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# AQUACULTURE EXTENSION IN SUB-SAHARAN AFRICA

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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# PREPARATION OF THIS DOCUMENT

While the delivery of general agriculture support has been problematical, the provision of specialized aquaculture extension support has been even more demanding. The 1999 Africa Regional Aquaculture Review, held in Accra, Ghana, concluded that there has been "reduced aquaculture extension activity" in recent years in a number of African countries. The Review recommended that extension efforts focus on small-scale farmers and that farmer-to-farmer extension approaches be implemented.

In late 2001, the Inland Water Resources and Aquaculture Service, through the Fisheries Department Group of the FAO Regional Office for Africa, contracted the WorldFish Center West Africa Office to review current aquaculture extension practices in the Africa Region. Case studies on aquaculture extension were subcontracted to extension specialists in five representative countries of sub-Saharan Africa to review the history, status and planning process of national extension services in these countries (Table 1).

In 2002, these national reviews together with available extension materials were sent to WorldFish in Cameroon where a local consultant was hired to review findings, prepare a synthesis of the reviews and critically examine the extension materials received.

The present review has been prepared within the framework of the Regular Programme activities of the FAO Inland Water Resources and Aquaculture Service of the Fisheries Department.

It is based on an original text proposed by Dr Randall E. Brummett (WorldFish Center, West Africa Office) and Dr V. Pouomogne (Institut de recherche agricole pour le développement) in Yaounde, Cameroon, and revised in Rome by Dr A.G. Coche, FAO-FIRI consultant.

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## ABSTRACT

As part of a regional review of aquaculture being undertaken by the Regional Office for Africa (Accra, Ghana) of the Food and Agriculture Organization of the United Nations (FAO), this document reviews the recent history of aquaculture extension in five representative countries of sub-Saharan Africa. Country reviews were commissioned, analysed and synthesized. A number of extension guides, field manuals and dissemination tools were compared. Each of the reviewed countries has a similar history of aquaculture development, beginning with colonial experiments in the 1950s, through a period of neglect following independence in the 1960s, a period of intense international involvement in small-scale rural development (including aquaculture) in the 1970s and 80s ending in a period of reflection on results in the 1990s. Many of these past projects were driven by foreign donors interested primarily in poverty alleviation and working on the basis of national food security targets, ignoring the desires and constraints faced by would-be producers and beneficiaries. Working within the broader context of rural development, rather than the somewhat simpler world of commercial aquaculture technology has created problems for poorly trained and motivated extension agents. New participatory paradigms have been incorporated into policy and planning, but are generally not reflected in the day-to-day work of either research or extension, leading to low rates of adoption and project sustainability. Extension systems based on the Training and Visit model continue to dominate aquaculture extension in Africa, but more sustainable gains made through participatory approaches are leading more and more governments in the direction of farmer-led approaches. Some countries have moved faster to capitalize on lessons learned than others. Madagascar has made great advances establishing a close working relationship between small-scale farmers and private sector hatcheries. Zambia has profited from a commitment to integrated agriculture-aquaculture systems and participatory approaches. Cameroon, Côte d'Ivoire and Kenya have lagged behind, but report some local successes with the use of participatory research initiatives. Lessons learned from these experiences lead the authors to the conclusion that aquaculture can play a much larger role in economic development if user interests and knowledge are better incorporated into research and extension processes, and if the quality of the extension services can be upgraded to ensure that good technology is made available to users.

# Abbreviations/Acronyms

| | |
|---|---|
| ADB | African Development Bank |
| AFD | Agence Française de Développement |
| AFVP | Association Française des Volontaires du Progrès |
| AGCD | Agence Générale de Coopération pour le Développement (Belgium) |
| ALCOM | Aquaculture for Local Community Development Programme (FAO/SADC)) |
| AFRICARE | International NGO |
| ANADER | Agence nationale de développement rural (Côte d'Ivoire) |
| APDRA | Association pisciculture et développement rural (International NGO) |
| APNV | Approche participative niveau village (Cameroon) |
| APVA | Animal and Plant Production Assistants (Côte d'Ivoire) |
| ASIP | Agricultural Sector Investment Programme (Zambia) |
| AVZ | Agents de vulgarisation de zone (Cameroon) |
| BSF | Belgian Survival Fund |
| CDCC | Centre de développement de la culture de crevettes (Madagascar) |
| CEPID | Centre d'excellence-production, innovation et développement (Cameroon) |
| CIDT | Compagnie ivoirienne pour le développement des textiles |
| CIDV | Compagnie ivoirienne pour le développement des vivriers |
| CIFOR | Centre international de formation en milieu rural (Cameroon) |
| CRDI | Centre de recherche pour le développement international (Canada) |
| CREPHY | Centre régional d'études phytosanitaires (Cameroon) |
| CTA | Technical Centre for Agricultural and Rural Co-operation (International NGO) |
| DFID | Department for International Development (UK) |
| DOF | Department of Fisheries (Zambia) |
| EU | European Union |
| FAC | Fonds d'aide et de coopération (France) |
| FAO | Food and Agriculture Organization of the United Nations |
| F CFA | Franc d'Afrique centrale |
| FD | Fisheries Department (Kenya) |
| FED | Fonds européen pour le développement (EU) |
| FNFP | Fonds national forestier et piscicole (Cameroon) |
| FSRP | Farmer-Scientist Research Partnership (Cameroon) |
| GTDR | Groupes de travail pour le développement régional (Madagascar) |
| GTZ | German Technical Co-operation Agency |
| ICARA | International Conference on Assistance to Refugees in Africa (NGO) |
| ICLARM | International Center for Living Aquatic Resources Management (WorldFish Center) |
| IDA | International Development Assistance (World Bank) |
| IFAD | International Fund for Agricultural Development |
| IRAD | Institut de recherche agricole pour le développement (Cameroon) |
| JICA | Japanese International Cooperation Agency |
| KMFRI | Kenya Marine and Fisheries Research Institute |
| LVEMP | Lake Victoria Environmental Management Programme (Kenya) |
| LBDA | Lake Basin Development Authority (Kenya) |
| MAFF | Ministry of Agriculture, Food & Fisheries (Zambia) |
| MARD | Ministry of Agriculture and Rural Development (Kenya) |
| MINAGRA | Ministère de l'Agriculture et des Ressources Animales (Côte d'Ivoire) |
| MINAGRI | Ministère de l'Agriculture (Cameroon) |

| | |
|---|---|
| MINEPIA | Ministère de l'Elevage, des Pêches et des Industries Animales (Cameroon) |
| MINREST | Ministère de la Recherche Scientifique et Technique (Cameroon) |
| MPRH | Ministère de la Pêche et des Ressources Halieutiques (Madagascar) |
| NGO | Non-Governmental Organization |
| NORAD | Norwegian Agency for Development |
| ONG | Organisation non-gouvernementale |
| PCV | Peace Corps Volunteer (USA) |
| PEA | Participatory Extension Approach (Zambia) |
| PIC | Pisciculture intensive camerounaise |
| PNVA | Programme national de vulgarisation agricole (Madagascar) |
| PNVRA | Programme national de recherche et de vulgarisation agricole (Cameroon) |
| PPA | Producteurs privés d'alevins (Madagascar) |
| PRA | Participatory Rural Appraisal |
| RAEP | Rural Aquaculture Extension Promotion (Zambia) |
| RRA | Rapid Rural Appraisal |
| SFCO | Senior Field Services Coordinator (Zambia) |
| SHAP | Small Holder Aquaculture Programme (Zambia) |
| T&V | Training and Visit extension system |
| UNDP | United Nations Development Programme |
| USAID | United States Agency for International Development |
| UNHCR | United Nations High Commissioner for Refugees |
| ZAP | Zambia Aquaculture Programme |
| ZPES | Zambia Participatory Extension Systems |
| ZSETA | Zambia Structured Extension and Training Approach |
| ZAPI | Zone d'actions prioritaires intégrées (Cameroon) |
| ZAREP | Zambia Agriculture Research and Extension Project |

# CONTENTS

# 1. Introduction

Aquaculture dates in most of sub-Saharan Africa from the 1950s. After four decades, by the early 1990s, returns on government and international aquaculture investments appeared insignificant. Many observers of rural development were led to the opinion that aquaculture could not work in Africa. The acknowledgement of failure was harsher when parallels were drawn with Asia. According to Lazard *et al.* (1991)[1], African aquaculture development received some US$72.5 million over the period 1978 to 1984, versus US$171.3 million for Asia and the Pacific. For this, less than three fold funding difference, Asian countries produce 1 000 times more fish than Africa.

