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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: 39-6-5225007 /Telex: 610181 FAO I/Fax: 39-6-52253020*

## Contents



## EDITORIAL

### *Aquaculture Statistics: Neglected by Fisheries and Agriculture*

*The need for more reliable and comprehensive statistics on aquaculture was emphasized in a thorough review of the state of world aquaculture prepared by FAO in 1995. While it was acknowledged that the FAO aquaculture production statistics in terms of weight and value had improved during the last ten years, various problems with these statistics and shortcomings with regard to the lack of other data were identified. Among the problems identified was the definition of aquaculture and the difficulty of distinguishing aquaculture (farming) from capture fisheries (hunting) due to increasing human intervention in ecosystems to maximize yields of commercial species (see article in this issue by Dr Robin Welcomme). Another was the lack of statistics specific to inland capture fisheries (i.e. excluding aquaculture), as FAO holds statistics on total production from inland fisheries for 1950-1994 and aquaculture statistics only for 1984-1994. Yet a third concern is the utility of statistics on production by environment (freshwater, brackishwater, marine) as opposed to production by origin (land-based, lakes, reservoirs, rivers, marine). FAO is taking steps to try to improve the statistics on fisheries and aquaculture it disseminates, but success in this venture will depend heavily on the improvement of national statistics and on collaboration between FAO and contributing countries.*

*Users of the FAO aquaculture statistics are diverse in nature and include policy makers, researchers, those working in the food and animal feed industries, non-governmental organisations, and those concerned with food security, development and resource planning. The demand for global and regional aquaculture data is growing rapidly. In addition to production statistics, there is a need for data on structural aspects of the industry such as areas under cultivation,*

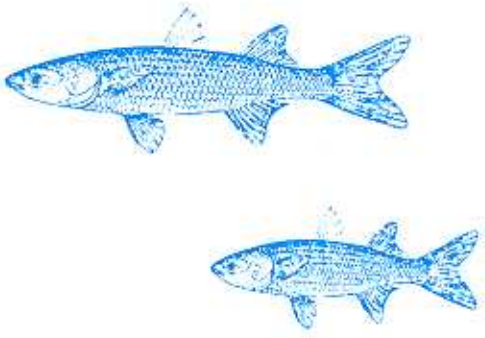
*types and capacities of production systems, resource use (e.g. land, water, feed components, etc.), and employment in the aquaculture sector and its allied services. FAO is not disseminating such information at present.*

*Although some forms of aquaculture have been practised for centuries in a few countries, aquaculture as we know it today has been a recent development. This is one reason why statistics on aquaculture are generally less well developed than those for capture fisheries, for which most countries have had data collection systems in place for decades, albeit collecting statistics of varying reliability. Since the commencement of the FAO aquaculture statistics programme in 1984, the number of countries providing aquaculture production statistics has increased. The proportion of total production which is based on FAO estimates rather than on reported data has fallen from between 8% and 14% prior to 1990 to about 4% in the latest years. However, the national reports are not always based on a statistical programme. Some countries which have sophisticated systems for collection of capture fishery statistics, for fisheries assessment and management purposes, have no formal system for collection of aquaculture statistics, even for production in weight which is the most basic information. In some cases, such countries report national estimates. As demand increases for this information at the national level, for policy formulation and development planning, countries will hopefully respond by establishing statistical programmes where they are lacking. Many countries require aquaculture operations to be licensed and an obligation to provide reliable data can be made a condition of the licence.*

*It may well be more appropriate for aquaculture statistics to be collected by agriculture rather than the fisheries authorities, and some countries follow this practice. One vehicle for the collection of data on agriculture which could be utilised to collect data on aquaculture operations are agricultural censuses which are undertaken in many countries. At present, most agricultural censuses only address aquaculture as a peripheral activity, if at all, and usually only if it is operated on an agricultural holding. This is the approach recommended by the recently issued programme for the World Census of Agriculture 2000 (WCA2000) which was developed by FAO to assist countries in designing national censuses to be undertaken in the decade 1996-2005. It provides guidelines on how to use common standards and procedures in order to achieve harmony in national practices. However, the Fisheries and Statistics Departments of FAO are jointly planning the preparation of a special supplement to WCA2000 which will provide guidelines on how aquaculture, marine as well as inland, can be effectively included in the census, whether as an activity conducted in conjunction with agriculture or separately, so that countries for which aquaculture is important can take advantage of the enumeration process developed for such a census to enlarge and improve the collection of aquaculture date. Those resources are often very substantial. The wealth of information that could be collected on aquaculture were it included in the many large agricultural censuses is immense.*

*In recognition of the increasing need for reliable aquaculture statistics, FAO has appointed its first specialist aquaculture statistician. Dr Krishen Rana of South Africa who has been working at the Institute of Aquaculture, University of Stirling, will have taken up duty with FAO by the time this newsletter appears. In supervising the aquaculture statistics programme and addressing some of the issues discussed here, he will oversee the preparation of aquaculture production statistics for the period 1950-1983, based on estimates where necessary. The preparation of those time series will facilitate disaggregation of the total fishery production statistics into aquaculture and capture fishery components. He faces challenging tasks.*

*Richard Grainger*
*Senior Fishery Statistician*
*Fishery Information, Data and Statistics Unit*



