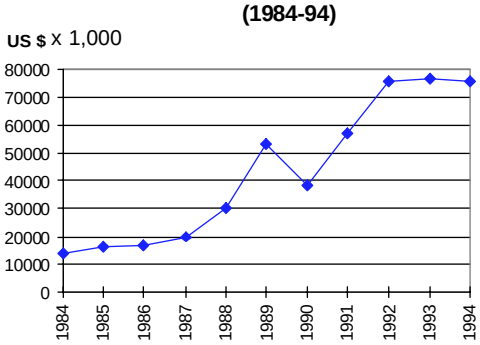


Figure 4. Value of aquaculture production (1984-94)



Production Value

In the period 1984-94, the value of aquaculture products increased from US$ 13.4 to US$ 75.8 million (Figure 4). The top species for 1994 were probably the tilapias as it is likely that a large part of the unclassified freshwater finfish consist of tilapias. However, and coming as somewhat of a surprise, the main group in 1994 were the catfishes, with a cumulative value of over US$ 22 million compared to slightly over US$ 21 million for the tilapias. Another important species is the common carp, with an overall value of US$ 6.7 million, followed by tiger prawn and rainbow trout valued respectively at US$ 4.4 and 4.3 million. The simple farming practices like that of *Euchema* in Zanzibar represented a significant contribution of US$ 1 million in 1994, and provided substantial employment and revenues to the women who supervise the culture of this seaweed.

Development issues

The review of aquaculture in Sub-Saharan Africa showed that there are still many countries with only incipient or erratic aquaculture production. Apart from the doubtful quality of the data on production, this demonstrates that only a few countries have actually given due emphasis to aquaculture. Very often, erratic production figures reflect inconsistent development efforts. Aquaculture development requires more rigorous programming, stronger institutions, and more sustained promotional efforts.

The possibility to transfer appropriate aquaculture packages is greatly influenced by water availability in particular, as well as by climatic variations. In recent years, attempts have been made with the assistance of the international community to utilise the potential of small water bodies in sub-arid and arid areas (e.g. Burkina Faso and SADC countries). These initiatives hold good potential for the future in view of the water surface available in these areas, although further efforts are still required to consolidate the packages and to disseminate this approach. As water conservation schemes in rural areas become more common, aquaculture should expand as an associated practice.

Aquaculture extension has tended to be specialised and not integrated with agricultural extension, hampering the capacity to disseminate aquaculture information. Public funds for extension services have been scarce due to the low economic importance of the sector. It is essential to upgrade the professional preparation of staff involved in aquaculture extension and its organization, as well as staff involved in running public fish farms and seed production centres. This is made difficult by the lack of adequate facilities/ institutions for aquaculture training.

Another important issue is the heavy reliance on external assistance for aquaculture development , even for aquaculture research projects. Project achievements have generally been short-lived and unsustainable for several reasons, including insufficient project duration, the very weak institutional context in which these projects are implemented, the changing priorities of donors and governments, and limited follow-up capabilities.

In most countries under consideration, formal credit is not generally available for aquaculture development. Rural farmers have very limited capital for investment in new practices which many of them would also consider risky. Although formal credit would probably be used mostly by farmers who understand credit schemes, capital is also necessary for building and operating aquaculture facilities as well as for establishing support services for aquaculture development. Extension services could facilitate access to credit by assisting farmers to prepare requests for loans, but should not be involved in loan recovery activities (collection of loan payments).

Until recently, aquaculture development projects in Africa have seldom taken into account small entrepreneurs, who may undertake a more commercial form of aquaculture to supply urban or local markets. These entrepreneurs have often been ignored in externally assisted development projects which predominantly targeted the rural poor or subsistence farmers. However, the growing urban populations in Africa also need protein supplies and the private sector in peri-urban areas can be more easily mobilised to supply these markets through aquaculture (generally benefiting from more readily accessible inputs and attractive prices). Interestingly, in recent years, more progress in aquaculture has been made in those countries where entrepreneurs and progressive farmers have been systematically involved.

An associated issue is the supporting infrastructures required for aquaculture development. Although public sector infrastructure exists for seed production and demonstration (a recent review made in 13 major aquaculture producing countries of the Region pointed out the existence of more than 200 stations), these are either very old or inadequate for seed production. Expansion of aquaculture is hampered by the distances involved in transporting seed to the scattered aquafarmers, and the lack of vehicles and funds to distribute seed. In at least two of the most successful countries, Madagascar in particular, the privatization of seed production has been a major breakthrough in expanding production. This implies a need to rethink past strategies regarding seed production and to redefine the role of governmental stations.

Aquaculture is still a new concept in Africa and specialised institutional set-ups are still extremely weak. In this context, external assistance continues to be essential for further development, but it should be more carefully planned and designed with longer time frames in order to establish strong bases for sustained development. At the rural level, efforts should be pursued to obtain a better integration of aquaculture with the prevailing agricultural practices of small-scale farmers, with due emphasis on more participatory approaches. In general, there is also a definite need to better integrate financial, economic and social

considerations in designing and implementing projects and packages. Projects aimed at more commercial/ investment oriented aquaculture, for seed production and supplying urban markets with food fish, should be implemented with supporting credit schemes.

Prospects for increased production

The contribution of aquaculture to fish supplies (only 0.7%) and food security, based on available statistics, is still modest although considerable potential exists in terms of land and water across the Region. It is estimated that less than 5% of this potential has been utilised. Six countries account for 90% of total production (32,700 mt). Expected difficulties in ensuring adequate fish supplies should favour aquaculture in a number of local markets, as prices of fish will increase. Despite this potential, the development of aquaculture is still hampered by a number of economic, social and institutional constraints which will have to be systematically assessed and mitigated. The concern expressed with regard to food security in the Region will probably lead to renewed emphasis on aquaculture development. Major and co-ordinated support from donors will be required to establish sounder bases for such development over the next 15 years.

In order to increase fish production, governments in the Region are likely to emphasise the strengthening of capacities to manage capture fisheries on a sustainable basis, and the elaboration of more appropriate frameworks for the development of aquaculture.

Achievement of sustainable increases in aquaculture production require that emphasis be given to: (a) integration of fish culture with agriculture: using family level technologies applied in schemes which contemplate water storage practices, including micro-irrigation and small ponds; encouraging aquaculture in irrigation networks and integrated rice-cum-fish culture, and in farming systems in general as appropriate, (b) encouraging investment-oriented aquaculture by progressive farmers in peri-urban areas, and (c) aquaculture-based stocking and stock enhancement in small and medium-size water bodies, focusing on reservoirs and eventually on medium size lakes and river floodplains, using local species, and including the development of cage culture.

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This article is based on the report "Supporting Aquaculture Development: Aquatic Farming Systems Information Network. A report prepared for the Inland Water Resources and Aquaculture Service, FAO Fisheries Department, by A.G. Coche and J. Collins in collaboration with A. Ziehi. FAO. 1997. 18p+5 annexes (in press).

ESTABLISHMENT OF THE AQUATIC FARMING SYSTEMS INFORMATION NETWORK FOR AFRICA

André G. Coche[1] and Mario Pedini[2]
[1] Consultant, [2] Senior Adviser
(Aquaculture Development)
Fishery Resources Division

ORIGIN

FAO, in collaboration with the Economic Commission for Africa and the European Commission (DG XII), launched in 1992 a Regional Study on Aquaculture Development and Research in sub-Saharan Africa, in the context of the Strategy for International Fisheries Research (SIFR). Details of the study were presented by the second author in an earlier issue of *FAN* (Pedini 1994). The resulting synthesis of information presented in 12 national reviews on development and research needs provided the basis for proposing an indicative action plan for aquaculture research in sub-Saharan Africa (Coche et al 1994; Coche 1994). The action plan was discussed with representatives of the countries at the Second Session of the Working Party on Aquaculture of the Committee for Inland Fisheries of Africa (CIFA) which was held in Harare, Zimbabwe, in September 1993, and subsequently at the main Session of the CIFA which endorsed the proposed plan.

The action plan was aimed to alleviate constraints identified in the regional study through collaborative regional research. The plan included eight regional research programmes which were identified and ranked in order of priority (Table 1), plus a supporting regional information programme to serve the eight research programmes. The analysis carried out in the study indicated that documentation of aquaculture research and access to aquaculture information in Africa were inadequate, limiting the scope, quality and utility of aquaculture research activities. Information collection, storage and dissemination through networking was considered essential for future development of aquaculture in Africa and thus became a top priority programme of the action plan.

Table 1: Classification of the proposed aquaculture research programmes

Research Programmes (sub-Programmes)	Prog. No.	Geographic coverage		Duration		Priority 1	Strategy 2
		National	Regional	Short Term	Medium Term		
Information centres	1		R	S		1	R
Socio-economics	2		R		M	1	N
Production indicators	3		R	S		1	N
Fertilization/feeds	4		R		M	1	N
*Organic fertilizatior	4.1						
*Feeds/feeding	4.2						
*Fish/livestock	4.3						
Broodstock management	5		R		M	1	N
Small water bodies	6		R		M	2	N
Irrigation schemes	7		R		M	2	N
New indigenous species	8				M	3	N
Marine aquaculture	9				M	3	N
Marketing research		N					
1/ From high (1) to low (3)			2/ Reference Centre (R) or specialized regior				

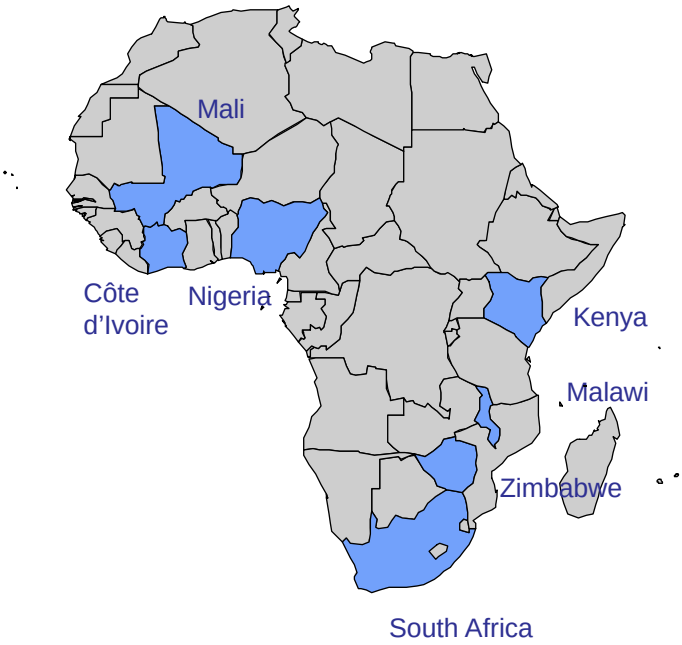
The overall objective of the information programme was the collection, storage and dissemination of aquaculture information at closely linked centres established in anglophone and francophone Africa. The idea was to have two information lead centres which would represent the two main official languages of Africa, English and French, that would be located in different geographic regions. The two lead centres would be linked to one another and to a network of satellite centres in various countries. The information programme would directly strengthen existing capabilities and literature collections at the selected centres of the network, and would establish links to exchange information with the major international information centres on aquaculture located in Asia, Europe, Latin America and North America.

THE FORMULATION MISSION

Unfortunately, support from donors involved in the SIFR process has not materialized since the meeting of the Second Working Party on Aquaculture of the CIFA. Therefore, in 1996, the Inland Water Resources and Aquaculture Service of the FAO Fisheries Department decided to start the implementation of the action plan with the resources available to it. A formulation mission to sub-Saharan Africa was organized, with financial support from the FAO Partnership Programme and a UNDP TSS-1 project for formulation of SIFR - related projects, to establish the Aquatic Farming Systems Information Network for Africa.

Sites Visited (Figure 1)

Figure 1: Countries visited by the mission



Guiding Principles and Objectives

The mission was planned with the following guiding principles in mind:

- coverage of as many of the five sub-Saharan agro-ecological regions as possible;
- coverage of both francophone and anglophone regions;
- emphasis on existing institutions;
- emphasis on existing databases;
- interest in information related to aquatic farming systems, aquaculture research and development aspects;
- central focus on fish production through small to medium-scale freshwater aquaculture and the management of small water bodies.
- access to information related to all other components of the production system, such as producers, vegetal/animal crops, and external factors influencing development in general.

The specific objectives of the mission were:

- to visit some of the existing institutions previously identified as potential contributors to an information network on aquatic farming systems;
- to ascertain existing interest and willingness to participate in the network;
- to evaluate the resources (infrastructure, trained staff, equipment, collections and networking activities) available at each of these institutions as a potential contribution to the information network;
- to identify possible ways for activating the proposed information network at the regional (sub-Saharan) level;
- to formulate a project to support the establishment of the network.