Actually, as Lazard *et al.* pointed out, the problem has less to do with aquaculture itself, than with the process of tackling aquaculture development in the African environment. Even today, most research, development and extension systems focus on the transfer of technology generated on research stations, through a rigid administrative structure, to farmers who play no part in the process. The top-down, Training and Visit (T&V) approach implemented with World Bank funding continues to concentrate on "technology packages" to be assimilated by farmers through regular training visits by extension agents. The poor outcomes of this system have caused donors to seek alternative approaches.

In many cases, simple common sense suggested that hard science be tempered with socio-cultural knowledge in multidisciplinary teams to better appraise rural development in Africa. Many workshops have been organized around this theme, and key criteria to select research and development projects by donors started to include such jargon as "farmer participation", "sustainability", and "social equity". In spite of many speeches, however, many projects continue to function with the old top-down system.

Over the years, the Food and Agriculture Organization of the United Nations (FAO) has accumulated considerable experience with the various approaches being used by the numerous projects conducted in Africa. Regular syntheses of current practice are an integral part of the effort to continually improve the approach being promulgated and answer key questions about the development process. The objectives of the current study were to:

**Table 1.** Lead authors of national aquaculture extension reviews by country.

| Country | Author |
|---|---|
| Cameroon | Jean Kouam<br>Direction des Pêches<br>BP 11143, Yaoundé<br>**E-mail**: kouamjean@yahoo.fr |
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| Kenya | Dr Charles C. Ngugi<br>Moi University, Dept of Fisheries<br>PO Box 1125, Eldoret<br>**E-mail**: cngugi@net2000ke.com |
| Madagascar | Dr Georges Rafomanana<br>Direction Générale du Développement des Ressources Animales et Halieutiques<br>B.P. 1699 Antananarivo 101<br>**E-mail**: rafomanana@simicro.mg |
| Zambia | Charles T. Maguswi<br>Director of Fisheries<br>PO Box 350100, Chilanga<br>**E-mail**: piscator@zamnet.zm |

[1] Lazard J., Lecomte, Y., Stomal, B. & Weigel, J-Y. 1991. Pisciculture en Afrique subsaharienne: situations et projets dans des pays francophones; propositions d'action. Ministère de la Coopération et du Développement, Paris. 155 pp.

- Evaluate the state of aquaculture extension in five representative countries of sub-Saharan Africa to characterize performance over the last 10 years and identify opportunities for improvement.

- Collect, compare and rationalize existing extension materials to produce a regionally relevant aquaculture information package for Africa.

The choice of countries to be reviewed was made to ensure a range of environments, cultures, experiences and approaches to the development of aquaculture (Table 2). Cameroon in Central Africa, for example, has a wide range of ecotypes in which aquaculture has been attempted ranging from sub-Sahelian to the rainforest. These have been executed by a number of international agencies, most notably the US Peace Corps and the World Bank.

**Table 2.** Key characteristics of countries selected for a review of aquaculture extension in sub-Saharan Africa.

| **Country** | **Cameroon** | **Côte d'Ivoire** | **Kenya** | **Madagascar** | **Zambia** |
|---|---|---|---|---|---|
| Size (km²) | 475 442 | 322 462 | 582 647 | 587 041 | 752 614 |
| Population (millions) | 15,5 | 15,8 | 28,8 | 14,4 | 9,7 |
| Official language | French & English | French | English | French | English |
| Per capita income (US$) | 610 | 700 | 330 | 260 | 330 |
| Aquaculture production 1990 (metric tonnes) | 150 | 100 | 1200 | 130 | 1500 |
| Current production (metric tonnes) | 300 | 500 (?) | 1200 | 1530 | 8600 |

Cameroon (Central Africa) has a long history of aquaculture development projects ranging from sub-Sahelian to rainforest systems, involving, *inter alia*, France, United States, UNDP and World Bank financing.

Côte d'Ivoire (West Africa) has a long history of involvement in a wide range of aquaculture development assistance projects from small-scale to commercial.

Kenya (East Africa) has also initiated a number of aquaculture development projects with, *inter alia*, US, British and Belgian financing. In addition, Kenya was the test site for a recent FAO project to develop an impact monitoring and evaluation tool.

Zambia was a primary research and extension site for the long-running Aquaculture for Local Communities (ALCOM) Programme for Southern Africa. In addition, WorldFish and Peace Corps have active projects in this country.

Madagascar, located off Southern Africa, was the location of an FAO hatchery-led aquaculture development project aimed at introducing rice-cum-fish culture into irrigated rice fields of the central plateaux.

# 2. Country Reviews

In each country, a locally recruited extension specialist (Table 1) was hired to produce and forward the necessary information and available extension materials to the WorldFish Center office in Cameroon where a local consultant, Dr V. Pouomogne of the Institute of Agricultural Research for Development (IRAD), reviewed their findings and prepared this synthesis. Information of history, structure, approach and performance of the aquaculture extension services in each country were tabulated in Tables 3 to 5. Summaries of the reports are presented in Annexes 1 to 5.

## 2.1 History of aquaculture development

Small-scale fish farming in sub-Saharan Africa is a rather recent activity. Apart from Madagascar where traditional water management for aquaculture began in the 18th century under the reign of King Andrianampoinimerina, the effective start of aquaculture in most of sub-Saharan Africa was in the 1950s under the impetus of the various colonial administrations. Most of these were aimed at colonial landowners for the production of sport or food fish to supplement the diets of plantation workers. Some efforts were being made to popularize fish farming in the years just prior to independence.

After independence, these new aquaculture initiatives suffered a long period of decline, of one to several decades, depending upon the country. In general, newly independent governments did not give aquaculture a very high priority. Virtually all new activities in the sector were initiated by foreign donors and depended upon international financing. Many of these were generalized, regional initiatives, based on theoretical approaches and designed with little or no input from national governments. For example, the Food and Agriculture Organization of the United Nations (FAO) established a number of experiment stations and model farms in the early 1970s, the United States Peace Corps put aquaculture volunteers in many countries, while the World Bank Training and Visit (T&V) extension approach (including aquaculture) was being widely implemented.

Despite the recognized failure of the majority of these foreign-led development projects to produce sustainable development of the aquaculture sector, many lessons have been learned. In some cases, most notably Cameroon, Madagascar and Zambia, new strategies based on the concepts of community management, participatory research and development, farmer field schools, etc. have evolved. A summary of the major steps leading up to this transformation is shown in Tables 3 and 4.

For nearly all the states, aquaculture remains today a minor priority amidst what are perceived as more burning issues such as public health and education. None of the countries reviewed currently has a formal, long-term plan for the development of the sector.