# DEFINITIONS OF AQUACULTURE AND INTENSIFICATION OF PRODUCTION FROM FISHERIES

**R. L. Welcomme**
*Chief*
*Inland Water Resources and Aquaculture Service*

The definition of aquaculture at present used by FAO for statistical purposes reads as follows -

*"Aquaculture is the farming of aquatic organisms including fish, molluscs, crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated. For statistical purposes, aquatic organisms which are harvested by an individual or corporate body which has owned them throughout their rearing period contribute to aquaculture, while aquatic organisms which are exploitable by the public as a common property resource, with or without appropriate licences, are the harvest of fisheries".*

One of the major problems with this definition is the difficulty of drawing the line between culture-based fisheries and aquaculture proper (see article by New and Crispoldi-Hotta, 1992)[1]. As it stands fisheries with only minimal inputs into the rearing process may qualify as aquaculture and even include such contradictory situations as the recreational fisheries of Europe which are maintained largely by stocking and where the ownership of the stocked fish is defined. Another weakness is that inland fisheries are not reported separately to FAO and are only derived by subtracting aquaculture yields from the total reported production. As the two categories are not always reported by species groups in the same manner this may lead to discrepancies in particular species. This weakness in the statistics is posing problems. The various forms of fisheries management that are intermediate between capture fisheries and aquaculture probably constitute the fastest expanding sector in fish production at present. In fact one suspects that the notable gains attributed to aquaculture proper may in many cases originate from this source. If this is the case there is a transfer in reported production from the inland fisheries and this, in turn, may have grave consequences for the formulation of policies for development and for the allocation of funds for research and development.

This definition of aquaculture contains two main concepts, the concept of husbandry and the concept of ownership. The concept of ownership deals with the degree to which the culturist is legally and socially entitled to the benefits from the investment he makes in the rearing system and to the fish he rears, to protection from appropriation by other people, to insurance of stock and facilities, and to compensation for damage to the fish by pollution and environmental degradation. It also reflects on his status and capacity to negotiate with other users of the resource to ensure a place in overall planning. True ownership of the water body and its resources is unusual and more frequently the rights to the resource are conferred on individuals or groups of individuals through some form of leasing by the actual owner or assignment of rights by a governmental body.

The concept of husbandry deals with the extent of human inputs into the system and controls over the production process. There are a range of management practices intermediate between capture fisheries and aquaculture which generally fall under the term *culture-based* or *enhanced fisheries* and together contribute to a process that could be termed intensification of production from inland and coastal waters. These practices are often adopted in the following stepwise manner leading to a progressive increase in fishery production per unit area of water through increasing human control of number, growth and mortality of the fish.

i) *Stocking* of natural waters to improve recruitment, bias fish assemblage structure to favoured species or maintain productive species that would not breed naturally in the system is now practised in most countries to a greater or lesser degree and is probably the major form of management of inland fisheries world-wide. The rationale for most stocking

programmes has not been examined nor has their success or failure been scientifically analysed. Instead some countries have developed empirically derived rules of thumb which are of little use when considering the transfer of the technology to other areas.

ii) The *introduction* of new species to exploit under-utilised parts of the food chain or habitats not colonised by the resident fauna has been a major management tool during the last two decades. It has achieved notable successes in increasing fish production in some lakes and reservoirs but is seen increasingly as a threat to biodiversity. Future movements are less likely to be of species but rather of strains and varieties adapted to local needs.

iii) Stocking does nct increase production beyond the natural support capacity of the environment, so attempts to raise the level of production through *fertilisation* with organic and inorganic fertilisers follow soon after stocking.

iv) *Elimination of unwanted species* that either compete with or predate upon the stocked species is also widespread as a means of channelling a greater part of the productivity into human consumption.

v) *Constructing an artificial fauna of selected species,* usually a mix of bottom feeders, herbivores, plankton feeders and low grade predators also ensures a more complete use of the available productivity. It has the additional advantage of producing overall improvements of productivity by mobilising nutrients that would otherwise be lost.

vi) *Engineering of the environment* through such practices as the selective removal of vegetation, restoration of spawning areas or dredging of accumulated bottom material improves levels of reproduction, shelter and vital habitat for the stocked species.

vii) *Installation of cage culture and parallel intensification of effort of the capture fishery* is probably one of the fastest growing ways of increasing areas under cultivation. As land for fish ponds becomes scarcer, and construction costs for land based ponds rise, the use of existing water areas in rivers, lakes and reservoirs provides an inexpensive easy alternative. Fish cultured in cages are either reared as food fish or used for stocking. Further gains are achieved for the capture fishery as the excess food provided a nutrient source for fish outside the enclosures.

viii) A similar principle applies in further *modifying the water body* by cutting off bays and arms to serve as intensive fish ponds.

ix) The final stage is to *manage the whole system as an intensive fish pond* especially in smaller water bodies.

In some parts of the world these practices represent the fastest growing sector in fisheries production and have implications for the larger picture with regard to the allocation of water among its various users as well as to the allocation of resources among the various fisheries sectors. The problems for managers and statisticians alike is where to draw the line between culture fisheries and aquaculture in this process. According to the current definition of aquaculture, provided there is some legal assignment of the exploited population to a particular user, aquaculture begins as soon as some intervention such as stocking occurs. Some countries appear to hold to this principle. Unfortunately if these criteria are applied uncritically even fisheries such as European recreational fisheries, which are maintained by stocking and which "belong" to various anglers clubs who manage the resource and the environment, fall within the definition of aquaculture.