In October-November 1996, a mission of three experts (Dr. A.G. Coche, Mission Leader and retired FAO Officer; J. Collins, FAO staff and A. Ziehi of IDESSA (Institut des Savanes, Côte d'Ivoire) visited the following institutions:

Côte d'Ivoire:
- Centre de Recherches Océanologiques and future RECOSCIX-CEA, in Abidjan;
- IDESSA, in Bouaké;
- West African Rice Development Association, in Bouaké;
- INFOPECHE, in Abidjan;

Mali:
- Institut du Sahel/RESADOC, in Bamako;
- Ministère du Développement Rural et de l'Environnement, in Bamako;
- Institut d' Economie Rurale, in Bamako;

Nigeria:
- University of Ibadan, in Ibadan;

Kenya:
- Kenya Marine and Fisheries Research Institute, in Mombasa;
- RECOSCIX-WIO Project (Belgium/IOC), in Mombasa;

Malawi:
- Bunda College of Agriculture, in Bunda near Lilongwe;
- SADC/IFS Documentation Centre, in Lilongwe;

Zimbabwe:
- ALCOM Programme, in Harare;
- Department of National Parks and Wildlife Management, in Harare;
- Ministry of Agriculture, Central Library, in Harare;

South Africa:
- J.L.B. Smith Institute of Ichthyology, in Grahamstown, Eastern Cape;
- Rhodes University, in Grahamstown.

MISSION FINDINGS

In most of the countries, there is a continuing loss of institutional memory due to the fast turnover of responsible personnel and frequent administrative reorganizations coupled with the absence of a central repository for information on aquatic farming systems at national or sub-regional level. Documentation of past research programmes and development project activities become rapidly inaccessible to most researchers and developers. It may even disappear from the country after a few years only.

The differences between the individual libraries, even within countries, are substantial in terms of facilities, collections and access to information. However, some general comparisons can be made between the

libraries in the geographical sub-regions and between the francophone and anglophone countries. Most notable is the advantageous position of those libraries in Eastern and Southern Africa in terms of:

- size of current collection and availability of a budget in order to maintain acquisitions;
- library facilities and equipment;
- level of professional education and training of library staff;
- significant donor funding for information activities.

Within the sub-region there are substantially better library resources in South Africa and Zimbabwe, the only countries with full Internet connectivity and access to external electronic information. Here also are the only libraries actually subscribing to current CD ROM databases.

Despite the relative disadvantages of those libraries in Western and Sahelian francophone countries, with respect to the above parameters, there are many important information and documentation activities undertaken by all the libraries visited in the entire region. These include :

- active participation in coordination of national and, often, regional or international information networks;
- organization, management and retrieval of information using PC-based software (Micro CDS/ISIS is used in all the countries visited, except in South Africa);
- provision of information services to a broad user community, including external users, in the subject areas relevant to development and research in aquatic farming systems. In most cases the libraries have direct access to agricultural CD ROMs (mainly donor-supplied), but even those libraries without CD ROMs are availing of search facilities at other institutions on behalf of users;
- participation in regional or international training programmes, often with donor support; many libraries are now involved in providing training.

In general, the differences in the physical facilities and budgets of the libraries are enormous, but the types of activities and information services have many features in common. It is also a common experience that the libraries, even the wealthier ones, rely more and more on access to external information sources and on the sharing of resources. Budgetary constraints and the increasing amount of information available at ever increasing cost, particularly in a subject area with the breadth of aquatic farming systems, make it impossible for libraries to acquire all of the relevant publications necessary to satisfy user demand.

The lack of access to the results and findings of research between the different sub-regions and between the anglophone and francophone countries is a major obstacle to development. The barrier separating the anglophone and francophone regions is a consequence of not only linguistic problems but also the distribution pattern of information. Research and development activities and problems in one sub-region are mostly ignored in the other, and ignorance of information older than 20 years in the other language is practically total among young researchers and developers. Other factors contribute to poor access to information:

- development of aquaculture/aquatic farming systems is at a relatively early stage;
- there is a lack of information flow between institutions;
- research results are mainly published as grey literature, and are not being collected/disseminated by readily available information systems, if at all.

Without exception, there exists a keen and genuine interest in the establishment of a specialized network promoting information exchange on research programmes/results and development projects/ approaches related to aquaculture and all related matters.

The Aquatic Farming System Information Network for Africa

Taking into account the above findings, and the need to support the priority research programmes that make up the aquaculture research action plan for sub-Saharan Africa (see first section of this article), as well as to facilitate future aquaculture development activities in general, the mission recommended the establishment of a regional network between those institutions in sub-Saharan Africa with programmes and information resources relevant to aquatic farming systems. In order to be effective and sustainable, this information network should:

- be based on existing francophone and anglophone institutions;
- be built on existing networking experience;
- be geographically diversified, involving as many of the five agro-ecological sub-regions as possible;

- provide its information on an exchange basis as far as possible;
- actively promote regular personal contacts between its staff members;
- be equipped with reliable, simple equipment, easily serviced locally;
- be able to rely on efficient communication facilities;
- have a multidisciplinary approach to information, addressing the production system as a whole.

It is proposed that the Aquatic Farming Systems Information Network for Africa be initially composed of two coordinating lead centres (Côte d'Ivoire & Malawi) and eight satellite centres, of which three are francophones (Côte d'Ivoire, Mali, Sahel) and five are anglophones (Kenya, Nigeria, Zimbabwe, ALCOM/ SADC, South Africa). The network could be progressively expanded within Africa as other libraries join in. Links with information centres and networks in Asia, Europe and North America could also be envisaged at that time.

The main objectives of the network should be to:

- stimulate the collection and organization of information relevant to aquatic farming systems at sub-regional level;
- improve access to and dissemination of existing information resources;
- harmonize the tools and methodologies for sharing this information throughout the region;
- train and share the expertise of professional staff by means of courses, workshops, meetings and bulletins;
- ensure that the results of research and development activities are incorporated into international as well as regional information systems;
- ensure that repositories of relevant publications are available in the sub-regions;
- produce bibliographic outputs which will benefit users in the whole region.

Technical and financial assistance is being identified to initially strengthen the proposed francophone coordination centre and to initiate regional networking activities on aquatic farming systems information in sub-Saharan Africa as outlined in the mission's project proposal. The project proposed by the mission to establish the network is made up of four phases with a total duration of eighteen months, and will be based at IDESSA. The first phase, to strengthen existing resources, will appoint a project coordinator and provide advance training at FAO headquarters, as well as purchase and install equipment and organize the IDESSA Lead Center.

The second phase will be a workshop for network members in which the network will be formally constituted. This workshop, which is to be convened at Bunda College of Agriculture (the anglophone Lead Center) near Lilongwe, Malawi, will also review the inventories of information relevant to aquatic systems research/development , establish personal contacts between all members of the network , decide on coverage and network objectives, activities and output which should be reflected in the Constitution of the Network Document, consolidate a multidisciplinary Union Catalogue of relevant periodical holdings (current/ non current) in the whole region, and initiate the production of a Directory of Information Resources on Aquatic Farming Systems in the region.

The third phase of the project will be the implementation of the activities agreed at the workshop by network participants, while the fourth phase will summarize the results obtained, prepare plans for the future and elaborate proposal for further assistance if required.

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ALCOM's Surface Water Body Database for SADC[1]

more than just a list of dams, lakes and swamps

[1] *Southern African Development Community*
[2] *Aquatic Resource Management Programme for Local Communities*

Lieven Verheust
Small Reservoir Fisheries Specialist
ALCOM[2]

Introduction

Since 1992, ALCOM has been gathering information on surface water bodies (SWBs) from all countries in the SADC Region. In the past four years, this work has evolved from a compilation of a list of dams to what is now probably the most complete and accurate database on all surface water bodies at the SADC Region level and, for a number of countries, even at the national level.

More than 14,000 water bodies have been inventoried in eleven countries and more data are being added daily. Database fields include geographical, administrative, meteorological, socio-economic, physical and chemical data as well as data on the use of the water body, presence of plant and animal species and fishing activity. Additional, supplementary information is generated by linking to other existing databases with other fields, using uniform identifiers.

Since 1996, the SWB database has been integrated in a geographical interface which has enabled a multitude of applications in various disciplines: hydrology, agriculture, fisheries, health, environment or general development. Besides the SWB digital map, which holds the point data for all geo-referenced water bodies, the database is now also adding polygon data for a number of water bodies as well as polygons of all watersheds in SADC.

Sources of data

The database incorporates data from different disciplines and different countries, collected from a number of governmental and non-governmental organizations as well as from literature and existing databases:

Information and grey literature from*:*
- national water departments or hydrological services;
- national fisheries departments;
- national departments and organizations involved in irrigation; and
- development organizations.

Official literature on :
- fisheries water physico-chemistry;
- hydro-electric installations.

Hardcopy and digital maps on:
- hydrological boundaries (lakes, dams, rivers and catchments);
- administrative boundaries; and
- land use.

Databases (international and/or national) on:
- reservoirs;
- fisheries; and
- hydrology.

Field work from:
- ALCOM; and
- other NGOs and GOs.

For Zimbabwe alone, the information in the core fields (name, geographical references and size) was compiled from more than 10 different sources. Information on other specialised fields is gathered from specific literature, much of which is classified as "grey" literature. Continuous contacts with the different sources of information is also ensuring a regular update on new information from these sources. New dams are still being constructed, new research is being conducted, fisheries statistics are being collected continuously and the new information is entered in the database when it becomes available.

A number of fields are generated by overlaying the geographical co-ordinates of water bodies with digital maps such as climatological, topographic, hydrological, geological, pedalogical and administrative maps. A meta-database contains the data sources for each individual entry so that sources can be retraced easily and contacted for verification or supplementary information.

Conditions for inclusion of Surface Water Bodies in the database

Both reservoirs and natural water bodies larger than one hectare (ha) are included in the inventory. Since most of the SWBs in SADC are reservoirs, a number of the data fields (e.g. dam wall data) are only valid for these water bodies. The following conditions have to be met for a water body to be included in the inventory:

1. situated within the physical boundaries of SADC (only mainland at the moment);
2. if seasonal, appearing regularly (appearing at least once every 10 years);
3. some geographical references (village, district,...) or co-ordinates known; and
4. stagnant water (rivers are not yet included) with a surface area bigger than 1 ha.

Data fields included in the main database

The main database includes more than 95 fields subdivided in geographical, administrative, meteo-rological, socio-economic, physical and chemical data as well as data on the use of the water body, presence of plant and animal species and fishing activity. A list of the fields included in the main database and the number of current entries in each field are given in Table1.

Linking to other existing databases with different fields (such as databases with time series on fish production) provides more details on water bodies and the geographical entity to which these water bodies belong (districts, provinces, countries,etc.). Calculation of other variables (such as Morpho Edaphic Index), overlay with digital maps (such as elevation, temperature, rainfall,etc.) and modelling provide additional information on each water body.

Collected data

At present, data from eleven countries have been collected (Table 2). Supplementary data are still expected from Botswana, South Africa (only big reservoirs included at the moment), Tanzania, Zambia and Zimbabwe.

Integration into a geographical interface and GIS (Geographic Information System)

Entries with latitude and longitude data have been integrated in a geographical interface. The integration of the database into a GIS is used to generate more data and to enable studies that require geographical analysis. It is possible to zoom into a certain area of SADC and click on displayed points or polygons (water bodies) to get more information about these bodies (Figure 1). One can also display one water body or a set of water bodies based on their characteristics from the database. This has been made possible using a combination of two simple and affordable software packages in the Windows environment by a transfer of unique identification numbers of the database program to the mapping program and vice versa.

Application of the database as a decision support tool

Modules are being developed in the database to function as a decision support tool for policy-makers, government services and non governmental organizations. Applications are numerous and only a limited number of them are described below. Note that most of the described modules are still in the planning or development phase.

Hydrology

Planning of new dams

GIS analysis of water availability versus demographic pressure can determine areas which have a critically low domestic water supply. Combined with the potential of the watersheds (river characteristics), priorities can be established for construction of new dams and estimates made on the required capacity of these dams. In Figure 2, land-use maps overlaid with maps of water bodies show a relatively low number of dams in communal areas compared to commercial farmland.