However, Africans rely heavily on fish as an important source of animal protein. Until recently, the abundant capture fisheries have managed to keep pace with growth in demand. Only in the last decade has population growth and decline of capture fisheries created the situation where demand now significantly outstrips supply, creating the market conditions crucial for the development of aquaculture. In light of this, many countries are now in the process of laying out strategic development plans for aquaculture.

**Table 3.** Historical summary of freshwater aquaculture extension in five countries of sub-Saharan Africa.

| | **Cameroon** | **Côte d'Ivoire** | **Kenya** | **Madagascar** | **Zambia** |
|---|---|---|---|---|---|
| Start | 1948: first dam built in Yaoundé<br>1954: 22 government fish culture stations | 1958: Société d'Assistance Technique pour la Modernisation de l'Agriculture en Côte d'Ivoire | 1900: some trials by colonial farmers<br>1952: small-scale native fish farmers project | 1794-1810: the King studies integrated agriculture-aquaculture<br>1952: 42 public fish stations | 1943: first six ponds constructed in Chilanga under colonial administration |
| Development Phases | 1952-60: pilot projects under colonial authority<br>1960-70: period of decline following independence<br>1970-90: many foreign-funded projects<br>1990: beginning of participatory approaches<br>2000: increase in private investment driven by rising fish prices | Similar to Cameroon with a strong small-scale, commercial focus as from 1970 | 1920: all ponds owned by colonials<br>1940: land reform policy transfers ponds to Africans<br>1960: Eat-more-fish campaign to encourage small-scale producers in Centre & West<br>1970s decline due to poor extension | 1952-62: same as Cameroon<br>1962-79: decline due to low interest of government in spite of aquacultural tradition<br>1979-92: many projects; success on private fingerlings producers establishment<br>1992-present: continued steady growth of the sector | Before 1980: low adoption due to top-down approach<br>1980-95: community based, participative approach started<br>1995-present: steady growth of the sector |
| Range of Development Projects & Donors | Twelve major projects since 1969; FAO, Peace Corps, OXFAM (UK), World Bank, Japan, IDRC, European Union, USAID, DFID | Two major World Bank projects; numerous smaller interventions mostly led by France | Many private investments; major national projects funded by Belgium, USAID, FAO | Six large FAO and/or UNDP projects; private investments in oysters, macroalgae and shrimp | Many small relief projects aimed at Zimbabwe war refugees; nine major development projects; FAO, UNDP, Africare, IFAD, Peace Corps |
| Main Achievements | About 6 000 small-scale farmers, producing 250 t.<br>Functioning extension training programme.<br>Farmer groups evolving and growing in number.<br>Some larger-scale farms starting up | Small-scale production of ± 500 t.<br>Development of medium-scale commercial tilapia and catfish (*Chrysichthys*) farms in coastal lagoons | >5 000 small-scale farmers, producing 1 200 t<br>Commercial tilapia and trout culture spreading | About 42 000 rice-cum-fish farmers producing 2 500 t.<br>Total aquaculture production of more than 9 000 t.<br>More than 60 private carp hatcheries well established<br>Crayfish commercial farms (2 000 t.) under development. | About 6 000 farmers, producing 6 000 t<br>Steady development of small-scale tilapia farms<br>One large-scale private farm (Kafue Fish Company) |

| **Table 4.** Major aquaculture development projects from 1980 to present in five countries of sub-Saharan Africa. | | | | | |
|---|---|---|---|---|---|
| **Country** | **Period** | **Funding (US$)** | **Foreign Implementing Agency** | **Main objectives** | **Performance/ Sustainability** |
| **Cameroon** | 1980-1984 | USA | Peace Corps | Training extension staff; small-scale aquaculture | Poor |
| | 1987-1992 | Netherlands; 260 000 | Haskoning Consultants | Station construction at Lagdo; develop technology for floodplain aquaculture (tilapia-clarias, rice-fish) | Poor |
| | 1987-1991 | International Development Research Centre (Canada); 400 000 | Consultants | Integrated aquaculture research & extension (tilapia-clarias, poultry, pigs) | Average |
| | 1991-1995 | Agence Générale de Coopération pour le Développement (Belgium); 450 000 | Catholic University (Leuven) | New species for aquaculture; freshwater fish inventory | Poor |
| | 1988-2000 | USA | Peace Corps | Participatory technology development (tilapia) | Average |
| | 2000-2003 | Department for International Development (UK); 1 500 000 | WorldFish Center | Aquaculture development; participatory research | On-going |
| **Côte d'Ivoire** | 1981-1993 | European Union loan; 15 356 000 | SEPIA International (French Consulting Firm) | Infrastructure development (hatcheries); pilot tilapia farm, artisanal lagoon demonstration farm | Poor |
| | 1991-2001 | Fonds d'aide et de Coopération (France); 2 400 000 | Association Française des Volontaires du Progrès/Association Pisciculture et Développement Rural (French NGO) | Small-scale commercial aquaculture | Concrete results in term of production; Promising |
| | 1992-1996 1997-2002 | Agence Française de Développement /African Development Bank loans; >100 000 000 | ? | Rural development, including fish farming | On going, but poor partial results |
| **Madagascar** | 1984-1987 | UNDP; 800 000 | FAO | Training, equipment, extension; rice-fish integration | Good, continued next |
| | 1988-1993 | UNDP; 1 300 000 | FAO | Privatization of common carp fry production; extension support for rice-fish integration | Good, continuous increase in fish production |
| | 1988-1991 | UNDP; 1 100 000 | FAO | Technology development (shrimp); training | Average |

| | | | | | |
|---|---|---|---|---|---|
| | 1997-2002 | Japan<br>? | Japanese International Cooperation Agency | Shrimp culture; training artisanal farmers | On-going |
| | 1996-2002 | European Union<br>? | Centre d'Information Technique et Economique de Madagascar (International Consulting Firm) | Algae culture; training artisanal fishermen | On-going<br>Average partial outcomes |
| **Kenya** | 1983-1993 | UNDP/FAO/Agence Générale de Coopération pour le Développement (Belgium);<br>1 000 000 | FAO | Training; hatchery design and construction; extension in the Lake Victoria Basin | Poor |
| | | USAID | Pond Dynamics/Aquaculture Collaborative Research Support Program | Aquaculture technology | Average |
| | 1980-1990 | Private | Consultants | Commercial fish farm | Poor |
| **Zambia** | 1980-1989 | UNDP/Netherlands | FAO | Integrated fish culture systems<br>Fingerling production<br>Training | Average |
| | 1987-1993 | Swedish International Development Agency | FAO/Aquaculture for Local Communities (ALCOM) | Extension methodology<br>Pond management | Good |
| | 1981-2002 | Japan | Japanese International Cooperation Agency | Seed production, feed mill | Average |
| | 1983-1989 | UNHCR/USA | International Conference on Assistance to Refugees in Africa | Assistance to refugees in pond building and management | Poor |
| | 1992-1995 | UNDP | AFRICARE (International NGO) | Pond management<br>Credit to farmers | Average |
| | 1988-2002 | Norwegian Agency for Development | Norwegian Agency for Development | Extension, participative approach | Good |
| | 1995-2002 | Partial funding from local government | FAO/ALCOM & Consultants. | Participatory extension under several names: aquaculture sector investment plan, smallholder aquaculture plan, rural aquaculture programme, integrated aquaculture irrigation | Promising |
| | 1998-2002 | Private sector | Consultants | Commercial farms | Promising |
| **General comments** | Early 90s was a poor period for aquaculture in Africa. | Relatively large funding for Côte d'Ivoire and Madagascar. | Long-term commitment by UNDP/FAO is a key component of success in Madagascar. | Promising outcomes appear to derive from projects focusing on extension approaches (Zambia, Côte d'Ivoire) and seed production strategies (Zambia, Madagascar) | More emphasis on lasting impacts needed in project design. |