Recent discussions with Malcom Beveridge of Stirling University and in FAO as part of an ongoing attempt to improve the definition of aquaculture, underline the need to amend the FAO definition at least with regard to the statement that "Farming implies some sort of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc". An alternative phrasing "*Farming implies an intervention in the rearing process to enhance production such as regular stocking, feeding, protection from predators, etc. during most or all of the life cycle*" would avoid the inclusion of casually stocked systems in the aquaculture category. This means that the various fisheries practices would fall under capture fisheries or aquaculture as in Table 1.

This question of a definitive definition of aquaculture for statistical purposes is still very much under discussion and will be pursued shortly through various mechanisms within and outside FAO in the hope of developing a refined definition which is both practical and widely acceptable.

**Table 1 : Proposed classification of various fisheries practices into capture fisheries and aquaculture (modified from CWP, 1992[2])**

| Production from | Designation | |
|---|---|---|
| | Aquaculture | Fisheries |
| Hatcheries | • | |
| Ponds | • | |
| Tanks | • | |
| Raceways | • | |
| Cages | • | |
| Pens | • | |
| Barrages | • | |
| Stocked lakes and reservoirs | | |
| *with other enhancement (predator control and/or fertilisation, habitat modifications), with "rights"* | • | |
| *no other intervention* | | • |
| Unstocked lakes and reservoirs | | |
| *with enhancement (fertilisation and/or predator control, habitat modifications), with "rights"* | • | |
| *no enhancement* | | • |
| Ranching of anadromous fish | | • |
| Fish and crustaceans caught in open waters | | • |
| Privately owned recreational fisheries | | • |
| Fish and other animals harvested from brush parks | | |
| *managed over time and with other enhancement* | • | |
| *harvested on an install and harvest basis* | | • |
| Fish and other animals harvested from | | |
| *fish aggregating devices* | | • |
| Fish and other animals harvested from | | |
| *artificial reefs* | | • |
| Molluscs | | |
| subject to open fishery | | • |
| *from owned and managed grow-out site* | • | |
| Enhanced marine fisheries | | • |
| Harvest of natural seaweed beds | | • |
| Harvest of planted and suspended seaweed | • | |
| Rice-fish culture | | |
| *from stocked rice-paddy* | • | |
| *from unstocked rice-paddy* | | • |
| Lagoon (including vallicoltura) production | • | |
| Private, tidal ponds (tambaks) | • | |

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# TRENDS IN AQUACULTURE PRODUCTION, WITH PARTICULAR REFERENCE TO LOW-INCOME FOOD-DEFICIT COUNTRIES 1984-1993[1]

**Albert G.J. Tacon**
*Fishery Resources Officer*
*Inland Water Resources and Aquaculture Service*

## Contribution to food supply

Aquaculture is currently one of the fastest growing food production systems in the world with an annual growth rate (APR - annual percent rate, calculated using the compound-interest formula) of 9%/year; total world aquaculture production more than doubling by weight from 10.4 to 22.6 million metric tonnes (mmt) and nearly tripling by value from 13.1 to 35.7 thousand million US $ between 1984 and 1993, respectively (FAO, 1995a; Table 1, Figure 1 and 2). Moreover, aquaculture's contribution to world food supplies is gaining increasing importance, aquaculture contributing 16% of total world finfish and shellfish landings (16.25 mmt in 1993; FAO, 1995b), including 13% of total finfish landings, 17.1% of total crustacean landings, 42.8% of total mollusc landings, 87.2% of total aquatic plant landings, and providing a total of 10.5 mmt of high quality *food* (after gutting and shelling) for direct human consumption in 1993 (92.5% fish, 4.3% molluscs, 3.2% crustaceans).

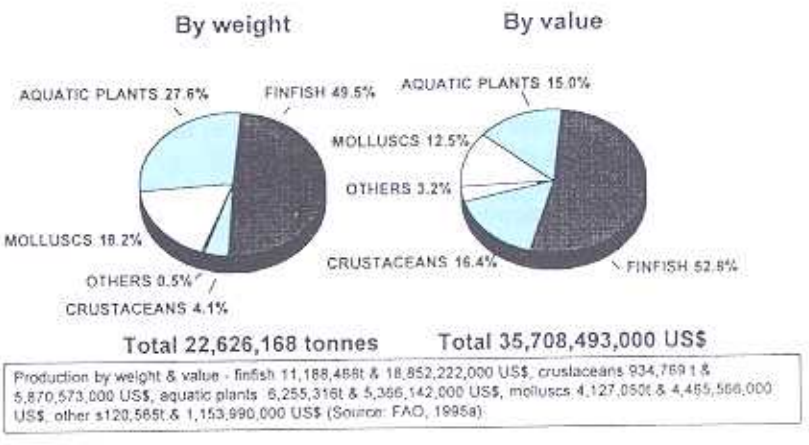
## Growth compared with livestock production

Aquaculture is currently outpacing livestock meat production in terms of growth two- to four-fold; farmed finfish and shellfish *food* production increasing at a rate of 10.2%/year since 1984 compared with only 2.8%/year for total livestock meat production (188.4 mmt slaughtered meat produced in 1993; FAO, 1994a), including 3.0%/year for pig meat, 0.7%/year for beef and veal, 5.2%/year for poultry meat, and 1.4%/year for mutton and lamb; Figure 3). Furthermore, in contrast to livestock meat production where the bulk is still produced within developed countries (ie. 53.8% of total meat, including 64.1% of total beef and veal, 55.8% of total poultry meat, 49.1% of total pig meat), over 83% of total finfish and shellfish aquaculture production (including 87% of finfish and 96% of crustaceans) is produced within developing countries (FAO, 1995a).