Monitoring of filling and drying of dams

Since the catchments of all geographically positioned dams can be determined relatively easily in combination with a DEM (Digital Elevation Model), it is also possible to determine rainfall in the catchment of individual dams by

Table 1: Characteristics and summary statistics on main fields in the SWB database

Nr.	Field name	Field description	No. of entries
1	**SADC ID**	SADC Database Identification Number	14,240
2	**Nat ID**	National Database Identification Number	14,240
3	**Nat_Index**	Index in national database (if applicable)	12,450
4	**Name**	Name of the water body	4,525
5	**Latitude**	Latitude (in decimal degrees)	11,442
6	**Longitude**	Longitude (in decimal degrees)	11,442
7	**Grid_Ref**	Map grid reference	11,719
8	**Map_Nr**	Map number	11,286
9	**Coord_South**	Coordinates south (in any format)	798
10	**Coord_East**	Coordinates east (in any format)	798
11	**UTM_Zone**	UTM zone number	0
12	**UTM_Coord**	UTM coordinates	0
13	**Rivername**	Name of the main river(s) which feed(s) the water body	1,054
14	**Sub-catchment**	Name of the sub-catchment	99
15	**Main catchment**	Name of the main stream catchment	0
16	**Division**	Division in which the water body is situated (if applicable)	10,560
17	**District**	District in which the water body is situated	12,617
18	**Province**	Province or Region in which the water body is situated	9,667
19	**Country**	Country in which the water body is situated	14,240
20	**International**	Is the water body shared by different countries?	13,715
21	**Owner**	Unit which controls the water body or name of owner	1,011
22	**Ownertype**	Type of ownership	884
23	**Surf. area**	Full supply surface area	9,342
24	**Capacity**	Full supply capacity	9,418
25	**Maxdept**	Maximum depth	600
26	**Meandepth**	Mean depth	8,478
27	**Catch. area**	Catchment area of the water body	443
28	**pH**	Average pH value of surface water	347
29	**Conductivity**	Average conductivity of surface water	350
30	**Transparency**	Average Secchi Disk value	349
31	**Alt_min**	Altitude - Min of range	646
32	**Alt_max**	Altitude - Maximum of range	646
33	**Permanence**	Is the water body permanent or seasonal?	647
34	**Rainmin**	Mean annual rainfall - minimum of range	598
35	**Rainmax**	Mean annual rainfall - maximum of range	598
36	**Soiltype**	Main soil type of the catchment of the reservoir	1
37	**Type**	Type of water body (Lake, Swamp or Reservoir)	3,305
38	**Constr_Yr**	Construction year of the dam	2,690
39	**Wallheight**	Height of the dam wall	768
40	**Condition**	Dam wall condition	572
41	**Siltation %**	Estimated percentage of dam silation (volume %)	565
42	**Breached or silted**	Is the dam breached or completely silted?	304
43	**Fenced**	Is the damwall fenced ?	1
44	**Access**	Access by road	432
45	**Dist.vill**	Distance from the nearest village	73
46	**Main use**	Main use of the water body	555
47	**Domestic**	Is the water body used for domestic water supply?	246
48	**Irrigation**	Is the water body used for irrigation?	6,560
49	**Livestock**	Is the water body used for livestock watering?	323
50	**Municipal water**	Is the water body used for municipal water supply?	280
51	**Bricks**	Is the water body used for brick construction?	6
52	**Industry**	Is the water body used for industrial purposes?	97
53	**Fishing**	Is the water body used for fishing?	69
54	**Other use**	Any other use of the water body?	1,717
55	**Fish**	Presence of any fish in the water body	51
56	**Stocked**	Was the water body stocked with fish ?	24
57	**Microph.bream**	Presence of microphageous tilapia (bream)	241
58	**Macroph.bream**	Presence of macrophageous tilapia (bream)	98
59	**Clarias**	Presence of Clarias sp.	193
60	**Labeo small**	Presence of small *Labeo* sp.like *L. cylindrus,...*	28
61	**Labeo big**	Presence of Big *Labeo* sp. like *L. capensis, umbratus, altivelis,...*	5
62	**Barbus small**	Presence of small *Barbus* sp. like *B. paludinosus,...*	86
63	**Barbus big**	Presence of big *Barbus* sp. like *B. holubi, marequensis,...*	3
64	**Carp**	Presence of carp (common, chinese,...)	50
65	**Eel**	Presence of *Anguilla* sp.	1
66	**Bass**	Presence of *Micropterus* sp.	31

Nr.	Field name	Field description	No. of entries
67	**Tigerfish**	Presence of *Hydrocynus vittatus*	1
68	**Lepomis**	Presence of *Lepomis macrochirus.*	8
69	**Lungfish**	Presence of *Protopterus sp.*	1
70	**Other fish**	Presence of other non-determined fish species	20
71	**Crocs**	Presence of crocodiles	394
72	**Hyacinth**	Presence of water hyacinth *(Eichornia crassipes)*	7
73	**Hook and line**	Presence of hook and line fishing	403
74	**Traps**	Presence of trap fishing	0
75	**Sport**	Presence of sport fishing	0
76	**Gill net**	Presence of gill net fishing	0
77	**Seine nets**	Presence of seine net fishing	0
78	**Fisherfolk**	Number of net fishers	53
79	**Nets**	Number of gill nets used (1 net = 100m2 mounted)	16
80	**Boats**	Number of boats/canoes/vessels	45
81	**Catch/yr**	Total yearly fish catch	75
82	**Comments**	Any observations or comments on data collection or water body	3,077
83	**Date**	Date of record (visit to water body)	11,174
84	**Lat/Long generation**	Source of the Lat/Long date	10,750
85	**Source of data**	Source of Data	11,713
86	**Orig_ID**	ID in original database	525
87	**Orig_Ref**	Reference source in original database	525
88	**Dupe_ID**	SADC ID of possible duplicate record	0
89	**Main_ID**	SADC ID of water body where this water body belongs to	0
90	**Nat region**	Natural region (if applicable, currently Zimbabwe only)	447
91	**Hydrozone**	Hydrozone (if applicable, currently Zimbabwe only)	10,564
92	**Subzone**	Subzone (if applicable, currently Zimbabwe only)	10,551
93	**Locality**	Locality (if applicable, currently Zimbabwe only)	10,413
94	**ZimOT**	Ownertype (used in Zimbabwe database only)	10,566
95	**ZimDT**	Division Type (Zimbabwe only)	10,562
96	**Reliability**	Reliability of Source data (ZAR data only)	503

Table 2. Number of entries per country for 3 important fields

Country	No. of entries with known lat. long. coordinates	No. of entries with known surface area	No. of entries with known capacity	Total number of entries
Angola	47	25	15	55
Botwana	36	291	332	338
Lesotho	591	68	526	593
Malawi	601	108	71	763
Mozambiqu	30	30	13	40
Namibia	21	21	19	21
Swaziland	7	11	7	11
Tanzania	47	62	5	83
Zambia	549	230	215	651
South Africa	495	0	474	517
Zimbabwe	9953	7995	7735	11168
Total	12377	9341	9412	14240

using cold cloud cover data. When rainfall data is plugged into a run-off model (overlaying vegetation, soil and topographic data), the inputs of water into the dam can be calculated on a weekly basis, which allows monitoring of filling and drying of dams. Reservoirs or other water bodies which are not readily accessible can be evaluated in this way.

Environment and ecology

Monitoring of aquatic pests and aquatic exotics

Presence of aquatic pests such as water hyacinth is being entered in the database. Potentially, these organisms can reach any other water body downstream and it is thus important to forecast their potential spread to permit timely preventive measures (Figure 3). The same applies to fish or other animal aquatic organisms that have been introduced into certain catchments.

Wildlife

Important sanctuaries for aquatic wildlife can be entered as part of the geographic database to identify possible dangers of introduction of species in the watersheds above these sanctuaries. The availability of a map layer with these sanctuaries facilitates decision making on the introduction of exotic species.

Irrigation

Analysis of potential for irrigation

Since there is already a field for the use of the water body for irrigation, it is quite easy to add the information on the surface area under irrigation. This will help in assessing the extent of utilization of water bodies for irrigation purposes.

Fisheries and aquaculture

Choice of the right species to stock

The generation of fish species maps, based on catchment areas, will provide information on which fish species are already present in the catchment of a selected water body. This information can then be combined with the climatological and physical data of the water body to determine the optimum species of fish to use for stocking and to forecast fish production potential (see below).

Determination of fisheries potential

Important factors for fish production such as temperature, growing season and water conductivity are generated through the GIS. One can then predict fisheries potential, MSY and optimum fishing pressure through modelling. This can be done by the input of soil data (determining conductivity and nutrients), physical water body data (such as depth, shoreline and surface) and climatological data, into fish production estimation models.

Health

Monitoring of water borne diseases such as bilharzia

Presence of bilharzia in water bodies can be entered in the database to help monitor the spread of this disease. Combining data on bilharzia with data on endemic fish species facilitates decisions on the stocking of macrophytophageous and/or malacophageous fish species for snail control.

Monitoring of water borne diseases such as malaria

Combining data on the permanence of a water body, population density and climatic conditions will help define high risk areas for malaria, as well as priority areas for the stocking of fish to limit the number of mosquito larvae.

General development and food security

The fact that water is a prime factor in food security is widely recognised; however, it is not enough to monitor rainfall alone to predict harvests. Water storage is an equally important factor which influences food production. The module which monitors filling and drying of dams can be used to make early warning systems more complete in predicting shortfalls of harvests.

Figure 1. Information about a water body displayed on a clickable map

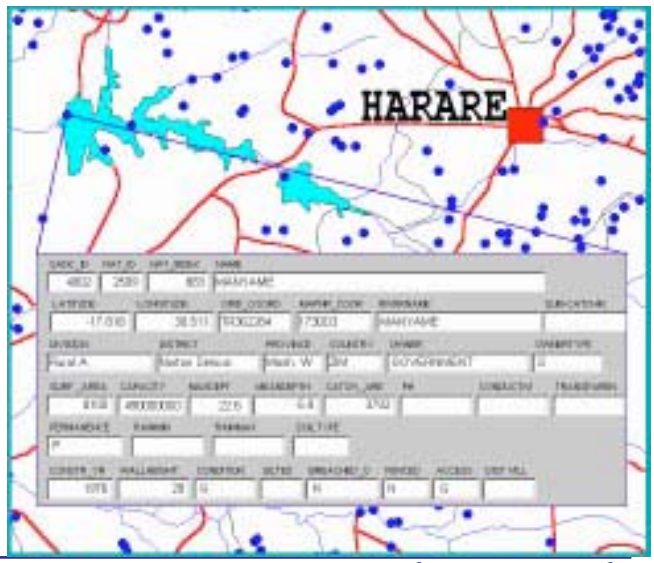


Figure 2: Distribution of dams in Zimbabwe in relation to land use

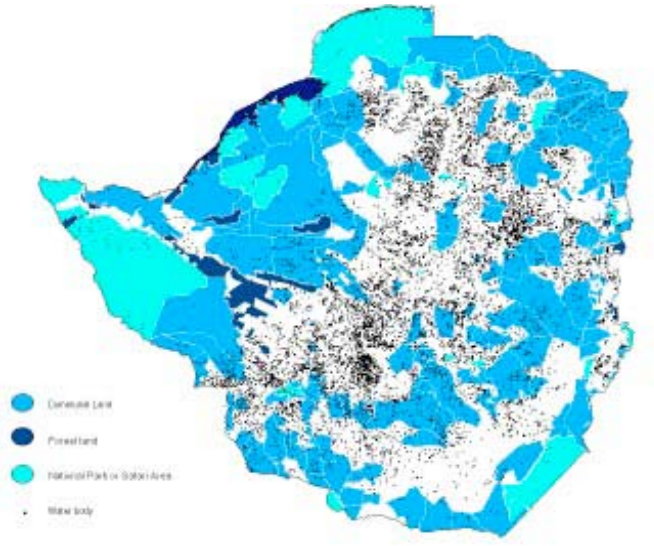
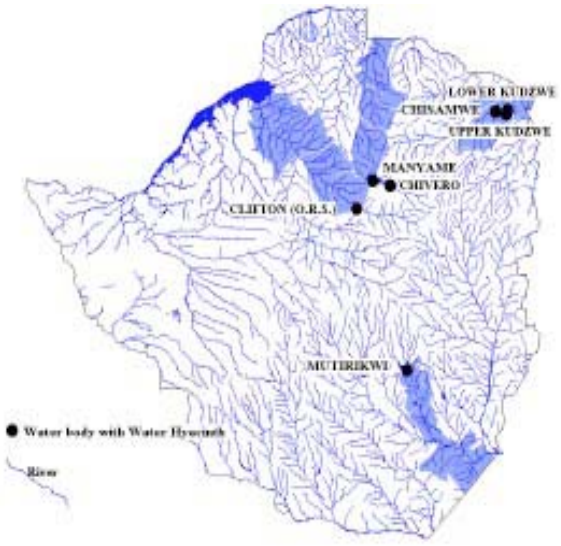


Figure 3: Watersheds affected by water hyacinth in Zimbabwe



FUTURE OF THE DATABASE

Just like most databases, the SWB SADC database is very dynamic. Dams are continuously being constructed and related information added to the database. More information is being collected to complete fields for registered water bodies and fields are being added when there is a demonstrated need. New databases are also being linked to the main database as necessary.

A number of data in time series require monthly or yearly inputs from the different SADC member countries. This underlines the need for an integration of the database management in a strong SADC structure that is able to fulfil these tasks.

Finally the database has to be accessible to all interested parties to perform queries and analyses. Part of these queries could be satisfied by making a part of the database available on a WWW server where a simple search instrument could provide users with information on a selection of water bodies. HTML (Hyper Text Markup Language) also provides a graphic clicking interface which allows users to zoom into the geographical area of interest. The same interface can be used on WWW and on a local network. ALCOM has already made some information available on WWW and plans to make a large part of the database available later this year. More specialised queries and requests for analysis should be directed to the database management team which should be able to respond to all demands through the decision support module of the database.