**Table 5.** Institutional structure and current extension approach in five countries of sub-Saharan Africa.

| | **Cameroon** | **Côte d'Ivoire** | **Kenya** | **Madagascar** | **Zambia** |
|---|---|---|---|---|---|
| Ministry in Charge | Ministry of Animal Husbandry and Fisheries; Ministry of Agriculture | Ministère de l'Agriculture (MINAGRA) | Ministry of Agriculture & Rural Development | Ministère de la Pêche et des Ressources Halieutiques | Ministry of Agriculture, Forestry and Fisheries |
| Main Extension Organism | Programme National de la Recherche et la Vulgarisation | Agence Nationale de Développement Rural (ANADER) | Fishery Department | Programme National de Vulgarisation Agricole | Agriculture Research & Extension Project |
| Current Main Alternative Service Provider(s) | Institut de Recherche pour le Développement (WorldFish Center) | Association Pisciculture et Développement Rural (APDRA) | Moi University & local NGOs | Local NGOs | Participatory Extension Systems (FAO); Rural Aquaculture Extension Promotion (Peace Corps) |
| Structure | • National coordinator PNVRA<br>• Provincial coordinator<br>• Subject matter specialists<br>• Area Extension Agent<br>• Contact farmer<br>• Farmers | • National coordinator ANADER<br>• Regional MINAGRA and ANADER offices<br>• Farmers | • Director of Fisheries<br>• Sub-Director for Aquaculture<br>• Assistant Director (by region)<br>• District Fisheries Officer<br>• Fisheries Officer<br>• Fisheries Assistant<br>• Farmers | • Technical Director with 3 cells (training, extension, monitoring & evaluation)<br>• Provincial<br>• Sub–provincial<br>• Zone or brigade<br>• Private fingerling producers<br>• Rice-cum-fish farmers | • Permanent Secretary<br>• Senior Field Services Coordinator<br>• Senior Fisheries Officer (province, district)<br>• Aquaculture extension officer<br>• Camp officers<br>• Farmer Motivators<br>• Farmers |
| Approach by the Main Extension Institution | T&V | T&V / Promotion of commercial units (pilots) | T&V / Aquaculture Demonstration Centres | T&V / Heavy funding, good practical training, close contacts with private fingerlings producers | T&V / Participatory |
| Alternative Approaches being Investigated | Farmer Scientist Research Partnership (WorldFish Center) | A number of participatory research projects (esp. APDRA) | Various participatory approaches. | Groupes de Travail pour le Développement Régional; heavily bureaucratic. | Farmer Field Schools |
| Place of Aquaculture | With animal husbandry, forestry & agriculture | With forestry & agriculture | With agriculture & wildlife | Independent Ministry | With agriculture & forestry |
| Ratio fish farmers: extension agents | 600 | ? | 64 | 1 200 | 800 |

## 2.2 Current structure and approach

The current institutional structure for aquaculture extension is very much top-down with often long chains of bureaucracy linking policy makers, research and technology users (Table 5). This arrangement results in the loss of much important technical information going from research to farmers, as well as misinterpretation of the needs and constraints of farmers on the part of policy-makers. On the other hand, some progress has been made in terms of clearer job descriptions for the various levels within the bureaucracy and more transparent and efficient administration of resources.

In addition to being heavily bureaucratized, the orientation of extension is still driven by development goals derived with minimal user consultation. Most countries still use a variation of the World Bank Training and Visit (T&V) approach wherein researchers attempting to meet national fish production targets develop technology that seeks primarily to maximize fish production as opposed to meeting the personal development goals of farmers. Research releases its findings in the form of written documentation that is not directly accessible by either extension agents or farmers. The information transmission system is consequently poor both in delivering knowledge of key constraints and development objectives to policy makers, and the delivery of technical information about production systems and markets to farmers. Overall, the achievements of the T&V model in Africa have been negligible in terms of both fish production and numbers of farmers.

A key problem appears to be the low level of support to field technicians, those front-line staff in direct contact with farmers. Extension is regarded as an entry-level position and a testing ground for new recruits. Typically, young people come from two-year technical training schools and are put into the field. Agents who perform well are rapidly moved, first to research and eventually into administration. This leaves only newer recruits and those who performed too poorly to be promoted in what might arguably be the most difficult development task of all.

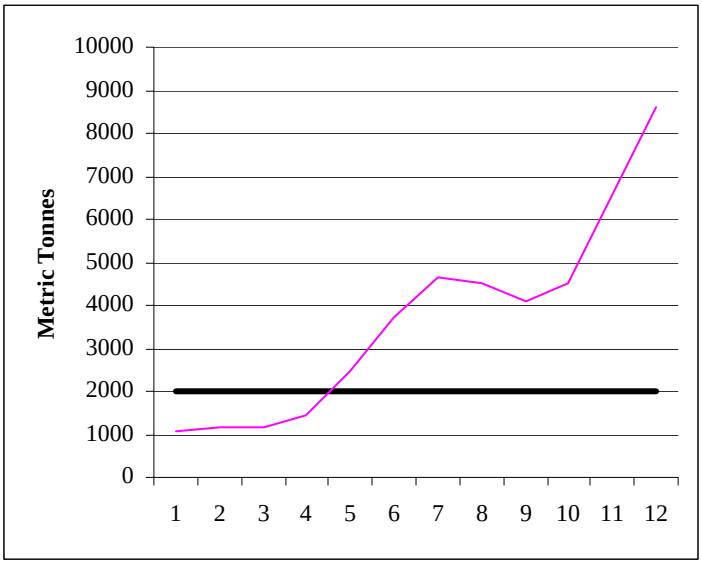
High quality human resources in the field are especially critical to the proper functioning of the T&V system, and this probably accounts for its very low success rate. For an approach such as the T&V system, which is based on adapting technological packages designed by research, field technicians require high levels of training in order to flexibly manipulate general principles to fit specific on-farm situations. Unfortunately, the time and resources needed to ensure the quality of field staff are lacking in most of the countries reviewed.

## 2.3 Lessons from success

The development status of the countries reviewed is similar. In addition to the lack of political stability and infrastructure that plagues all sectors, the most important constraints to aquaculture growth were identified in the national reviews as:

- Inadequate inputs (lack or high cost of feeds)
- Shortage of fingerlings
- Weak research and extension
- Poor market development

**Figure 1.** Steady increases in production over a 15-year period of encouraging aquaculture development through a range of participatory extension approaches.




As these problems are broadly similar to those in most of the rest of sub-Saharan Africa, lessons learned by one in overcoming constraints might be applicable to many others. While lessons about general approach might be gleaned from failures, more specific guidance might be had from a review of successes.

A notable exception to the general failure of aquaculture development projects comes from Madagascar where a long-term commitment from donors and large investments in fieldwork have paid off with substantial increases in fish and sustained involvement of the private sector. The Food and Agriculture Organization of the United Nations (FAO) and the United Nations Development Programme (UNDP) were directly involved in Malagasy fish farming from 1984 through 1991. The focus of a series of projects was the transfer of responsibility for fingerling production and extension from government to the private sector.

Training was concentrated on private hatchery owners, not only in reproduction technology, but also in food fish production. This enabled the hatchery operators to expand their markets and profits by encouraging and assisting their neighbours to go into fish farming. Aquaculture is now growing and, meanwhile, the government has gone largely out of the fingerling business. Instead, they are concentrating on the much smaller and more manageable tasks of transferring new knowledge to a limited number of better-educated hatchery owners.