## Production by geographical region

Asia currently produces 89.5% and 81.7% of total world aquaculture production by weight and value, respectively (Figure 4). China alone accounts for 58.7% of total world aquaculture production, followed by India (6.4%), Japan (6.3%), the Republic of Korea (4.6%), and the Philippines (3.4%); these top five countries producing 79.4% of the total world production in 1993. The next largest aquaculture producer by region in 1993 was Europe (5.3%), followed by North America (2.5%), South

FIGURE 1. WORLD AQUACULTURE PRODUCTION IN 1993




Production by weight & value - finfish 11,188,468t & 18,852,222,000 US$, crustaceans 934,769 t & 5,870,573,000 US$, aquatic plants 6,255,316t & 5,366,142,000 US$, molluscs 4,127,050t & 4,465,566,000 US$, other s120,565t & 1,153,990,000 US$ (Source: FAO, 1995a)

America (1.3%), the former USSR (0.8%), Oceania (0.4%), and Africa (0.3%). Of particular note is the fact that aquaculture production is generally growing at a much faster rate within developing countries and regions (ie. Asia, South America, Oceania, Africa) than within developed countries and regions (ie. North America, Europe, former USSR). For example, farmed finfish and shellfish production has increased by only 27% by weight (118% by value) since 1984 within developed countries (from 2.2 to 2.8 mmt with an APR of 2.7%/year) whereas within developing countries production has increased by 184% by weight (272% by value) between 1984 and 1993 (from 4.7 to 13.5 mmt with an APR of 12.3%/year). Similarly, within developed countries finfish and crustacean production has grown by only 43% and 16% by weight (120% and 141% by value, respectively) whereas within developing countries finfish and crustacean aquaculture production has grown by 166% and 335% by weight (209% and 420% by value, respectively); the mean APR (period 1984 to 1993) for finfish and crustaceans within developed countries being 4.0%/year and 1.6%/year, and within developing countries being 11.5%/year and 16.5%/year, respectively. It follows from the above that the developing countries share of total aquaculture production has been steadily increasing over the past decade; from 69% to 83% for total farmed finfish and shellfish, from 78% to 87% for total farmed finfish, and from 87% to 96% for total farmed crustaceans from 1984 to 1993, respectively (FAO, 1995a).

## IMPORTANCE OF AQUACULTURE WITHIN LIFDCs

Approximately 74.2% of total world aquaculture production (16.73 mmt) was produced within Low-Income Food Deficit Countries (LIFDCs) in 1993 (FAO Fisheries Department FISHDAB Database, 28/02/96); LIFDCs including all food deficit countries with a per caput income below the level used by the World Bank to determine eligibility for IDA assistance ca. 1,345 US$ in 1993. For example, LIFDCs contribution to the major farmed species groups in 1993 included:

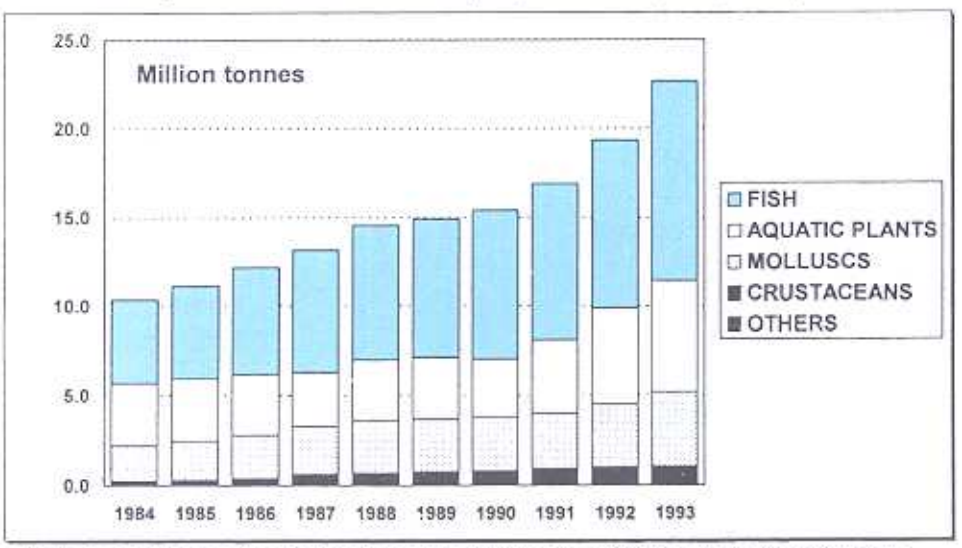
- 72.7% of total farmed fish and shellfish (production increasing by 211% by weight from 3.80 mmt in 1984 to 11.8 mmt in 1993 with an APR of 13.4%/year);
- 78.2% of total farmed aquatic plants (production increasing by 165% by weight from 1.84 mmt in 1984 to 4.89 mmt in 1993 within an APR of 11.5%/year);
- 80.6% of total farmed finfish (production increasing by 174.2% by weight from 3.29 mmt in 1984 to 9.01 mmt in 1993 with an APR of 11.9%/year; Figure 5);
- 63.7% of total farmed shrimp (production increasing by 284% from 133,107 mt in 1984 to 511,461 mt in 1993 with an APR of 16.1%/year); and
- 54.9% of total farmed molluscs (production increasing by 497% from 0.38 mmt in 1984 to 2.27 mmt in 1993 with an APR of 21.9%/year).