Figure 4. Coverage of the SWB database

- Excellent coverage
- Relatively good coverage
- Basic coverage

For additional information, contact:
ALCOM SWB database management team
e-mail (Harare, Zimbabwe): alcom@ harare.iafrica.com
Fax: 00263-4-736847

COMMERCIAL FISH FARMING POISED TO TAKE OFF IN ZIMBABWE[1]

by J.D. Balarin[1], A. Chishawa[2] and R. Evans[3]
[1] Consultant to FAO Regional Office for Africa
[2] Senior Ecologist , Department of National Parks, Zimbabwe
[3] Fish Farmer, Zimbabwe

The FAO Regional Office in Accra, Ghana, recently initiated a survey of aquacultural development in the region. The directory generated for Zimbabwe lists 57 commercial fish farmers. The results suggest there is a recent resurgence of interest in large scale fish farming in Zimbabwe.

Background

Zimbabwe has no tradition of aquaculture, although the concept was first introduced as early as the 1950s. The main activities at that time were stocking farm dams and commercial trout farming in the Eastern Highlands. Intensive research was also initiated at the then Henderson Research Station but the aquaculture section closed in the 1960s and developments in general appear to have remained relatively static until the 1980s.

Since the late 1980s, with the establishment of ALCOM in the region and the reactivation by FAO of the Henderson Research Station, there has been a marked increase in support to small scale community-based aquaculture. At the same time, a healthy interest has developed in commercial fish farming.

Annual fish farm production in 1984 was estimated at 800 t. However, the estimates of potential output from proposed commercial projects were as high as 2 500 t/yr.

In 1986 and 1987 the Agricultural Extension Services organized two Fish Forums to discuss aquacultural issues. Although there was a high degree of interest, a number of planned aquacultural projects did not materialize. The severe drought of 1991-92 caused some efforts to be abandoned. Coupled with this, the advent of ESAP (Economic Structural Adjustment Programme) and the entry into the market in 1993 of an estimated 43 000 t/yr of relatively inexpensive horse mackerel from Namibia, led to a further decline in commercial fish farming efforts. The opening of the economy meant that commercial fish farms, especially those located in marginal climatic zones, were no longer economically competitive with cheap imported fish now available on the local market.

A 1992 ALCOM survey in Zimbabwe estimated annual aquacultural production of 750 t. More recently, a survey by National Parks and Wildlife has shown a noticeable recovery in the commercial sector with an estimated annual production at 1100 t in 1994. The current survey by FAO estimated 1995 production from the commercial sector alone was 1655 t. Future prospects seem bright. Interest is being shown by external investors with markets for top quality tilapia fillets. A number of large scale production facilities ranging from 2 000 to 5 000 t/yr are currently being considered for Kariba and the Zambezi River by ventures in Zimbabwe and Zambia.

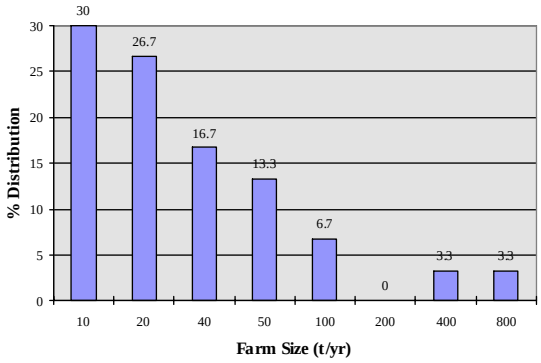
Study design

This study was carried out on behalf of the FAO Regional Office for Africa in Accra in collaboration with the Zimbabwe Department of National Parks and Wildlife. Targeted individuals were sent a postal questionnaire asking for current information about their aquacultural enterprises. The questionnaire was also circulated through the Commercial Farmers Magazine. In all, 57 returns were received, reviewed and a directory compiled. This directory will be published by FAO as part of a series listing all fish farms and aquacultural institutions in Africa.

CURRENT STATUS OF COMMERCIAL AQUACULTURE IN ZIMBABWE

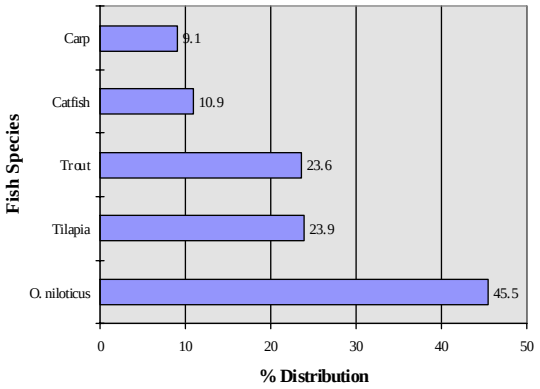
Most fish farms are relatively small, 56 % were of a production level below 20 t/yr (Figure 1) and only 6 producers reported yields over 50 t/yr. The bulk of production (45%) comes from a single farm on the Zambezi, presently averaging 750 tons and with plans to expand to 2 000 tons annually. Over 87 % of respondents were using ponds and 55% had tank systems while cages were of lower interest (16 %). Yields were below 5 t/ha/yr for 52 % of farms. Most farms (63%) relied on rivers as the main nutrient input but a significant number (46%) used commercial fish feeds.

Figure 1: Average size of fish farms



Nearly 75% of respondents produced their own seed while 14%, mainly trout farmers, depended on National Parks for fingerlings. Approximately 70% of respondents are farming tilapia, with an increasing number of farms (46%) growing *Oreochromis niloticus.* However, the requirements to obtain permits to import this non-indigenous species were considered a constraint by some producers. Trout were the next most important cultured species (24%), while catfish (11%) and carp (9%) were farmed to a lesser degree (Figure 2). Of the 27 farms currently active, 5% of

Figure 2: Fish species cultured



respondents indicated they were operating on a pilot or experimental stage and 12% were in the process of expansion. Conversely, 14% (8 farms) had stopped production as they were not satisfied with the market and a further 30% (17 farms) indicated that recent years of drought had adversely affected their production.

In addition to producing fish for the food fish markets, a popular reason for growing fish was for farm workers' food and for recreational fee fishing. A number of dams have been converted to angling waters. In several of these cases, feeding is promoted and some waters have yielded record bass in recent years. If production from the 9 610 farm dams stocked as culture-based fisheries and the 2 200 rural fish ponds are considered, aquaculture could contribute an important part of Zimbabwe's national fish production.

THE FUTURE

In the near term, plans are underway to develop three large commercial farms producing tilapia fillets for the export market. These proposed production units could eventually produce a total of over 6 000 t/yr. The recent upsurge in interest in tilapia fillets on the American and European markets has inspired considerable commercial interest in growing the fish in Africa, capitalizing on the warmer climatic conditions and relatively cheaper resource and labour base.

In 1993, over 15 000 tons of tilapia (live weight equivalent) were imported into the USA, an 87% increase over imports of the previous year and higher than the imports of salmon. Tilapia production in the USA amounted to 7 500 tons in 1994, growing at 30-40% per year, but the economic scope for expansion is limited by the less than favourable climatic conditions which necessitate the need to heat and recirculate water.

Forecasts by *Fish Farmer* and *Fish International* are that the demand for tilapia fillets on the USA market will continue to increase. Priced at US$4-5/kg (1994 prices), this lucrative market is opening opportunities for producers in tropical climates where the fish could be produced at more competitive prices. As has been the example of the horticulture and ostrich industries, Zimbabwe may also be well placed to cater for this growing export market for high quality tilapia fillets.

[[1]:Reprinted from ALCOM Newsletter Oct 1996, No.23. The Aquaculture for Local Community Development Programmes (ALCOM), operates in SADC countries with funding from SIDA, Belgium, and FAO, and is implemented by FAO.]

WEALTH RANKING: *Mozambique*[1]

by François Noël
ALCOM Socio-economist

In June 1996 ALCOM undertook a pilot smallholder farming survey in Chazuka, Machipanda District of Manica Province, Mozambique. The immediate objectives of the survey were to:

1. acquire household information describing how smallholder farmers merge small scale fish farming with traditional agricultural enterprises;

2. gain quantifiable and comparative data about the social, cultural, economic and managerial qualities of smallholder farmers and fish farmers.

The outputs expected from the survey include a detailed catalogue of the interrelatiosnships of farming activities including their nutritional and economic contribution to the family budget. Compilation of data is now proceeding and preliminary results are expected soon.

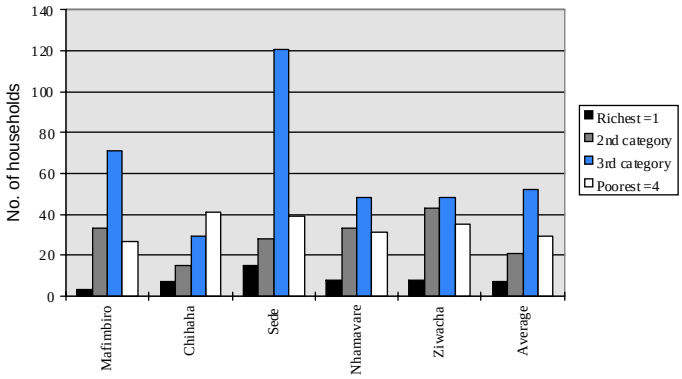
An important prerequisite before carrying out the survey was to have appropriate information regarding the size of the population residing in the area. However, due to the long period of civil strife in Mozambique, reliable census information was difficult to obtain.

Fortunately it was discovered that most community leaders had not relied on government services to keep abreast of developments in their own communities. For the purpose of their own good administration, they had kept track of household births and deaths as well as new entrants and departures from their respective villages. The information nearly always contained the name, age and sex of the head of household. In most cases it was possible to know whether or not a family practised fish farming. After explaining the objectives of the small holder farming survey, village leaders freely shared this information with ALCOM.

This method of collecting information worked so well it was decided villagers would also have a good understanding of who among them was more or less well-off. A number of key informants who had been either living in the community for a long time, or who knew a large number of the households, were asked to participate in a wealth ranking exercise.

These individuals were asked to sort the names contained in the census lists into as many wealth categories as they wished. After all the informants had completed the exercise, the wealth categories of each of the informants were sorted into four categories. Figure 1 shows the results of this ranking with category 1 representing the most affluent group, category 4 the poorest members of the community, and categories 3 and 4 intermediate levels of wealth.

Figure 1: Wealth category distribution of households in bairos of Chazuka



Wealth ranking results comparing female (Female HH) versus male (Male HH) headed household are presented in Figure 2. From the total of 687 households inventoried, over 17% were said to be de-jure female headed households. The figure shows no female headed households are in the richest category, and a significantly larger proportion of female headed households are classified in the poorest income category.

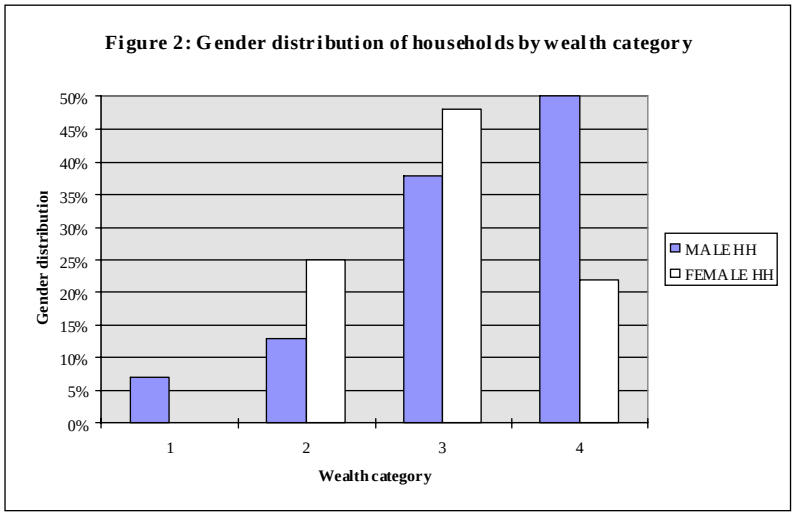


Table 1: Gender distribution of fish farmers by wealth category

Wealth category	Female HH (%)	Male HH (%)	Total (%)
1	0	33	22
2	25	31	23
3	25	31	23
4	50	5	7
Total	100	100	75
%	0.11	0.89	100

Table 1 presents the percentage of female and male headed households in each wealth category practising fish farming. It appears as though poorer female headed households have a greater tendency to adopt fish farming. However, because the sample is very small, it is premature to draw any conclusions at this time. Although female headed fish farming families represented only 11 % of the total, it seems that many of them only started fish farming in the past nine months. It is hoped that the smallholder farmer survey will be able to compare the various household types in a more detailed manner.

Wealth ranking has provided insight into the differences and inequalities which exist within the community. It can be used to determine whether or not families practising fish farming improve their scores over time. Their progress can then be compared with those who do not practise fish farming. This information may also be used for targeting households and for ascertaining if fish farming is spreading amongst the poorer segments of the society.