In some other countries, most notably Cameroon, Côte d'Ivoire and Zambia, various agencies have been successfully experimenting with other new approaches to aquaculture extension (Figure 1). In Côte d'Ivoire, these efforts are being led by NGOs, while in Cameroon and Zambia, international donors are working in conjunction with local government. In both institutional arrangements, the primary objective is to create systems that will more effectively move information from farmers to policy-makers and from researchers to farmers.

What these new approaches have in common is the direct involvement of farmers in the process of priority setting and choice of technology. In Côte d'Ivoire and Zambia, a range of participatory techniques are being used to stimulate local communities towards independent thinking and action with aquaculture as one of several technological options available for use by farmers who wish to diversify their agricultural enterprizes. These efforts are led by general agriculture practitioners and experts in extension and/or participatory methods.

In Cameroon the main theme is research-led development. senior scientists from the Institute for Agricultural Research for Development are leading small teams of two to three extension agents in participatory on-farm research projects. Farmers and researchers work together to identify key constraints and design experiments that will adapt current aquaculture technology (contributed by research) to the reality of the farming system (contributed by farmers). Extension agents gain significant and important training in both technology and participation, researchers gain an appreciation of the real constraints facing farmers, and farmers gain access to the best available knowledge on fish culture.

One lesson from all of these approaches is that "quality extension" does not simply mean that technicians have adequate technical training (although even this is generally lacking). Also important are the skills necessary to overcome cultural barriers and communicate effectively with farmers who have important knowledge and social standing, even if they are uneducated and illiterate. Part of this is mastery of the technology, but participatory research approaches might also permit technicians with less technical capacity to engage in joint learning exercizes that advance the knowledge of both purveyors and anticipated recipients of technology at the same time. The key lesson here seems to be that participation is more than the process of designing policies and projects. It is of crucial importance that the capacity of field workers to be participatory is strengthened.

Foreign donors have always played a key role in initiating aquaculture development and remain essential if research and extension are to focus on the rural poor. However, the crucial role of the private sector, particularly in commercial fingerling production, cannot be underestimated. Government hatcheries have uniformly failed to meet demand for high quality seed. As the success of carp culture in Madagascar demonstrates, government and the private commercial sector can cooperate to mutual advantage.

# 3. Review of extension tools

Nearly 60 extension books, pamphlets, fliers, brochures, etc. were reviewed. Each is briefly summarized below, in chronological order, either by country when produced there or in a general category when produced elsewhere but used in at least one of the countries.. These extension tools were of two general types: those aimed directly at farmers and those aimed more at extension agents. Both tend to be technical in nature attempting to generalize aquaculture technology according to the perceived needs of policy-makers and researchers.

In addition, some extension tools are not printed, but take the form of radio or television programmes. A number of radio and television stations carry agricultural messages, including aquaculture. We were not able to review these, but they were mentioned as important tools in the country reviews and can be used to effectively convey a variety of technical and non-technical messages.

### 3.1 General

- Chakroff, M. 1976. Freshwater fish pond culture and management. Volunteers in Technical Assistance, Manual 36E, Washington, DC. 191 p.
  General aquaculture with line illustrations. Aimed at extension agents and educated farmers. The text covers most technical aspects of rural fish farming and management. Used by US Peace Corps.

- FAO & US Peace Corps. 1978. Simon élève des poissons / Simon grows fish. Guide de vulgarisation piscicole en Afrique / Guide to fish culture extension in Africa. Bangui, Central African Republic. 50 p.
  A nicely illustrated, bilingual (French/English) guide on fish farming. Accessible to the small-scale fish farmer. Focus on rural tilapia farming, with compost and low-density stocking. Out of print.

- FAO. 1978. Freshwater fish farming: how to begin. Better Farming Series, (27): 43 p. FAO, Rome, Italy.
- FAO. 1981. Water: where it comes from. Better Farming Series, (28): 31 p. FAO, Rome, Italy.
- FAO. 1981. Better freshwater fish farming: the pond. Better Farming Series, (29): 43 p. FAO, Rome, Italy.
- FAO. 1981.Better Freshwater fish farming: the fish. Better Farming Series, (30): 48 p. FAO, Rome, Italy.
- FAO. 1986. Better freshwater fish farming: further improvement. Better Farming Series, (35): 61 p. FAO, Rome, Italy.
- FAO. 1990. Better freshwater fish farming: raising fish in pens and cages. Better Farming Series, (38): 83 p. FAO, Rome, Italy.
- FAO. 1980. La pisciculture en eau douce: comment débuter. Série FAO: apprentissage agricole, (27): 43 p. FAO, Rome, Italy.
- FAO. 1983. L'eau: D'où vient l'eau. Série FAO: apprentissage agricole, (28): 31 p. FAO, Rome, Italy.
- FAO. 1984a. La pisciculture en eau douce: l'étang. Série FAO: apprentissage agricole, (29): 44 p. FAO, Rome, Italy.
- FAO. 1984b. La pisciculture en eau douce: les poissons. Série FAO: apprentissage agricole, (30): 48 p. FAO, Rome, Italy.
- FAO. 1987. La pisciculture en eau douce: amélioration de l'exploitation. Série FAO: apprentissage agricole, (35): 61 p. FAO, Rome, Italy.
- FAO. 1990. La pisciculture en eau douce: l'élevage des poissons dans des enclos et des cages. Série FAO: apprentissage agricole, (38): 83 p. FAO, Rome, Italy.

The FAO Better Farming Series are very well illustrated handbooks for extension agents and educated farmers. Topics covered include pond construction, harvesting, detailed information on water sources, pond site selection (topography, soil, water), water inlet and drainage systems, how soil type can influence water quality, compost, water fertilization, fish handling, fish reproduction, stocking density, pest control, etc. for tropical, earthen pond aquaculture.

- Martel, J., N. Narakas & M. Banza. 1984. Comment élever le *Tilapia nilotica*. Projet Pisciculture familiale, Département de l'Agriculture et du Développement Rural du Zaïre / USAID/Corps de la Paix. 62 p.
  An illustrated handbook with easy to understand technical advice on how to raise Nile tilapia. Very similar to "Simon élève des poissons" used in Cameroon. General information on integrated aquaculture-agriculture.

- Mutale, J.C., H.W. van der Mheen, J. van der Mheen-Sluijer & C.N.Kanoso. 1991. How to construct your fish pond. ALCOM Extension Pamphlets, (1): 32 p. Aquaculture for Local Community Development Programme FAO INT/436/SWE, Harare, Zimbabwe.
- Mutale, J.C., H.W. van der Mheen, J. van der Mheen-Sluijer & C.N.Kanoso. 1991. How to feed your fish. ALCOM Extension Pamphlets, (2): 39 p. Aquaculture for Local Community Development Programme FAO INT/436/SWE, Harare, Zimbabwe.
- Mutale, J.C., H.W. van der Mheen, J. van der Mheen-Sluijer & C.N.Kanoso. 1991. How to take care of your fish pond. ALCOM Extension Pamphlets, (3): 19 p. Aquaculture for Local Community Development Programme FAO INT/436/SWE, Harare, Zimbabwe
  Theses three bilingual pamphlets (English and Swahili), well illustrated, are designed for the typical African farmer. They respectively focus on pond construction, fish feeding, and routine care to the pond.