Moreover, the contribution of LIFDCs to total world finfish and shellfish production has increased from 54.8% to 72.7% by weight and from 45.1% to 53.9% by value from 1984 to 1993. By region, the major LIFDC aquaculture producers in 1993 included:

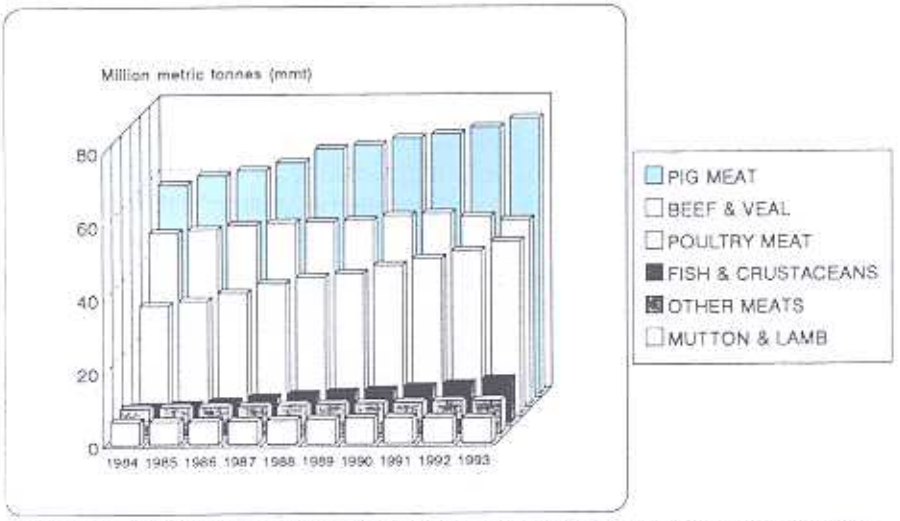
- Far East (97.9% of total; production increasing from 3,704,972 mt in 1984 to 11,597,251 mt in 1993, APR 13.5%/year: main producers - China, India, Philippines, Indonesia, Bangladesh, Pakistan, Nepal, Cambodia);

**FIGURE 2. TOTAL WORLD AQUACULTURE PRODUCTION 1984-1993**

Total production in 1993 was 22,626,168 tonnes (FAO, 1995a)




Growth of major species categories (expressed as % increase since 1984 and APR for 1984-1993): Finfish 4.7 to 11.2 mmt, 139% & 10.1%; Crustaceans 0.24 to 0.83 mmt, 295% & 16.5%; Molluscs 2.0 to 4.1 mmt, 107% & 8.4%; Aquatic plants 3.4 to 6.3 mmt, 81.5% & 6.8%; Others 0.097 to 0.12 mmt, 24.7% & 2.5%




Growth since 1984:1) Mutton & lamb 12.9% (6.1-6.9 mmt) 2) Others (Buffalo, horse & goat meat) 25% ( 7.2-9 mmt) 3) Fish & crustaceans 146% (4.9-12.1 mmt) 4) Poultry meat 59% (29.7-47.1 mmt) 5) Beef & veal 6.8% (47.0-50.2 mmt); and 6) pig meat 31% (57.5-75.2 mmt)

• **Latin America** (1.1% of total; production increasing from 34,980 mt in 1984 to 126,492 mt in 1993, APR 15.3%/year: main producers - Ecuador, Colombia, Honduras, Dominican Republic, Guatemala, El Salvador, Bolivia),

• **Europe (CIS)**[2/] (0.4% of total; production increasing from 38,415 mt in 1984 to 49,566 mt in 1993, APR 2.9%/year: main producers - Romania, Uzbekistan, Lithuania, Armenia);

• **North Africa** (0.3% of total; production increasing from 15,180 mt in 1984 to 35,940 mt in 1993, APR 10.0%/year: main producers - Egypt, Morocco);

• **Sub-Saharan Africa** (0.2% of total; production increasing from 8,725 mt in 1984 to 27,649 mt in 1993, APR 13.7%/year: main producers - Nigeria, Zambia, Kenya, Madagascar, Tanzania, Ghana);