It should be kept in mind that this activity reflected the community's own perception and criteria of wealth. However, the results of the exercise will serve as a useful cross check of the findings contained in the current socio-economic field survey. If it can be shown there is a significant relationship between the communities' perception of wealth and poverty and quantifiable survey results, the method could be used to assist planners, institutions and target groups in:

- the description of wealth-specific constraints and opportunities for participation of both affluent and poorer households in the benefits of fish farming;

- the identification of possible strategies and measures to overcome specific constraints each group may face; and

- the recognition of different effects or impacts of the development of fish farming on different wealth categories of a community.

[[1]:Reprinted from ALCOM Newsletter Oct 1996, No.23.]

EXPERT CONSULTATION ON SMALL-SCALE RURAL AQUACULTURE[1]

(FAO Headquarters, Rome, Italy, 28-31 May 1996)

[1]Based on excerpts from *Report of the Expert Consultation on Small Scale Rural Aquaculture, FAO Fisheries Report No. 548, FIRI/R548. Rome, Italy. 1997. See previous related articles: 'Rural aquaculture : From myth to reality'. FAN, number 2, 1992. 'Development of type rural II aquaculture in Latin America'. FAN, number 11, 1995.*

Manuel Martínez-Espinosa
Fishery Resources Officer
Fishery Resources Division

(Photo courtesy of John Benjamin: PitViper 78@aol.com)

BACKGROUND

The term "aquaculture" refers to a diverse range of practices, undertaken in equally diverse locations with varying constraints, potential and objectives. It encompasses large scale, high input, industrial fish culture and small scale, low input - low output fish farming. For the former, principal motivations relate to productivity and financial profit. For the latter, a complex blend of food security, income generation, livelihood strengthening, and diversification are all likely to be important. Between the two extremes are varying levels of input and intensity of cultivation: a continuum.

Aquaculture production from developing countries in 1994 accounted for 84% of global production of finfish and shellfish by volume. The bulk of this production comes from small scale farmers in rural areas, and much of international assistance has been to smaller scale, low input and output aquaculture. For many of the adopters of this kind of aquaculture, it is a secondary activity, with a number of benefits. It can provide a supplement to incomes, a source of extra food, and a means of spreading risks. Small scale aquaculture is often integrated with other aspects of farming, such as crop and livestock production, with each aspect enhancing the benefits of the others.

Although small scale aquaculture has a long history in some parts of Asia (China and India for example) which is reflected in a thriving sector, optimism about the prospects for developing similar models elsewhere has waned in recent years. This is most marked for Africa south of the Sahara and Latin America. The precise nature of the "failure" in these regions is complex. However, certain factors are characteristic: the reluctance of farmers to adopt the technology, a tendency for ponds to be abandoned, less than optimal productivity, and the poor sustainability of aquaculture development projects. On the departure of external assistance, aquaculture activities have often slowed down, and eventually stopped. Arguably, such

problems have beset many other aspects of rural development.

Recently, a number of attempts have been made, under diverse geographic coverage and approach, to learn from the diagnosis of unsuccessful earlier development efforts. To date, little attempt has been made to draw together and synthesize the results and implications of those efforts or to reflect on their effectiveness and impact, in order to provide guidance for appropriate future actions in policy and practice.

The general objective of the consultation was therefore aimed at providing FAO and its Members with information and advice on the role of small scale aquaculture in rural development in the light of recent experiences in research and development.

THE MEETING

The Consultation was attended by 5 experts from Africa, two from Asia and one from Latin America. Five consultants assisted with the background documentation, preparatory work and general support. A good number of FAO staff members from the Department of Fisheries as well as from other FAO units involved in activities related to rural aquaculture participated in the Consultation (Rural Development, Animal Production and Health, Land and Water Development, Food and Nutrition*).*

The meeting was organized in 4 thematic sessions plus one concluding session. An overview background paper, 4 thematic background papers and 4 information papers provided the inputs for the discussion. The main issues covered in these papers and the subsequent discussions were:

1) defining objectives and indicators and identifying target groups,

2) the implications of integrating small-scale rural aquaculture within agriculture and rural development,

3) the institutional context: roles of the public and private sectors/other institutional mechanism, and

4) options in research methodologies/approaches and mechanisms for extension based on research results.

HIGHLIGHTS

Defining objectives and indicators and identifying target groups

As with many other technologies, those most likely and most able to become productive fish farmers are not the most needy. Policy makers face a dilemma: whether to focus development efforts on the resource poor or to concentrate on technology development which may be viable in the long term but which is unlikely to be related to the needs of the poorest , at least in the short term.

Participants agreed that even small-scale rural aquaculture is far more readily adopted by relatively wealthier groups in rural communities. The “poor”, who have often been targeted by rural aquaculture programmes in the past, frequently face considerable problems in effectively making use of aquaculture technology or gaining access to the resources required to make it work. They are unlikely to be early adopters of aquaculture unless they are specifically targeted for long term support. A number of participants stressed the importance of working with those farmers who show evidence of capacity to succeed. The nature of this capacity was the subject of some debate. While there was general consensus about minimum capacity in terms of land and water availability, there was more disagreement as to whether it is justifiable, appropriate, or possible, to identify in advance those farmers with ‘progressive’ or ‘entrepreneurial’ attitudes. Some participants suggested that this was a necessary prerequisite for successful adoption, while others maintained that promoters should not impose such criteria. However, it was agreed that although early adopters are likely to be the more well off in rural communities, the promoters of aquaculture should make every effort to ensure the continuing availability of low-input and low-cost technology likely to be accessible to the poorer segments of the rural population.

It is widely accepted that conventional methods for socio-economic rural diagnosis have not been very effective in determining the real needs and aspirations of people when development projects are formulated. In this context, new diagnostic methods have appeared, such as Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA), that incorporate community members in the identification, analysis and evaluation of their limitations and possibilities, according to their own perceptions, so that priorities are established jointly with institutional facilitators. Some of the risks in using participatory approaches “out of context” were also highlighted. Participants differed in their perceptions of the importance of these problems. It was mentioned that greater attention paid to the “ground rules” for use of participatory approaches and the sort of limits likely to be encountered in different contexts could remove some of the perceived difficulties. The need to regard RRA and PRA as options which can be combined with other approaches as appropriate was highlighted. Means of linking participatory planning in the field with mechanisms for policy formulation and national planning were felt to be generally lacking. It was also pointed out that development approaches which aim at empowerment of local communities require adaptive

political, social and institutional frameworks which are not always available.

The implications of integrating small-scale rural aquaculture within agriculture and rural development

The importance of approaching small-scale rural aquaculture as one component or option for rural development, not an isolated technology, was emphasized by many participants. The need for a more widespread adoption of a holistic farming systems approach was seen as key to ensuring that aquaculture is adopted as a development option where it is genuinely appropriate and addresses specific needs recognised by the intended beneficiaries themselves. Wider use of interdisciplinary approaches to rural development, which include aquaculture, is essential for this purpose.

The risk of aquaculture losing its identity during the process of integration into "rural development" was also highlighted. Examples were given of how, once aquaculture is incorporated into a more integrated development approach, it can easily end up being given such low priority that it is practically ignored as a potential solution to problems of rural income-generation and food supply, especially in areas of the world where it is not yet widely practised.

In this connection, the need to promote aquaculture and its potential, and to analyze past problems and failures, was underlined. It was also noted that there is need to demonstrate the usefulness of aquaculture as an option, with well-documented proof of its current and potential contribution in integrated farming systems and rural development in general. While such documentation is available from many parts of Asia, information and cases from Africa and Latin America need to be made more readily available. Materials promoting aquaculture clearly need to show how it compares to the range of alternatives generally available for rural development.

The structural inadequacies of many development organizations to accommodate the kind of multi- and inter-disciplinary work which more integrated rural development approaches require was also noted by many participants. The FAO itself was felt to have considerable difficulty in ensuring the proper incorporation of different disciplinary skills and knowledge into its rural development activities, at least in relation to aquaculture in rural development.

Integrated duck/fish culture in Thailand

At government level, participatory approaches require new mechanisms and planning procedures which can link participatory planning efforts at the field level with the policy formulation processes at higher level. As noted earlier, techniques for doing this are not always available.

The effect of structural adjustment programmes and changes in the macroeconomic environment obviously have complex, and sometimes paradoxical, impacts on the development of rural aquaculture. The need to assist governments in analysing these effects was identified by several participants as a possible role for the FAO.

The institutional context: roles of the public and private sectors/other institutional mechanism

A principal criticism of earlier development efforts has been that production was subsidized from government and donor funds without creating the stimulus required to ensure autonomy. Recent changes in the political and economic environment have led to a change of approach. The role of the state has been reduced, and the emphasis is now on decentralization and privatization.

For aquaculture development, this clearly means that the role of government in providing key support services such as extension and fingerling supply has to be reconsidered and alternative channels identified. Aquaculture development agencies need to identify new , more effective means to reach their objectives

and target groups. It was pointed out that the current trend to encourage co-operation between development institutions and the private sector has greatly expanded the range of possible counterparts for rural aquaculture development programmes. The possible role of the private sector, particularly in fingerling production and supply was repeatedly mentioned as of great importance. Participants noted that over the past few years, many development organizations have increased their delivery of aid through non-governmental organizations (NGOs). While generally supportive of this, they stressed that there is still an important role for governments, particularly in the effective regulation of the private sector.

The implications of decentralization processes undertaken by national governments need to be taken into account and understood. It was noted that in many instances decentralization has been carried out without the devolution and delegation of authority.

A farmer in Northeast Thailand discusses fish production

Options in research methodologies/approaches and mechanisms for extension based on research results

Variations (and similarities) between regions and individual sites are significant. A generalized, blueprint approach to aquaculture technology development was accepted as being generally inappropriate but lessons from one area need to be communicated to others. Some disagreement arose over the way in which research feeds into development in the field. Participatory approaches to development emphasize the need for research to be reactive to the needs and problems encountered at the field level and for participation of farmers in research. New methodologies for conceiving and conducting research have evolved from field trials in which the farmer's perspective is fully appreciated and farmers are incorporated into the research process from the beginning. Farmer-participatory approaches in research aim to capitalize on the strengths of both modern science and traditional knowledge bases. These new approaches require important shifts in the structure and focus of many aquaculture research institutions. On the other hand, the representatives of research institutions clearly feel that prior research, at research institutions, to develop viable technical options, is of key importance. Compromise solutions which combine the two elements need to be worked out according to local conditions.

Questions were raised about the linkage between participatory farm research and extension. Some participants felt that farmer-to-farmer extension is the most effective way of transferring information. Others expressed concern that if this were relied upon as the main method of extension, it would be impossible to control side effects. These might include the conveyance of inaccurate or misleading information and the consolidation of inappropriate practices.

The need for both global and regional co-ordination of research efforts and the collection and diffusion of information was highlighted. It was felt that this was an important role for the FAO. The FAO's "bird's eye view" of world-wide developments can be of great assistance to governments trying to refine and develop new policies for rural aquaculture development. While the weaknesses of transferring techniques developed in one area directly to another was widely recognised, the FAO can make important contributions by developing and diffusing methodologies, whether for research, extension, needs analysis, development planning or policy formulation.

Other potentially important contributions of the FAO would be in assisting governments in developing appropriate research strategies and techniques and in balancing adaptive and technical approaches to aquaculture research, as well as in the regional and global co-ordination of research and dissemination of information on rural aquaculture. Assisting governments in the decentralization of research activities might also be important.

Small-scale fish farming in Ivory Coast

There was agreement that FAO regional offices and programmes should be emphasized over activities directed by head-quarters. It was also felt that the Organization should assist in investigating and clarifying the impact of the changing macro-economic environment on small-scale farmers; restructuring of research, extension, credit and marketing systems; and to continue to play a major role in supporting national, regional and global information systems.

General issues

The role of the consultation itself was discussed at some length. On the one hand, some participants were anxious to see concrete and workable recommendations produced by the meeting while others were emphatic that the consultation was a "first step" in analyzing the issues facing rural aquaculture development, and further discussion and research would be required before recommendations or proposals could be produced. In particular, given the emphasis placed by participants on the incorporation and integration of aquaculture into more generalised rural development processes, the importance of greater involvement of agricultural and extension specialists in the discussion was highlighted.

The relative level of intervention of the FAO was also discussed. While generally the FAO's role as a global and regional focal point for information collection and diffusion was recognised, there was also concern expressed over the possibility of the FAO becoming isolated from the realities of the field, particularly as the funding for field projects is steadily reduced. The need to keep open channels to the "grass-roots" was felt to be important and, while the FAO will inevitably continue to deal primarily with governments, contacts with properly recognised, more locally-based institutions, such as NGOs or local administrations need to be maintained in some form. In this connection, there is need for a review and analysis of the wide range of institutions with which FAO could work, directly and indirectly, including those within the private sector.

Selling cultured common carp in Laos

Photos p24-25: courtesy of AIT, Asian Institute of Technology. Partners in Development: The Promotion of Sustainable Aquaculture.