### 3.2 Cameroon

- Satia, B.P.N. 1980. Principes élémentaires de pisciculture. Tomes 1 à 3. Ministère de l'Elevage, des Pêches et des Industries Animales, Direction des Pêches. Yaoundé, Cameroun. Mimeo, 200 p.
  A practical course on fish farming in three A4-booklets, includes general information on fish farming and technical information from pond construction to harvesting. Focus is on semi-intensive pond farming of the four main cultivated species in Cameroon: *Oreochromis niloticus*, *Clarias gariepinus*, *Cyprinus carpio* and *Heterotis niloticus*. The content, in French, is dense and detailed, more designed for graduate students (A-level plus one to three years) than for fish farmers.

- CIFOR. 1994. Vers une pisciculture intégrée. Centre International de Formation en Milieu Rural, Bafoussam, Cameroun. 45 p.
  An easy to use booklet on integrated fish farming. The booklet covers different aspects of earthen pond fish farming of the usual species. The reliability of the information delivered is average. Improvement is needed, basically on the quality of the drawings.

- Breine, J.J. 1995. A guide to fish farming. CONTACT Hors série N°6, Centres Nationaux de Formation Zootechnique et Vétérinaire du Cameroun et l'Administration Générale Belge de la Coopération au Développement. 46 p.
  An illustrated guide to fish farming, produced for a Belgium-Cameroonian research project (1991-1995) and used at the government aquaculture training centre. Graduate technician level. Also available in French. Out of print.

- Pouomogne, V. 1997a. Fiche technique sur la Pisciculture en étang. Deuxième édition révisée et augmentée. Unité de recherche piscicole IRAD Foumban/Service d'appui aux initiatives locales pour le développement (SAILD), Yaoundé, Cameroun. 16 p.

Technical information on tropical pond fish farming. Aimed at farmers. Partially reproduced in the Farmer Technical Bulletin edited by SAILD (local NGO). This document lacks illustrations.

- Pouomogne, V. 1997b. Fiche technique sur la fertilisation organique des étangs. Projet FAC/CDI 95/CD/095 Développement de l'activité piscicole à Yemessoa. Centre d'excellence pour la production, l'innovation et le développement (CEPID)/IRAD Foumban, Cameroun. 19 p.
  Practical information on pond fertilization in tropical fish farming, The document covers different aspects of water management including liming, use of compost, manures to indirectly feed fish, how to integrate with poultry or pigs, etc. Few illustrations; graduate technician level.

- Peace Corps. 1998. Pisciculture intensive camerounaise (PIC). US Peace Corps-Direction des Pêches, Ministère de l'Elevage, des Pêches et des Industries Animales, Yaoundé, Cameroun. 119 p.
  A fish farmer handbook, usable by educated farmer leaders trained by the Peace Corps in Cameroon from 1990 to 2000. This document repeats all the information available in "Simon élève des poissons" (see above). It gives more advanced information for a better-educated fish farmer ending with a detailed list of addresses of all governmental services and NGOs capable of providing funding or help to the farmer in Cameroon in 1998. The document also tackles how to create a common initiative group and to use it as a tool for group development.

- Pouomogne V. 1998. Pisciculture en milieu tropical africain: comment produire du poisson à coût modéré (exemples du Cameroun). Coopération Française/CEPID. Presses Universitaires d'Afrique, Yaoundé, Cameroun. 236 p.
  This is a handbook providing current information on semi-intensive fish farming in Cameroon. An easy to use document, mainly by graduate level readers and educated fish farmers who are willing to pay for information.

- Pouomogne V. 2002. Guide technique pour la production de poisson d'eau douce en étang. FAO Special Programme on Food Security/ Institut de recherche agricole pour le développement, Foumban, Cameroun. 21 p.
  This is revision of Pouomogne,1997a with more illustrations. Designed for extension agents.

- La pisciculture progressive (Progressive fish culture). A very convenient newspaper entirely committed to fish farming, produced in 1993-1995.

- SAILD. La voix du paysan (The farmers' voice). Monthly; in French and English. This newspaper focuses on all matters of the rural development. It regularly publishes technical and economic data on fish farming and on the marketing of fish in Cameroon.

### 3.3 Côte d'Ivoire

- FAO. Kouadio élève des poissons: comment Kouadio a retrouvé la joie de vivre au village. Projet FAO-UNDP IVC/84/001 en collaboration avec la Direction de la Pisciculture et des Pêches, Ministère du Développement Rural, Abidjan, Côte d'Ivoire.

This is a set of 49 slides telling the story of a young man (Kouadio) who decides to raise fish after meeting an aquaculture extension worker and visiting a fish farm. Only the comments booklet attached to the film was available for review. An interesting tool to captivate potential farmers to be interested in fish farming providing a slide projector is available.

- Anonyme. Le calendrier de la pisciculture scolaire. Ministère du Développement Rural, Abidjan, Côte d'Ivoire. 7 p.
  This is an illustrated school calendar, presenting a timetable of fish farming activities (from stocking to harvesting and selling the fish). Aimed at school children. Illustrated with cartoons and includes a ready-to-fill form for data recording. In French.

- Nugent, C., G. Wambongo & J. Ban Gueu. La pisciculture rurale en images, No. 4: Petit poisson deviendra grand. Projet FAO-UNDP IVC/84/001 en collaboration avec la Direction de la Pisciculture et des Pêches, Ministère du Développement Rural, Abidjan, Côte d'Ivoire.
  A set of 74 slides, about a young boy (Bato) who caught one fingerling after a fishing party. Bato decided to put the fish back into water (in a big hole he dug) and to feed it every day for several months. Following his example, his school mates decide to raise fish too. The students dig ponds and produce many fish under the supervision of an aquaculture extension agent. Only the comments booklet was reviewed. Part of a series of four filmstrips.

- INADES-Formation. 1993. Guide du Pisciculteur: conduite d'une exploitation piscicole. Projet de Développement de la pisciculture en milieu rural. Institut africain pour le développement économique et social: Centre africain de formation, Cocody-Abidjan, Côte d'Ivoire. 48 p.
  General information presented in an easy to understand way for farmers. Very well illustrated. The book specifically shows how to construct ponds and raise fish, with a focus on economic management and accounting.

### 3.4 Kenya

- FAO. 1979. Ufugaji wa samaki katika maji matamu (Yasiyo na chumvi). (Fish Culture in freshwaters in Swahili).
  General rural fish farming from site selection to pond construction, management and harvesting in one of the major languages of Kenya. Not sent for review.

- INADES-Formation. 1982a. Fish farming manual (72 p.) and INADES-Formation. 1982b. Ufugali wa samaki (Swahili), 76 p. The African Institute for Economic and Social Development, African Training Centre, Nairobi, Kenya.
  Nicely illustrated texts giving additional information on fish farming as an agro-business, focusing on economic aspects and record keeping. Similar to the French version used in Côte d'Ivoire (see above).

- Murnyak, D. & M. Murnyak. 1990 (English) and 2000 (Swahili). An elementary guide to fish farming in Kenya. Kenya Fisheries Department, Nairobi. 50 p.
  Similar to the Agrodok Series from CTA, this is a very well illustrated manual (pictures and drawing) providing general technical information on warm and cold freshwater

aquaculture and on marine fish farming in Kenya. It is designed for use by aquaculture technicians and advanced farmers.

- Campbell, D., S. Obuya & M. Spoo. 1995. A simple method for small-scale propagation of *Clarias gariepinus* in Western Kenya. LBDA/FAO Support to Small-Scale Rural Aquaculture in Western Kenya. Project FAO TCP/KEN/4551. Field Document No.2. FAO, Kisumu, Kenya. 27 p.
  This report focuses on small-scale production of catfish fingerlings using semi-artificial techniques and minimal equipment and facilities. Designed more as a research report than an extension guide, it is of limited use to extension and farmers.