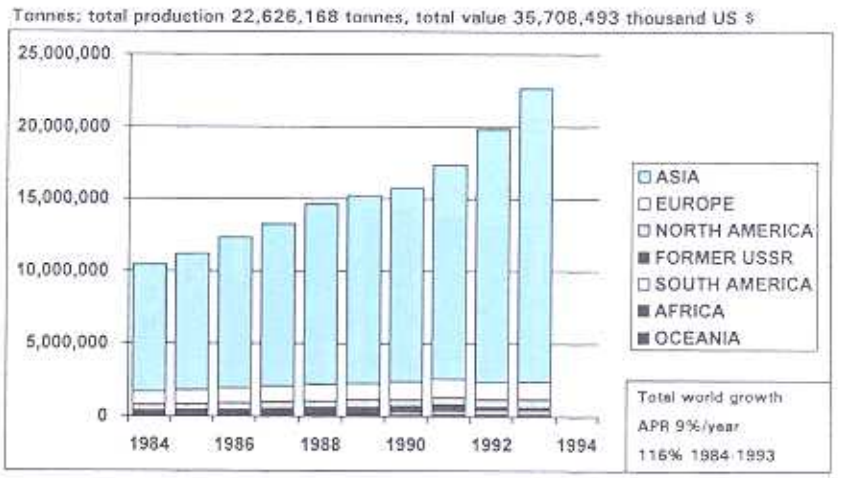
• **Near East** (0.04% of total: production increasing from 1,555 mt in 1984 to 5,060 mt in 1993, APR 14.0%/year: main producers - Syria, Jordan) and **Oceania** (17 mt).

## Concluding remarks

At present the bulk of finfish aquaculture production within LIFDCs, including 99% of total finfish production in China and India (7.92 mmt in 1993) is based on the culture of lower-value (in marketing terms costing between 1-1.5 US $/kg) freshwater finfish within inland rural communities within semi-intensive farming systems (SIFS) or extensive farming systems (EFS); animals usually being reared as a polyculture of complementary omnivorous/ herbivorous fish species within earthen ponds, pen enclosures, or small water bodies at low (extensive) to moderate (semi-intensive) stocking densities (range: <0.1 to 15 animals/m²) with corresponding low to moderate nutrient inputs and therefore yields (fish range: 100kg - 15 mt/ha). The main aim of these farming systems is to produce *affordable food fish* for domestic or home consumption using locally available resources (ie. feed, fertilizer, seed, water, land etc.) and technology, and the minimum of off-farm inputs. In marked contrast to these low-input

### FIGURE 4. TOTAL AQUACULTURE PRODUCTION BY REGION

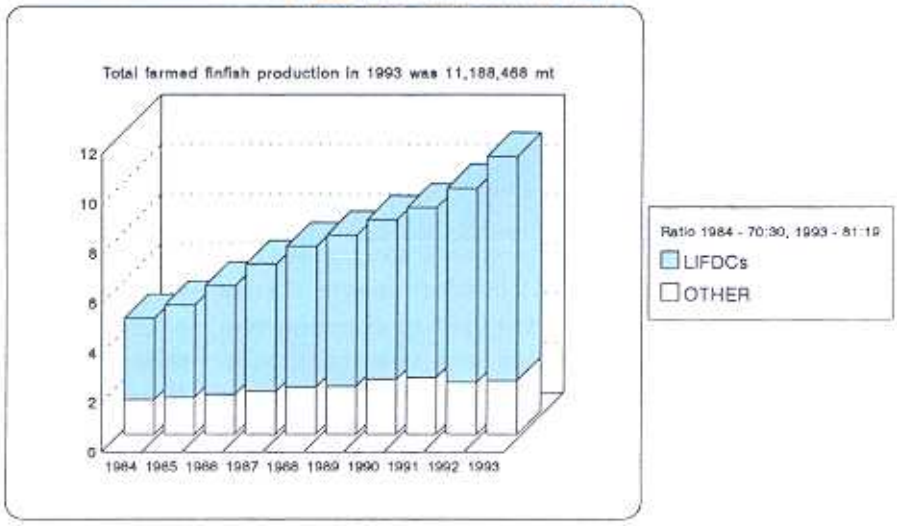
(Source: FAO, 1995a)




Production share (by weight/value in 1993) & growth (%APR/% prod.incr. 1984-1993): Asia 89.5/81.7 & 9.7/131%; Europe 5.3/9.3 & 2.9/29.6%; North America 2.5/3.4 & 3.8/36.4%; South America 1.3/3.0 & 19.6/401%; Former USSR 0.8/1.0 & -4.3/-31.7%; Oceania 0.4/1.0 & 14.2/231%; Africa 0.3/0.5 & 13.2/218%

and therefore low-output and low-cost farming systems, over 60% of total finfish production within developed countries is currently based on the monoculture of high-value carnivorous finfish within intensive farming systems (IFS); fish being reared within ponds, tanks, pens or net cages at high stocking densities (> 15/m²) and usually fed on high-quality (and therefore high-cost on a unit weight basis), nutritionally complete commercial aquafeeds, or fed on natural food items of high nutrient value such as 'trash' fish (Tacon, Phillips and Barg, 1995).