Projects and other activities

Mario Pedini, Z. H. Shehadeh,
M. Martínez-Espinosa,
A. Tacon and D. Bartley
Fishery Resources Division

CUBA

A second mission under the Fisheries Management and Law Advisory Programme (FIMLAP), funded by NORAD (Norway), took place in January 1997 to assist the country in planning its aquaculture programme. The main objective of the mission was to analyze aquaculture production in 1996 from a technical and economic standpoint. The past year was crucial for the development of aquaculture in Cuba since a new plan had been launched with production models which were rather new. The mission evaluated the partial results which had been gathered before its arrival and visited stations in the provinces of Cienfuegos, Sancti Spiritu and la Habana.

The 1996 production from aquaculture was 33 300 mt, of which 28 000 mt were obtained from stocked reservoirs, 2 500 mt from semi-intensive systems in micro-reservoirs and 2 800 mt from ponds managed using semi-intensive (carp polyculture techniques) or intensive farming practices (tilapias). The production from extensive systems (reservoirs) was higher than foreseen (21 000 mt) due to the implementation of improved Chinese harvesting techniques and provision of incentives in convertible currency to workers exceeding established quotas of production. Intensive practices gave results which were lower than expected, due to problems including the availability of ponds and fingerlings, and the shortage and low quality of the feeds produced.

The mission made a preliminary analysis of the results gathered from the various farms which had been harvested, and while holding a final evaluation pending the examination of more complete sets of data which should be available to the third mission, alerted the Cuban authorities that the financial viability of some of the production models employed seemed to be rather doubtful. A third mission is foreseen around April-May 1997, to conclude this project, which should come up with a series of recommendation on the most suitable approaches to boosting aquaculture production in Cuba.

SRI LANKA
" Aquaculture Development"

This new TCP project, with a total budget of US $ 311 000, was signed in February 1997. It will assist the country in its efforts to enhance aquaculture production through: the strengthening of a Planning Information Unit, that will provide a decision support and monitoring system for aquaculture development in the coastal and inland areas using GIS and remote sensing as planning tools; training of personnel in the Planning Information Unit; undertaking zonal planning of coastal areas and monitoring during and after investment periods, both for the regulation of coastal development and for disease diagnosis and prevention; training staff at the aquaculture center in Uda Wallabe and Dambulla in the practical aspects of pond management, fish seed production, fish diseases control, fish transportation and distribution and reservoir fisheries management; and a planning workshop to present the results of the work carried out to strengthen local capacity for aquaculture development planning.

The project will be implemented over a period of 18 months and FAO will provide the services of international consultants on freshwater aquaculture, coastal aquaculture and Geographic Information Systems, as well as national consultants for GIS/ Remote Sensing applications. The project provides funds for training of Sri Lankan staff and the necessary equipment for implementation of planned activities. It will be supervised by the FAO Regional Office in Bangkok and by FAO Headquarters, Rome. The Government institution responsible for the implementation of the project is the Ministry of Fisheries and Aquatic Resources Development (MFARD), which will appoint a National Project Coordinator. He will be assisted by the staff of the Inland Aquaculture Research Division of the National Aquatic Resources Agency (NARA) and the MFARD Aquaculture Division. Dr. J. Kapetsky, responsible at FAO Headquarters for GIS applications in aquaculture and inland fisheries development, will visit the country in April 1997 to initiate the work on the GIS component.

As part of the technical backstopping provided by FAO Headquarters to the above mentioned project, Dr. Rohana Subasinghe visited Sri Lanka from 1 to 13 March 1997. One of the purposes of the visit was to check on the status of appointment of the national team. A National Project Director was already appointed and in place and a Technical Officer appointed but still to be transferred to Negombo. The Aquaculture Extension Center in Negombo had also been established by the government but the Progress Review Committee was still to be appointed. An agreement was reached on the requirements for services of international and national consultants: an international consultant on shrimp health management for 1.5 m/m, an international consultant on HACCP for 0.5 m/m, a consultant on animal quarantine/health certification for 0.75 m/m and a consultant on environmental aspects, to be provided from FAO Headquarters staff, for 1 m/m, as well as a legal consultant from the FAO Legal Office for 0.7 m/m. A national consultant on legislation would also be appointed for 1 m/m.

The initial surveys carried out by NARA show that the problems with the SEMBV disease are rather diverse and occur in different sites on the northwestern coast of the island. This has led to the identification of 15 locations where training at grass root level would be provided to farmers. In the course of the visit it was also agreed that the project would organize and hold three national workshops: i) on health management, environment and sustainability of shrimp farming in Sri Lanka, ii) on HACCP, and iii) public seminar on shrimp culture in Sri Lanka. Regarding the international training programme envisaged in the project document, it was agreed to train two national officers for 5 weeks on health management and new diagnostic tools for SEMBV at the Acuatic Animal Health Research Institute (AAHRI), Thailand, plus a third officer on the new diagnostic tools also at AAHRI, Thailand. A fourth officer will be trained for three months on shrimp health aspects at Mahidol University, Thailand. The research programme agreed to will focus on screening of post-larvae (PLs) and broodstock, including the monitoring of environmental quality to ascertain the fate of the stocked PLs in relation to their pond environment. A preliminary list of required equipment for the project has also been prepared and will be finalized by the shrimp health consultant.

Dr. Subasinghe noted the high interest and expectations from this project by the various national institutions due to the importance of the Sri Lankan shrimp industry.

MEXICO

As the project TCP/MEX/4555 "Camaronicultura para el Sector Social en Nayarit y Sinaloa" , which is aimed at the development of sustainable aquaculture in two coastal sites of Nayarit and Sinaloa, is reaching it conclusion, the Government of Mexico approached the FAO for a possible follow-up activity through a Unilateral Trust Fund project. The new project is to be jointly funded by the Secretaria de Medio Ambiente, Recursos Naturales y Pesca (SEMARNAP) and the Fondo Nacional de Apoyo a las Empresas de Solidaridad (FONAES). Mr. Pedini, FAO Headquarters staff, visited Mexico from 26 to 29 January to discuss with the interested parties the formulation of a one year project to consolidate the activities undertaken under the TCP project. On the basis of the discussions with the various Mexican groups, the new project should have four areas of intervention: shrimp culture; environment; production diversification and postlarvae production.

In the case of the first area (shrimp culture), the work of the project will continue previous activities to improve the capacity of the local producers through training and promoting access to improved production technologies, and to techniques for prevention and control of diseases.

Regarding environmental aspects, a farm monitoring programme will be implemented following the characterization of initial environmental condition under the TCP project. The project will also continue the work on mitigation measures to reduce the environmental impact of the farms and to ensure adherence of farms to laws governing environmental protection. It will also create a higher awareness amongst producers about sustainable forms of production.

The area dealing with diversification of production will have as objectives the reduction of human pressure (shrimp farms) on the environment by creating alternatives for gainful employment through new forms of aquaculture which will be demonstrated through some small pilot projects.

Finally the area of PL production will address one of the main problems of the industry: the scarcity of wild seed during certain periods of the year. The project will carry out feasibility studies for the establishment of a hatchery.

According to initial discussions, the inputs to be provided by the FAO through the project include international expertise (a shrimp culture consultant, an expert in diversification, a consultant on shrimp hatcheries, and a junior expert on permanent basis for shrimp culture and to ensure liaison with FAO) as well as national expertise (an expert on shrimp hatcheries

and a consultant for environment). The project will be supervised from FAO Headquarters. It is expected that negotiation for the new project will be concluded before the closure of the TCP project in June 1997.

VENEZUELA

The government of Venezuela requested the assistance of the Fisheries Department in establishing a TCP project on the genetic improvement of red tilapia in Venezuela (see also *FAN,* December 1996, No.14; p. 30). Red tilapia are currently farmed in many areas of the country, and are found in some river systems entering the country from Colombia. However, problems with growth rate, body conformation and coloration have been observed. Thus, the TCP project will attempt to establish a genetically improved stock of fish for culture. There are also environmental concerns associated with the use of an introduced fish, such as tilapia, that the project will attempt to address.

The preliminary mission of this project was carried out by Drs. Devin Bartley (24.1.97 to 5.2.97) and Manuel Martinez-Espinosa (25.1.97 to 30.1.97) from FAO Headquarters, Rome. The general objective was to assist the local authorities in the preparation and planning for the arrival of international consultants on quantitative genetics, biological diversity, and economics. The main activity was assisting these authorities in the selection of an institution for the experimental component of the project, as well as identifying potential national experts to work on the genetic improvement of red tilapia. With this purpose, the mission visited several public and private Institutions located in different parts of the country: Ministry of Agriculture aquaculture experimental stations in Guanapito (Guárico State) and Papelón (Portuguesa State), University of Zulia Faculty of Science in Maracaibo (Zulia State), private fish culture farms in Guarenas (Miranda State), San Cristobal (Táchira State), Guanare (Portuguesa State) and Valencia (Carabobo State). The selection of the research site was based on existing facilities (hatchery, growout, lab.) and equipment (computers, water quality, electrophoresis), trained staff, vicinity to commercial tilapia farms, training and lodging facilities. Additional considerations were made based on the background of the institutions and their support to the project.

SIPAM

A workshop of the SIPAM Information System for Promotion of Aquaculture in the Mediterranean was organized from 5 to 7 March 1997 in the premises of the CIHEAM institute in Bari, Italy, to introduce the new Windows based software to participating countries. The new software, which had been developed by the Institute of Marine Biology of Crete, Greece on behalf of SIPAM, was demonstrated to the National SIPAM Coordinators which had gathered for this meeting. The meeting was also an occasion for the Regional Coordinator to present the status of the network and to propose a programme of work for the year and for 1998, as had been requested at the First Session of the GFCM Aquaculture Committee.

The main points in the presentation of the Regional Coordinator on the status of the system referred to: the distribution of the DOS software in 1996; the coverage of the various data bases; the discussions with SELAM experts regarding the preparation of a marketing data base; the results of the first meeting of the GFCM Aquaculture Committee, especially the work to be still carried out with the FAO Legal Office to formalize the participation of the countries in SIPAM and for software licenses; the contacts initiated for the expansion of the system, including Bulgaria, Syria and Algeria; and personnel recruitment. Regarding this last point, the Regional Coordinator announced the recruitment of a part time SIPAM specialized librarian, but difficulties were reported in replacing the SIPAM programmer. Request to accelerate the recruitment of the programmer were made by several participants.

Data stored in the system, prior to the Bari meeting, amounted to 2 300 records in 11 data bases. It was pointed out that not all the countries were showing the same degree of commitment in filling their national data bases.

A demostration was provided of the SIPAM software under Windows environment, the final version of which was developed on MS Access. The programme, which was distributed to the countries at the meeting, contains a complete help on line, which replaces the user manual. An installation manual was also provided. The new software is a translation of the DOS version. Apart from the original functionalities, it can export reports, queries and results to Ms Word or Excel to improve the presentation of the data. The system has four levels of security protected with passwords. The first one is the design level, in which the authorized staff can redesign or add forms, or delete existing ones. The second level is the System Manager level which is responsible for everything except redesign of forms. The third is the user level, which allows modification of the data the user provides to the system and preserves the security of the data provided. The last level is the

guest level, in which the guest can navigate and read the data but cannot enter data (read only). The future development of this first Windows version could be its transformation into Windows 95, upgrading to a 32 bit architecture.

The demonstration was followed by a session in which the national SIPAM coordinators practised with the new software to get acquainted with its operation, taking advantage of the presence of the IMBC staff and Mr. Coppola (FAO Headquarters) for technical backstopping.

The SIPAM meeting concluded with a discussion on the plan of work for the years 1997-98 which was presented by the Regional Coordinator. The discussion dealt with the organization of the visit of the Regional Coordinator to the participating countries, the organization of meetings with TECAM and SELAM to design specialized data bases, the need to ensure that data from the countries are provided on a more frequent basis to the Regional Center, the liaison with other groups like the Federation of European Aquaculture Producers, the need for the countries to find the national resources required to fulfill their commitments to the system, and the utility of attaching the SIPAM Regional Center to ASFA (which could now be implemented with the arrival of the specialized librarian).

CYPRUS

In the context of the TCP/CYP/5611 project (see *FAN,* December 1996, No. 14, p. 27), Dr. Albert Tacon of FAO Headquarters, visited Cyprus from 27/1/93 to 3/2/97, as feed specialist consultant to the project, to assess the country's needs in aquaculture nutrition, including the identification of training, extension, and infrastructure development needs, and the preparation of a work plan for the proposed fish nutrition expert of the project.

According to government records on aquafeed usage in Cyprus, it is estimated that the commercial aquaculture sector consumed about 2 100 mt of aquafeed in 1996 valued at just over C£ 1 million, or 22% of the total gross value of aquaculture production of C£ 4.5 million. Approximately 93% of the aquafeeds consumed in Cyprus in 1996 were imported, and included 1 777 mt of marine pelleted aquafeeds (over 50% in the form of expanded or extruded high-energy pelleted feeds) with total value C£ 811,624 (unit value C£ 0.457/kg), ca. 150-200 mt of pelleted trout aquafeeds (unit value ca. C£ 0.40/kg), ca. 15-25 mt of pelleted marine shrimp aquafeeds, 5 681 kg of Artemia cysts (valued at C£ 156,133; unit value C£ 27.48/kg), and 2 899 kg of live food enrichment media/larval feeds, valued at C£ 28 710 (unit value C£ 9.90/kg).