- FAO. 1995a. The problems encountered and recommendations for the operation of revolving credit funds for small-scale fish farmers. Field document No.2. Project FAO KEN/86/027. FAO, Kisumu, Kenya. 37 p.
  This document reports on the experience gained from an aquaculture credit project. Bankers and donors engaged in rural development will learn interesting things such as: extension agents should not be at all involved in credit repayment, and credit should be given only to internally cohesive groups (neighbours, traditional friends or religious brethren, etc.) of 6-10 members.

- FAO. 1995b. The impact of the field-day extension approach on the development of fish farming in selected areas in Western Kenya. Field document. Project FAO TCP/KEN/4551. FAO, Kisumu, Kenya. 26 p.
  The document focuses on the impact of field-days on development of fish farming. It stresses field-days as a cheap way to train farmers and stimulate farmer-to-farmer exchange of information. An interesting document for planning and policy-makers.

- van Eer, A., T. van Schie & A.D. Hilbrands. 1996. Small-scale freshwater fish farming. Agrodok 15, Agromisa/ Technical Centre for Agricultural and Rural Co-operation (CTA), Wageningen, The Netherlands. 74 p.

- Hilbrands, A.D. & H.C.A. Ijzerman. 1998. On-farm fish culture. Agrodok 21. Agromisa/ Technical Centre for Agricultural and Rural Co-operation (CTA), Wageningen, The Netherlands. 67 p.
  More recent guidelines on pond construction and management for the basic culture species. Topics include: site selection, pond construction, natural fish food, rice-cum-fish-culture and pond fertilization. More accessible to technicians than to typical fish farmers, they are a little less illustrated than documents from INADES-formation (see above).

### 3.5 Madagascar

- Anonyme. 1989. Bande dessinée «Rizipisciculture» sur les hautes terres malgaches. «Mamokara trondro». Project UNDP/FAO MAG/88/005. FAO, Madagascar. 17p.
  This document is presented in the form of a typical cartoon. It tells the story of a rice farmer, who decides to rear fish in his rice field. His neighbour, M. Radera, introduces him to the local extension technician, Paul, who provides the necessary advice to be successful with his project. M. Manantsoa, a nearby private fingerling producer provides the necessary common carp fingerlings.

- Lardinois, P. & J. Janssen, 1990. Première partie. Etude de faisabilité d'une station privée de production d'alevins de carpe. Etude fictive. Projet UNDP/FAO MAG 88/005. Document technique no. 1. FAO, Madagascar. 37 p.
- Lardinois, P. & J. Janssen, 1992. Deuxième partie. Etude de faisabilité d'une station privée de production d'alevins de carpe. Etude réelle. Projet UNDP/FAO MAG 88/005. Document technique no. 2. FAO, Madagascar. 50 p.
  This is a feasibility study for a private fingerling production station in Madagascar. In a very detailed and exhaustive presentation, the authors go over the importance of market studies, technical set up, management design, and financial analysis. Aimed at commercial investors.

- Anonyme. 1993a. Manuel sur la boîte à images "Rizipisciculture": amélioration de la technique rizipiscicole. Projet UNDP/FAO MAG/88/005. Document technique no. 7. FAO, Madagascar. 19 p.
- Anonyme. 1993b. Manuel sur la boîte à images "Pisciculture": amélioration de la technique piscicole. Projet UNDP/FAO MAG/88/005. Document technique no. 8. FAO, Madagascar. 22 p.
  These are "how-to" guides in the form of 30x40 cm drawings illustrating how a malagasy family could improve their standards of living by following step by step technical directions for fish farming in rice fields (a) or in ponds (b). These booklets are very detailed but understandable for most any literate reader. However, they are primarily designed to assist extension technicians to efficiently communicate with farmers about improved fish farming techniques.

- Anonyme. 1993c. Intégration de l'activité piscicole dans les systèmes de production chez quelques producteurs privés d'alevins dans les régions du Vakinankaratra et du Betsileo. Projet UNDP/FAO MAG/88/005. Document techique no. 11. FAO, Madagascar. 63 p.
  This is a socio-economic study analysing the main features of a typical fingerling producer in Madagascar. He is a healthier fellow comparatively to other farmers, more open minded and ready to benevolently serve his neighbours. Often, these people have experience in other regions of the country and have made money on other enterprises, returning to his/her native region with capital and conviction. The study thus concludes that in the context of aquaculture extension and development in Madagascar, fingerling production should be focused on motivated farmers who show a willingness to share knowledge and a strong desire to improve their standard of living.

- Avalle, O. 1991. Manuel pratique pour l'élevage de *Penaeus monodon* en bassin. Projet UNDP/FAO MAG/88/006. Rapport de terrain no. 9. FAO, Madagascar. 52 p.
- Avalle, O. & R. Randriantomponiony. 1994. Manuel d'écloserie. Projet UNDP/FAO MAG/88/006. FAO, Madagascar. 43 p.
  These technical documents provides practical information on production of shrimp in ponds and post larvae in a modern hatchery. Details are given on semi-intensive earthen pond management as well as on hatchery fresh and marine water management, maturation, spawning of breeders, egg collection, incubation, hatching, larval rearing, nursing, artemia and algae production units. Aimed at educated shrimp farm and hatchery managers.

- Rakotomanantsoa, S. & J. Jansen. 1994. Manuel sur les diaporamas rizipisciculture et pisciculture : amélioration des techniques rizipiscicoles. Programme sectoriel pêche. Projet UNDP/FAO MAG/92/004. Document technique no.1. FAO, Madagascar. 24 p.

This booklet is presented in the same way as the «Boîte à images» (see above), synthesising fish farming in rice fields and in ponds. Three farmers are involved in the story: M. Radera, a successful farmer in applying improved methods, M. Rakoto, a farmer discouraged by poor results from his traditionally managed ponds and M. Manantsoa, a private fingerling producer. The document is aimed at fish farmers and is designed to illustrate the advantages of new technology.

- van den Berg, F. & J. Janssen. 1994. Manuel pour le développement de la rizipisciculture à Madagascar, Tome 2: marketing et gestion financière d'une micro-entreprise de production d'alevins en milieu rural. Programme sectoriel pêche. Projet UNDP/FAO MAG/92/004. FAO, Madagascar. 88 p.
  The document, simple, concise and well illustrated, exposes on marketing, passive and active extension, sales campaigns, communication techniques and efficient use of audio-visual materials, farm management and accounting. Aimed primarily at private hatchery operators, the language used is simple and at the level of any average 0-level reader. The document could also be of interest to farmers, extension technicians, and could even serve as a tool for broader training at the regional level.

### 3.6 Zambia

- FAO, 1987a. Manual for fish farming production units in schools. FAO Technical Cooperation Programme. FAO, Lusaka, Zambia. 21 p.
  The book presents general knowledge on pond construction and integrated tilapia farming (*Oreochromis andersonii*) with ducks, pigs or chickens. Interesting data are made available in the book, but important detail is lacking.

- FAO. 1987b. Integrated fish farming in Zambia. FAO Technical Cooperation Programme in Zambia. FAO, Lusaka, Zambia. 7 p.
  A set of 46 slides focusing on fish-cum-duck farming. Only the comments booklet attached to the film was available. An interesting tool designed for emerging fish farmers.

- FAO, 1991. Fish farming in Zambia: training programme for agriculture extension officers. Guidelines. FAO Technical Cooperation Programme. FAO, Lusaka. 39 p.
  A set of six chapters providing general knowledge on fish farming, from pond construction to farm economics. Designed for graduate technicians. Similar to the FAO technical series.