FIGURE 5. CONTRIBUTION OF LIFDCs TO WORLD FINFISH AQUACULTURE PRODUCTION
(Source: FAO/FIDI FISHDAS Database, 22/2/96)




Since 1984 total finfish production has increased by 174.2% within LIFDCs (from 3,286 to 9,013 mmt; APR 11.9%) and by 55.3% within other remaining countries (from 1,400 to 2,175 mmt; APR 5.0%). Total value of production in LIFDCs increased by 203% (from 3,30 to 9,98 thousand million US$, APR 13.1%)

In essence, the farming approach employed by most developing countries (and in particular LIFDCs) has been targeted more toward *Management for Survival* (Zweig, 1985), whereas the farming approach used by most developed countries has been targeted more toward *Management for Profit*. However, whether these or other farming approaches will continue to be more sustainable in the long-run is another matter. Clearly both farming approaches will have to learn from the other if aquaculture is to continue to sustain its high growth rate and help meet the future demands for *food fish* by an ever increasing population. The key to long term sustainability and future aquaculture expansion will be to improve the overall efficiency of resource use, rather than relying on farming approaches which are based upon resource over-exploitation and degradation, and to develop farming systems which are both economically and ecologically viable and socially acceptable.

*1/ For additional information and the full version of the manuscript 'Global trends in aquaculture and aquafeed production' contact Albert.Tacon@fao.org*

*2/ CIS = Community of Independent States*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# HEALTH CERTIFICATION AND QUARANTINE OF AQUATIC ORGANISMS:

## PRACTICAL GUIDELINES FOR ASIA AND THE PACIFIC

**Rohana P. Subasinghe**
*Fishery Resources Officer*
*Inland Water Resources and Aquaculture Service*

### Introduction

World aquaculture production has increased from 10.5 million mt in 1984 to 22.6 million mt in 1993 with an average compounded growth rate of nine percent per year. The total contribution of aquaculture production to global fisheries increased significantly (115 percent) during this period, as has the value of aquaculture production (174 percent from US$ 13 thousand million to 35.7 thousand million) (FAO/FIDI, 1995). Considering the present rate of population expansion and average per caput fish consumption of 13 kg/year, it has been estimated that the global demand for fish and shellfish may be in the order of 87 million mt by the year 2010 (FAO/Japan, 1995). In order to meet this predicted demand through aquaculture, global production through aquaculture would have to double over the next 15 years.

Asia is at the forefront of aquaculture production both in terms of volume and value. China, India and Japan alone account for 65% percent of world production. Asian aquaculture production derives from a number of different aquaculture systems ranging from intensive and semi-intensive systems to extensive systems and culture-based fisheries. There is potential for further growth in Asia, through intensification, diversification, fishery enhancement and horizontal expansion. However, if this potential is to be realized, Asian aquaculture must grow in a sound and more sustainable manner. In particular, one of the most significant constraints that will re-emerge during the process of expansion of Asian aquaculture is the threat of disease.

The economic impact of disease on the aquaculture industries of Asia has been substantial. According to recent estimates, fish disease accounted for at least US $1.36 billion in losses in Asia in 1990. Actual annual losses may be two to six times this estimate. The highly visible collapse of the shrimp culture industry in China, Thailand, India, Cambodia and Bangladesh has had considerable negative financial and environmental consequences.

In marine fish culture, Japanese losses in 1992 for the most important species amounted to $US 114.4 million or about 5.7% of total production. In Southeast Asia, diseases in cage-cultured grouper, snapper and seabass in Malaysia cost growers $US 1.3 million in potential income in 1982 alone. In 1990 an outbreak of vibriosis in sea-cage farms in Malaysia cost farmers $MR[1] 20 million, and more recent losses have amounted to $MR 6-10 million per year. In Thailand, losses of marine cage-cultured seabass and grouper in 1989 were in the order of $US 1.9 million. These facts demonstrate the importance of fish health in the success or failure of aquaculture in Asia and the Pacific.

### Quarantine and Health Certification

quarantine programmes form part of a first line of defense against possible adverse effects resulting from the trans-boundary movement of aquatic species. As such, they must be developed within the context of larger national and international plans addressing this problem. "Codes of Practice" for the international movement of aquatic species which have been developed by international organizations provide a starting point for designing national and regional fish health legislation as well as international agreements aiming at preventing the spread of disease. To succeed, such efforts must be accompanied by the development of regionally agreed-upon lists of notifiable pathogens, the standardization of diagnostic techniques and the production of health certificates of unambiguous meaning. A strong commitment by aquafarmers and governments, and the cooperation of importers and exporters as well as seed producers and traders are considered key

elements in the success of health certification and quarantine programmes. Successful disease prevention will also be directly related to (i) the ability of countries to reduce their dependence on imported broodstock and fry for the aquaculture industry, and (ii) to regulation of shipments for the ornamental fish trade, particularly those involving wild-caught fishes (Arthur, 1995).

## Regional Scenario

The development, adoption and implementation of uniform regional health certification and quarantine practices in the Asian-Pacific region must be viewed as a long term goal because of the complex nature of the problem. Countries in the region have disparate quarantine legislation, policies and practices, which reflect the magnitude and socio-economic importance of trade in living aquatic animals and products. Many people in the region depend on trade in aquatic animals/products for their livelihood and the diversity of species and purposes for which aquatic animals and products are traded is broad. Most countries in the region have limited laboratory capabilities for evaluating the health status of imported/exported aquatic animals and limited quarantine holding facilities. The availability of epidemiological data on pathogens, their movements, and the incidence of disease epizootics are also lacking in the region. Furthermore, since the adoption and enforcement of health certification and quarantine measures could bring about non-tariff trade barriers, the industry may be reluctant to support quarantine initiatives. These factors have hampered the adoption of effective quarantine practices in most countries in the region.