At present aquafeeds are imported in bulk either direct from overseas suppliers or from local agents in Cyprus. Although imported aquafeeds and feed ingredients are not currently subjected to any import duties, they are subject to strict veterinary controls.

Although no commercial figures were available concerning the reported biological or economic feed conversion ratio (FCR) of the aquafeeds used by individual fish farmers, it is possible to make a crude industry/country estimate based on the total reported aquafeed used by farmers and total fish produced or sold in 1996; the industry's average economic FCR being about 2.6 for marine finfish (i.e. a total of 1 911.84 mt of marine aquafeeds used in 1996 to produce about 720 mt of marine finfish and 11 mt of marine shrimp). Although complete data for trout were not available at the time of this mission, the economic FCR for 1995 was 1.7 (i.e. a total of 165 mt of trout feed used in 1995 to produce 98 mt of rainbow trout). The reported economic FCR of the three marine cage fish farmers interviewed during this mission ranged from 1.7 to 2.3. It is interesting to note here that according to two leading aquafeed manufacturers in Europe, the average economic FCR for seabass/seabream within the Mediterranean region in 1996 ranged from 2.2 to 2.4 (average for 14 countries); total aquafeed and seabass/seabream production within the Mediterranean region in 1996 ranging between 90 000-110 000 mt and 40 000-50 000 mt, respectively.

At present fish farmers receive only limited technical assistance from the Department of Fisheries regarding aquafeed quality or on-farm feed management (however, this was not the case in the early 90's when the industry was still very new and inexperienced); individual farmers currently being almost totally reliant on the feeding tables/manuals supplied by the aquafeed manufactures and the erratic visits of the aquafeed sales representatives. Despite this, on the basis of the farmers interviewed, the feed management methods employed by farmers appeared to be generally satisfactory; the majority of the farmers interviewed not blindly relying on the usually arbitrary fixed feeding tables supplied by the aquafeed companies, but rather feeding their fish by hand to appetite and developing their own farm and site specific feeding tables based on their own practical experience.

With the exception of the marine shrimp farm A.P.Z. Aquarium Ltd., both of the marine finfish hatcheries visited employed conventional (i.e. standard) hatchery feeding methods for their fish larvae, based on the use of a combination of live food organisms (i.e. cultured algae, rotifers, Artemia) and imported larval hatchery

feeds and enrichment media with good success. However, it was also interesting to note that A.P.Z. staff have successfully developed their own hatchery feed as a partial replacement for Artemia and imported larval feeds; the hatchery feed consisting of a mixture of hens eggs, milk, squid, and a vitamin/mineral premix.

At present only one local feed manufacturer produces aquafeeds in Cyprus, namely Mr. Georgios Tsappis of Issorropimene Zootrophe Ltd. Established in 1975 the feed company has the only expander/extruder in the country, with a production capacity of 1.8 mt/h for fish feed, two shifts/day. The company initiated its aquafeed production in mid-1995 under license through a collaborative venture with an Israeli-Dutch consortium. This collaborative venture was however dissolved toward the end of 1996. At present there are no facilities at the factory for crumbing and the production of starter/fry feeds (aquafeed sold as 3-8 mm pellets). The company is still very keen to pursue and increase its production of aquafeed from a total of 142.5 mt of extruded (i.e. expanded) aquafeed in 1996, including 134.8 mt of marine seabream/seabass aquafeed (sold to five different farms) and 7.8 mt of trout aquafeed (sold to two farms). In addition to the sales in the domestic market, the company has also been producing limited quantities of floating tilapia feed for export to Israel.

At present there is no national association of feed millers in Cyprus, and compound animal feeds are manufactured generally following the EU codes of feed manufacturing practice (legislation prepared by the Cyprus Council of Feedstuffs and Feed Additives). However, apparently there is no mention of fish in this legislation. The main constraints currently faced by the compound feed manufacturing industry in Cyprus are related to high energy (electricity) and labour costs, the reluctance of the banking sector to give loans for the modernization and expansion of the sector and, more seriously, the need for the sector to divorce itself from government subsidies (in the form of cheap feed ingredient sources), in line with GATT policy, and the harmonization of the country toward the EU Aquis Communautaire.

KINGDOM OF SAUDI ARABIA

The Fish Farming Centre (FFC), Jeddah, (UTFN/SAU/010/SAU) has achieved significant progress in the controlled reproduction and grow out of local species of groupers, rabbitfish and shrimp. The FFC carried out the first reported growout and marketing trials of hatchery produced *Epinephelus polyphekadion* (camouflage grouper). This species exhibited an extended spawning season in 1996, from March to November, with a break in May and June, but egg quality was best during the early part of the season (March and April). Broodstock raised from hatchery reared fingerlings in 1992 also spawned for the first time in 1996, thus closing the life cycle in captivity. However, as noted in other marine finfish, egg quality at first spawning was poor and produced eggs were not incubated.

Growout trials were initiated in October 1995, with hatchery reared fingerlings, using onshore tanks, ponds and offshore sea cage facilities. Attempts were also made to study growth and production of this species under different stocking densities, using onshore tanks. After 12 months of growout, individual fish size of 800 g, with an average of 600 g, was attained. Marketing trials were initiated in October 1996. These tests are the subject of two articles to be published in *Aquaculture Research* and *Asian Fisheries Science.*

Additional advances include the extended captive spawning of *E. fuscoguttatus* (brown marbled grouper), mass hatchery production of fingerlings and initiation of nursery and growout trials. Results to date show that this species grows much faster than *E. polyphekadion.* A hybrid of female *E. fuscogottatus* and male *E. polyphekadion* has also been mass produced in the hatchery and preliminary nursing tests show the hybrid to have a faster growth rate than the camouflage grouper.

Pond production trials with rabbitfish (*Siganus rivulatus*) using locally produced feed (32% crude protein) yielded 440 kg from a 220 sq. metre pond (almost 20 mt/ha by linear extrapolation), with average individual fish weight of 94g, during an eight month growing period. A record production rate of 320 kg of shrimp (*P. indicus*), of 23 g average individual weight, was also produced from a 600 sq. metre pond (equivalent to 5 mt/ha/crop) using locally formulated feed.

SPECIAL PROGRAMME ON FOOD SECURITY

Zambia

In the framework of the FAO Special Programme for Food Security (SPFS), a priority programme for the FAO as a whole, Zambia is the first country where aquaculture components have been integrated with other farming activities. The SPFS, which consist of two main phases, a Pilot Phase and an Expansion Phase, is already in various stages of implementation in about 20 countries. The Pilot Phase of the programme consists of four major areas : (a) water control, (b) plant production intensification, (c) diversification of production and (d) analysis of constraints for expansion of the programme. Aquaculture development is a component of diversification and is also integrated with water control.

In Zambia, the SPFS initiated its aquaculture activities by providing assistance to convert a farm into a demonstration farm for integrated aquaculture. The integrated production system of the Kalimina demonstration farm has attracted considerable interest among farmers. More recently, a consultant, drawing on the experiences of the regional ALCOM project, visited the sites of the SPFS in the country, where improved micro-irrigation practices are being introduced, to investigate the feasibility of integrating aquaculture into irrigation schemes to improve the use of farm resources and water and to increase overall farm output. A total of six sites were visited and five different options for integration identified . The sites are located in Kalomo, Mkushi and Chibombo Districts. The types of integration suggested were: Integrated ponds located at the highest point in the garden; ponds in flat waterlogged areas; ponds in sloping waterlogged areas; ponds as enlarged irrigation wells and; ponds not directly integrated into the irrigation water system. A specific pilot project for the demonstration of the proposed integration was formulated by the mission and is at present under consideration.

VIETNAM

A TCP project for Vietnam "Integrated Golden Apple Snail Management in Rice" has been jointly implemented by the Agriculture and Fisheries Departments of the FAO since 1995. The Golden Apple Snail *Pomacea canaliculata* was introduced from South America into Vietnam were it became a serious pest of rice fields. After an initial assessment of the problem, the government of Vietnam requested assistance from the FAO for snail management in rice fields. Assistance included documentation of distribution of the pest in the various provinces of the country and the assessment of the degree of infestation. GIS techniques have been utilized for this purpose. Results indicate that the Golden Snail occurs in all the provinces, with the southern provinces showing more severe infestation. The floods continue the expansion of the infestation. The Government has initiated a massive programme to fight this pest, through the Plant Protection Department (PPD) of the Ministry of Agriculture and Rural Development as lead unit and with the assistance of the Ministry of Science and Technology and the Ministry of Fisheries. Regulations on banning the import, transport and breeding of the Golden Snail have been issued. In addition an extensive information campaign has been initiated through posters and leaflets providing information on the snail. Experiments on snail control were also carried out using different botanical and chemical products and fish have been identified as a potential control mechanism. A fish breeding programme, including black carp and other species, was designed in 1996 to supply fish for snail control. The black carp breeding programme will be started by the Research Institute for Aquaculture (RIA) No.1 in 1997 and it is expected that the selected sites will be stocked in August 1997.

MEDITERRANEAN AQUACULTURE NETWORKS

TECAM Seminar on Genetics and Breeding of Mediterranean Aquaculture Species

The seminar was convened in Zaragoza, Spain on 28 - 30 April 1997, by the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM) in co-operation with the Fisheries Department of the FAO, as part of the activities of the Network on Technology of Aquaculture in the Mediterranean (TECAM). The seminar reviewed the status of application of genetics and breeding to the farming of fish and shellfish in the Mediterranean. It was organized in six sessions with the following themes:

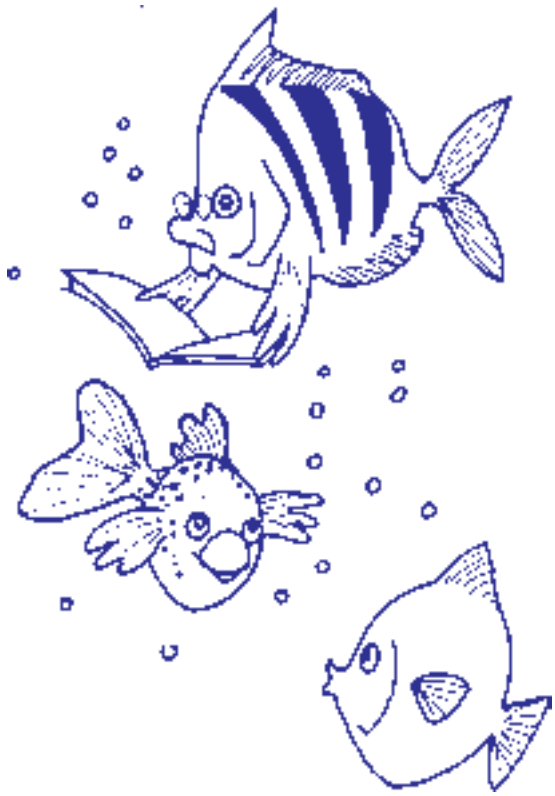
- selection and crossbreeding in marine fish;
- selection and crossbreeding in shellfish;
- application of molecular markers to aquaculture and broodstock management;
- chromosome manipulation and transgenesis;
- integrated design and breeding programmes; and
- biodiversity and conservation of genetic resources in aquaculture and fisheries.

Dr. Devin Bartley of the FAO Fisheries Department attended the seminar and presented a paper entitled "Current status, tendencies and problems of genetics and breeding in aquaculture and fisheries".

The seminar was followed by a workshop which prepared a programme of work on genetics for TECAM, for submission to the next meeting of the Co-ordinating Committee for TECAM and SELAM. The main recommendations of the seminar and the proposed programme of work on genetics will be reported in the August issue of FAN, following publication of the relevant reports.

NEW FAO PUBLICATIONS

Ziad H. Shehadeh
Senior Fishery Resources Officer (Aquaculture)
Fishery Resources Division



Martinez-Espinoza, M. 1996. Report of the Expert Consultation on Small-scale Rural Aquaculture. Rome, Italy, 28-31 May 1996. *FAO Fisheries Report*. No. 548. Rome, FAO. 1996. 182p.

The publication deals with the results of a preliminary consultation on small-scale rural aquaculture, convened by the Inland Water Resources and Aquaculture Service, Fishery Resources Division, FAO, at FAO HQ, Rome in May 1996. It presents a summary of discussions and principal conclusions reached, followed by abstracts and full versions of the overview and thematic papers, together with abstracts of the information papers. The objective of the consultation was to provide FAO and its members with information and advice on the role of small-scale aquaculture in rural development. To this end, participants were asked to analyze and reflect on four keynote papers prepared by selected participants. The keynote papers covered four themes, identified in an overview paper: "O*ptions for small-scale aquaculture development".* The four theme papers were:

- defining objectives and indicators and identifying target groups,
- the implications of integrating small scale aquaculture within agriculture and rural development,
- the institutional context: the roles of the public/ private sector, and
- options in research methods/approaches and mechanisms for extension based on research results.