- NORAD 1995. Guidelines of basic fish culture extension services in Northern Province of Zambia. Northern Province Fish Culture Development Project. Ministry of Agriculture, Food and Fisheries, Department of Fisheries, Lusaka. 62 p.
  Flipcharts and posters on fish farming to be used by serious extension agents to better communicate with serious professional fish farmers. The document is of high pedagogic quality and may serve as a reference, whatever the extension approach adopted.

- Peace Corps. 1998. How to raise *Tilapia nilotica*: a guide to fish farming in rural areas. Zambia Aquaculture Project & Peace Corps, Lusaka, Zambia. 100 p.
  A book providing detailed information on fish farming. Presented in a pedagogic way, with review questions at the end of each chapter. An interesting tool for educated farmers desiring practical knowledge on the subject. Similar to Martel *et al*. (1984) used in Côte d'Ivoire, but with fewer illustrations.

- WWF. 1999. Fish conservation: a teacher's reference book. Zambia Education Project Document. World Wide Fund for Nature, Lusaka, Zambia. 36 p.
  The book presents general information on fish biology, pond fish farming and sustainable methods of capturing fish from the wild. The document is designed for lecture to lower level college students. Below average quality; too general for actual fish farmers.

### 3.7 Analysis and recommendations

Many of the documents reviewed have been in use for many years and are widely available throughout Africa. Most of these are technical documents aimed primarily at extension agents, acknowledging the generally low quality of training and support provided to aquaculture extension in Africa. The best of these are produced by international agencies, particularly those generated by the series of UNDP/FAO projects in Madagascar and by FAO headquarters in Rome. Other examples of high quality tools are those produced by INADES-Formation, the Agromisa/CTA Agridok Series and the NORAD project in Zambia.

To include farmers in the target audiences, efforts have been made to incorporate good pictures, posters, videos, slides and films in the repertoire of extension tools. However, these are expensive and sometimes rely on technological infrastructure (e.g. slide projectors), limiting their usefulness in rural Africa. In addition, international projects are often the only initiatives with sufficient financial resources to produce such tools and when projects end, little or no effort is made to continue to update or disseminate them.

That so many aquaculture projects have identified the inappropriateness of existing (general) tools for their particular target farmers reflects the high levels of variability among farmers that render highly generalized approaches of limited use: sometimes good at encouraging adoption, but poor at guiding problem-solving adaptation of technology.

Technical documents that attempt to describe how a system will perform under particular circumstances, tend to rely on technology packages that extension agents and farmers attempt to memorize. These packages describe experiment station results conducted under idealized conditions, so farmers must expect results that differ significantly from the package. Small-scale farmers, particularly in rain-fed areas, are accustomed to variability but they also expect their extension agents to be able to interpret this variability and give specific answers for a specific situation. Farmers have this kind of ability, gained through years of practical experience. This sort of knowledge is, however, very difficult to write down succinctly and is almost never available to extension agents with limited field experience.

Another type of general extension manual does not deal with technology at all, but rather focuses on the process of doing extension. If these guides take local cultural mores and the motivation of farmers into consideration, then they can be more broadly useful than the technical bulletins. However, these "how-to" manuals generally fail to deal with the basic problem faced by extension: farmers want specific answers to specific questions and these questions are usually technical in nature, involving quantitative phrases such as How much? How long? How big? In the absence of an extension service that incorporates the knowledge gained through experiential learning over the course of extensive field experience, these types of questions are very difficult to answer and cannot be derived from even the longest and most participatory discussion if no one in the group has ever weighed a fish.

Our review of the available extension documents in five countries has revealed a large gap: specific technical documentation that can take into account the large variation among farmers in terms of land, soil, water and human capacity. We imagine that such a document could only be usefully produced at a very local level.

A more general approach might be to combine the technical and process approaches into a process of guided experiential technical learning, such as the participatory research systems currently being tested in Cameroon and Côte d'Ivoire. Such an approach combines the generalized process approach to adapt generalized technology to specific situations. In effect, a guide to the process of gathering the needed technical data to answer farmers' questions.

# 4. Conclusions

As the predominant research/extension paradigm in sub-Saharan Africa, the T&V approach must be considered the baseline against which to compare and contrast newer approaches. The T&V approach relies heavily on good quality and properly equipped extension staff that can transfer technical information generated at research stations or universities to poorly educated farmers. These extension agents must be able to read technical journal articles and then condense the key elements based on personal experience with local farm conditions into information packages that are understandable by farmers. Unfortunately, this critical component of the system is usually lacking or available only for short periods of time while donor-supported projects are fully functional. Only a complete reform of the extension service that would substantially improve remuneration packages and reward extension agents for success by promoting them within the field of extension rather than moving them up and away from contact with farmers is likely to render this system functional. Cosmetic alterations based on short-term, in-service or overseas training have made no fundamental changes to the productivity of aquaculture extension.

On the other hand, progress has been made in several countries based on a re-structuring of the relationship between research, extension and farmers. In Madagascar, instead of attempting to directly assist large numbers of small-scale rice farmers to add fish, attention was focused on a much smaller number of individuals who (i) had some experience with aquaculture; (ii) had some education and capital assets; and (iii) were interested in assisting their fellow farmers. Working with these individuals was much easier and more effective because the number of extension agents could be effectively reduced and those remaining better trained and equipped. With this approach, both numbers of farmers and production per farm has increased, albeit at the cost of a relatively long-term commitment from external donors.

In Zambia, a longer-term commitment to participatory development paradigms has paid off in terms of steady, if not staggering, progress. Without large training or equipment budgets, highly generalized and relatively simple technology was easier for extension agents and impoverished farmers to implement. This focus on process rather than technology is now coming to the fore in many countries. However, most of the gains have been in terms of numbers of farmers, each of whom produces relatively few fish with minimal overall impact on national poverty alleviation and food security objectives.
A third approach that has shown promising results in Cameroon is based on the adaptation of more advanced technology to increase both adoption and yield, while remaining within the national budget. In this system, researchers who normally concentrate on controlled

experiments and journal articles, are attached to small teams of extension agents who carry-out participatory trials and/or experiments aimed at adapting aquaculture to fit specific farming situations. Rather than working with farmers to comprehend complex systems and then adopting them wholesale, participatory research is evolutionary and comes up with a slightly different technology for each farm. This approach can be highly flexible and usable under a wide range of conditions[2]. By enlisting the direct engagement of researchers, the cost of the overall extension system is somewhat higher, but only marginally so when compared to the low cost-effectiveness of the T&V system currently in place.

**Key issues for aquaculture development planning**

Based on our review of national aquaculture extension programmes, a number of key issues have been identified that should be considered when planning aquaculture development:

- Accurate and current information on aquaculture technology should be available to research and extension. Libraries and information access are crucial components.
- General extension materials have limited usefulness for extension. More illustrations make them better for farmers, but the emphasis should be on adaptation of technology rather than memorization.
- If credit is a constraint, commercial bankers and/or local credit agencies should be enlisted as partners; extension *per se* should not be engaged in allocating or monitoring credit.
- Research should be actively engaged with both farmers and extension agents to ensure that (i) research relevant to user's needs is being conducted and (ii) the best available information and technology are made available to farmers.
- Experiential learning and participatory methods can be effectively used to improve the adoption of technology and should be compared for cost-effectiveness.
- Rural development is good for business and opportunities should be found to link the private sector with public development goals.

[2] For more information see: Brummett, R.E. 1999. Integrated aquaculture in sub-Saharan Africa. Environment, Development and Sustainability 1(3/4):315-321 ***and*** Brummett, R.E. & Williams, M.J. 2000. The evolution of aquaculture in African rural and economic development. Ecological Economics 33:193-203.