Four information papers were also presented and discussed. Highlights of the meetings are summarized in a preceding article in this newsletter.

FAO Fisheries Department. 1996. Fisheries and aquaculture in the Near East and North Africa: situation and outlook in 1996. *FAO Fisheries Circular*. No. 919. Rome, FAO. 1996. 37p.

FAO Fisheries Department. 1996. Fisheries and aquaculture in Latin America and the Caribbean: situation and outlook in 1996. *FAO Fisheries Circular.* No. 921. Rome, FAO. 1996. 54p.

FAO Fisheries Department. 1996. Fisheries and aquaculture in Europe: situation and outlook in 1996. *Fisheries Circular*. No. 911. Rome, FAO. 1996. 54p.

FAO Fisheries Department. 1996. Fisheries and aquaculture in Sub-Saharan Africa: situation and outlook in 1996. *FAO Fisheries Circular*. No. 922. Rome, FAO. 44p.

The FAO Fisheries Department has prepared a major review entitled *The State of World Fisheries and Aquaculture*, which includes eight regional summaries prepared from detailed analyses of the state of fisheries and aquaculture in each of the eight regions. These detailed studies are being published in the *FAO Fisheries Circular* series. The first four to appear in print are listed above. The circulars follow a standard format and are organized in five main sections: (1) *Current Fisheries Situation* - dealing with the role of fisheries in the regional economy and the role of regional fisheries in world fisheries; (2) *The Fisheries Sector: situation and trends* - including trends in production and status of stocks in marine and inland capture fisheries and production from aquaculture, fish utilization, distribution and marketing, domestic consumption and nutrition, international trade in fishery products, technology and infrastructure, and investment in the fisheries sector; (3) *Institutional and Policy Framework* - including macro-economics and fisheries sector planning, national policies for conservation and management, regional fisheries organizations and arrangements, national fisheries administrations, and fisheries research and training; (4) *Special Issues* - dealing with main issues facing fisheries and aquaculture in the region and (5) *Outlook* - which examines future production and consumption of fish and prospects for increased production by sub-sector.

Townsley, P. 1996. Rapid rural appraisal, participatory rural appraisal and aquaculture. *FAO Fisheries Technical paper*. No. 358. Rome, FAO. 1996. 109p.

This publication is intended for aquaculture development specialists, aquaculture project managers, and officials and specialists involved in the planning and management of aquaculture activities. It is intended to provide an introduction to Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA) for people working in these fields. The principle components of these two approaches to information collection and planning are described along with the various tools used with a case study to illustrate their use and some of the issues they raise. Possible applications of the approaches for those involved in aquaculture development are given and an outline provided of the sorts of planning and institutional context where they can best be applied. The problems and shortcomings of the approaches are also discussed and guidelines given for the use of alternative approaches to information gathering and planning.

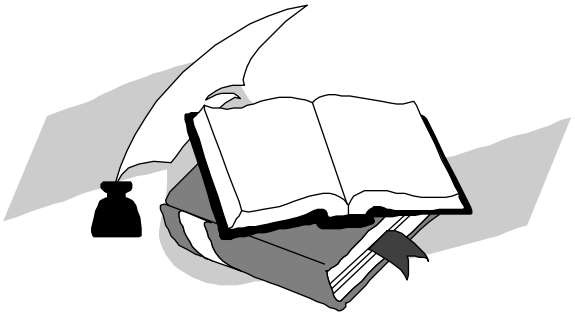
Subasinghe, R.P.; Arthur, J.R.; Shariff M. (Eds.) 1996. Health management in Asian aquaculture. Proceedings of the Regional Expert Consultation on Aquaculture Health Management in Asia and the Pacific. Serdang, Malaysia, 22-24 May 1995. *FAO Fisheries Technical Paper*, No. 360. Rome, FAO. 1996. 142p.

The drive to produce more fish and shellfish to meet growing demand has lead many aquaculturists in Asia to intensify their operations. In many instances, the complex balance between the fish/shellfish and the environment is not well understood and the organism under culture often becomes stressed and prone to infections. As has been witnessed, disease has been and will continue to be a major constraint to the development of the aquaculture industry. Considering FAO's priority on developing sustainable aquaculture, the large Asian contribution to global aquaculture production and the seemingly high losses of revenue due to diseases and health-related problems, FAO, in consultation with the Network of Aquaculture Centres in the Asia-Pacific (NACA), the Aquatic Animal Health Research Institute (AAHRI), the South East Asian Development Centre (SEAFDEC) and the Universiti Pertanian Malaysia (UPM), and in collaboration with the Fish Health Section of the Asian Fisheries Society (FHS/AFS), organized a Regional Expert Consultation on Aquaculture Fish Health Management in Asia and the Pacific, which was held at the Universiti Pertanian Malaysia in May 1995. This document comprises the technical papers presented at the Consultation, and is a supplement to the report of the consultation *(FAO Fisheries Report* No. 529. FAO, Rome, 1995. 24p).

FAO. 1996. Precautionary approach to fisheries. Part 2: scientific papers. Prepared for the Technical Consultation on the Precautionary Approach to Capture Fisheries (Including Species Introductions). Lysekil, Sweden, 6-13 June 1995. (A scientific meeting organized by the Government of Sweden in cooperation with FAO). *FAO Fisheries Technical Paper*, No. 350, Part 2. Rome, FAO. 1996.

The document contains a series of scientific papers intended to provide a comprehensive review and analytical background for the drafting of guidelines on the precautionary approach to fisheries by the Technical Consultation on the Precautionary Approach to Capture Fisheries organized in Lysekil, Sweden, 6-13 June 1995 by the Government of Sweden in co-operation with FAO. It provides a comprehensive review of the concept of precaution in all aspects of fisheries and its implications for fishery research, technology development and transfer, as well as for conservation and management. It also provides a series of topical papers on: (a) the development of scientific advice with incomplete information; (b) risk assessment, economics

and precautionary fishery management; (c) precautionary management reference points and management strategies; (d) the assessment of the precautionary nature of fishery management strategies; (e) the precautionary approach to species introduction; and (f) the precautionary aspects of fishery technology development. The paper entitled *Precautionary approach to the introduction and transfer of aquatic species* by D. Bartley and D. Minchin should be of special interest to aquaculturists, who would also benefit from the general principles and approaches discussed in the technical papers.



FAO, 1997. Management for freshwater fish culture: ponds and water practices. *FAO Training Series,* No. 21/1. Rome, FAO. 1996. 233p.

The training manuals on simple methods for aquaculture published in the FAO Training Series are prepared by the Inland water Resources and Aquaculture Service of the Fishery Resources and Aquaculture Division, Fisheries Department. They are written in simple language and present methods and equipment useful not only for those responsible for field projects and aquaculture extension in developing countries but also for use in aquaculture training courses. They concentrate on most aspects of semi-intensive fish culture in fresh waters from selection of the site and builing of the fish farm to the raising and final harvesting of the fish. This is the fifth manual in the series. It deals with the practical aspects of pond management in freshwater fish culture, including mangement of water quality, controlling water losses, protecting farm structures and fish stocks, pond fertilization, and the integration of animal husbandry and fish farming.

FAO Fisheries Department. 1997. Aquaculture development . *FAO Technical Guidelines for Responsible Fisheries.* No. 5. Rome, FAO. 1997. 40 p.

Aquaculture is one of the fastest growing food production systems in the world, with the bulk of its output currently being produced witthin developing countries, and with expectations for aquaculture to continue its contributions to food security and poverty alleviation. The vast majority of aquaculture practices around the world have been pursued with significant nutritional and social benefits, and generally with little or no environmental costs. However, it is essential for current efforts aiming at the future success of aquaculture in both developing and developed countries, that potential social and environmental problems are duly addresed in order to ensure that aquaculture develops sustainably.

This document provides annotations to the Principles of Article 9 of the Code of Conduct for Responsible Fisheries. These annotations are meant to serve as general guidance, and should be taken as suggestions or observations intended to assist those interested in identifying their own criteria and options for actions, as well as partners for collaboration, in support of sustainable aquaculture development.

Given the diversity in aquaculture and the sometimes different perceptions of “sustainability”, more balanced and informed approaches are required to address developmental and environmental issues at any given location. Commitment for collaboration, constructive dialogues among responsible partners, and participation of aquafarmers and their communities are important when assigning responsibilities for sustainable development of aquaculture.

De Graaf, G. And H. Jensen. 1996. Artificial propagation and pond rearing of the African catfish *Clarias gariepinus* in sub-Saharan Africa - A handbook. *FAO Fisheries Technical Paper.* No. 362. Rome, FAO. 1996. 73p.

The manual is based on the experiences of the authors on the artificial reproduction and pond rearing of the African catfish *C. Gariepinus* within FAO field projects in the Central African Republic, the Republic of the Congo, Kenya and Nigeria.

The manual is divided into five major sections dealing with: 1) general biology, including natural feeding habits and reproduction; 2) induced propagation without and through hormone injection; 3) fry nursing in earthen ponds, including pond preparation, fertilization, feeding and management; 4) monoculture, including feeding methods; and 5) polyculture with tilapia. Information is also provided concerning the economics of different fingerling and grow-out farming practices in Africa, and concerning diseases and hybridization.

STAFF CONTRIBUTIONS TO EXTERNAL PUBLICATIONS, MEETINGS, ETC.

Barg, U.C., D.M. Bartley, A.G.J. Tacon and R.L. Welcomme. 1996. Aquaculture and its environment: a case for collaboration. Paper presented at the Second World Fisheries Congress, 28 July-2 August 1996, Brisbane, Australia.

Bartley, D.M. 1997. Current status, trends and problems on genetics and breeding in aquaculture and fisheries. Paper presented at the Seminar on Genetics and Breeding of Mediterranean Aquaculture Species. Network on Technology of Aquaculture in the Mediterranean (TECAM), Zaragosa, Spain, 28-30 April, 1997.

Halwart, M., M. Borlinghaus and G. Kaule. 1996. Activity pattern of fish in rice fields. *Aquaculture* 145: 159-170.

Heidenreich, A. and M. Halwart. 1995. Fish farming and other integrated pest management strategies against *Pomacea* snails in rice fields: A computer simulation. Paper presented at the 4th Asian Fisheries Forum, 16-20 October, Beijing, P. R. China.

Satia, B.P. and D.M. Bartley. 1997. The paradox of international introductions of aquatic organisms in Africa. Paper presented to the First Meeting on Population Genetics and Aquaculture in Africa. Abidjan, Ivory Coast, 1-4, April, 1997.

Tacon, A.G.J., 1996. Feeding tomorrow's fish - the Asian experience. Paper presented at the INFOFISH-AQUATECH 96 International Conference on Aquaculture, 25-27 September 1996, Kuala Lumpur, Malaysia

Tacon, A.G.J., 1996. Raw materials for salmonids - alternatives to fishmeal. Paper presented at the Nutreco Aquaculture Business Conference 'Aquavision', 13-14 November 1996, Stavanger, Norway

Tacon, A.G.J. & D.M. Akiyama. 1997. Feed ingredients, In L.R. D'Abramo, D.E. Conklin & D.M. Akiyama (Editors), Crustacean Nutrition. *Advances in World Aquaculture,* Vol.6, 587pp.

Welcomme, R.L. and D. M. Bartley. 1997. A review of present techniques for the enhancement of fisheries. Presented to the FAO/ODA International Expert Consultation on Inland Fishery Enhancements, Dhaka, Bangladesh, 2 - 14, 1997.

STAFF ARTICLES IN THE FAO AQUACULTURE NEWSLETTER (FAN) AND OTHER FAO PUBLICATIONS

Barg, U.C. and R. Lavilla-Pitogo. 1996. The use of chemicals in aquaculture: a summary brief of two international expert meetings. *FAO Aquaculture Newsletter (FAN)*, December 1996, No. 14: 12 - 14.

Pedini, M. 1996. Aquaculture in the GFCM countries: its evolution from 1984 to1994. *FAO Aquaculture Newsletter (FAN)*, December 1996, No. 14: 18 - 23.

Shehadeh, Z.H. and I. Feidi. 1996. Aquaculture development and resource limitations in Egypt. *FAO Aquaculture Newsletter (FAN),* December 1996, No. 14: 3 - 7.

Tacon, A.G.J. 1996. European aquaculture - trends and outlooks. FAO GLOBEFISH Research Programme, Vol. 51, 205p. Rome, FAO.

Van Houtte, A. 1996. Legal aspects concerning aquaculture: some food for thought. *FAO Aquaculture Newsletter (FAN)*, December 1996, No.14: 14 - 17.

Welcomme, R.L. 1996. Stocking as a technique for enhancement of fisheries. *FAO Aquaculture Newsletter (FAN)*, December 1996, No. 14: 8 - 11.

The FAO Aquaculture Newsletter is now available in the internet at the following address: http://www.fao.org/waicent/faoinfo/fishery/newslet/newslet.htm