Recognition of the need to develop, adopt, and implement regional quarantine and health certification programmes is not new. Fundamental guidelines and principles for aquatic animal quarantine for the Asian-Pacific Region have been developed in a number of papers, workshops and reports over the past two decades (Adams 1993, ADB/NACA 1991, Arthur 1987, 1995, Copland and Lucas 1988, Davy and Chouinard 1983, Davy and Graham 1979, Eldredge 1993, Humphrey 1994, Morschel 1988a,b, Roberts 1981, SPC 1988). The need for extreme caution with respect to disease incursions in considering introductions of aquatic animals in the region has also been emphasized by Davy and Chouinard (1983) and SPC (1988).

## Initiatives

The Code of Conduct on Responsible Fisheries (FAO, 1995) has been approved and agreed upon by the FAO member countries at the twenty-eighth Session of the FAO Conference (20 October to 2 November 1995, Rome). Articles 9.3.2 and 9.3.3 of the Code, respectively assert that *"States should cooperate in the elaboration, adoption and implementation of international codes of practice and procedures for introductions and transfers of aquatic organisms"* and *"States should, in order to minimize risks of disease transfer and other adverse effects on wild and cultured stocks, encourage adoption of appropriate practices in the genetic improvement of broodstocks, the introduction of non-native species, and in the production, sale and transport of eggs, larvae or fry, broodstock or other live materials. States should facilitate the preparation and implementation of appropriate national codes of practice and procedures to this effect"* (FAO, 1995). Considering the importance given by the Asia-Pacific region and in response to the requests made by the FAO member countries to facilitate development of national codes of practice on health certification and quarantine for aquatic animals and animal products, the Fisheries Department of FAO has set out to develop a global document on Practical Guidelines for the Responsible Movement (Introduction and Transfer) of Aquatic Organisms.

The regional importance of aquatic animal health management and the role of aquatic animal health certification and quarantine has simultaneously been recognized by the Network of Aquaculture Centres in Asia and the Pacific (NACA) and a program to develop and implement aquatic animal health management has been incorporated into the second five-year work program of NACA (NACA, 1996). On the request of NACA member countries, the NACA Governing Council has recommended the drafting and adoption of regional guidelines for health certification and quarantine of aquatic animals in the Asia-Pacific region.

## The Way Forward

Responding to the need for the development and adoption of minimum aquatic animal health certification and quarantine for the region, and the recommendation of the NACA Governing Council, FAO organized a *Workshop on Health and quarantine*

*Guidelines for the Responsible Introduction of Aquatic Species* in collaboration with NACA and Aquatic Animal Health Research Institute in Thailand (AAHRI), a recognized regional centre of excellence in aquatic animal health management. The workshop, which was convened on 27-28 January and 4-6 February 1996 in Bangkok, Thailand, was attended by representatives from ten countries in Asia, and a number of regional and international institutions including FAO, Office International Des Epizooties (OIE), Australian Centre for International Agriculture Research (ACIAR), NACA, and AAHRI. The workshop evaluated the practical applicability to the Asia-Pacific region of existing international codes on aquatic animal health and quarantine, including those of the OIE, the European Inland Fisheries Advisory Commission (EIFAC) and the International Council for the Exploration of the Sea (ICES), and revised the new draft guidelines developed by FAO on health certification and quarantine for the responsible movement (Introduction and Transfer) of aquatic organisms. The workshop also attempted to develop a strategy for the implementation of an Asia-Pacific regional program for the development of appropriate guidelines and protocols for aquatic animal health certification and quarantine.

In view of the numerous, well recognized and documented incursions of aquatic animal disease associated with introductions and transfers of living aquatic animals, and the adverse social, economic and environmental impacts arising from such incursions, the workshop agreed that the governments should recognize the risks of uncontrolled entry of living aquatic animals and should adopt and introduce quarantine measures, especially in the face of rapid expansion and reliance on aquaculture and other fisheries industries.

Considering the many common social, economic, industrial, environmental, biological and geographical factors in the Asia-Pacific region, the workshop recognized that it is logical to adopt and implement Asia-Pacific regional quarantine practices and aquatic animal health certification procedures which could facilitate trade and enhance the protection of industry and the environment from incursions of disease. It was recommended that that FAO/NACA should communicate with the South Pacific Commission (SPC) on linking the common Asian and Pacific initiatives on aquatic animal quarantine and health certification.

As a basis for developing a strategy for implementing a regional program to develop guidelines for aquatic animals health certification and quarantine, a number of fundamental guiding principles have been identified and agreed upon at the workshop. They include:

1. Trade in living aquatic animals and aquatic animal products is economically and socially justifiable. An entitlement exists within and between nations for individuals or organizations to import such animals or products where deleterious effects can be minimized or avoided. Considerable benefits have resulted from the introduction of aquatic animals and aquatic animal products.

2. Living aquatic animals and aquatic animal products imported for different purposes should be treated in a similar manner where equal risk of introducing exotic disease exists, i.e., an equity of principle must apply in all considerations.

3. Concerns regarding exotic disease incursions and adverse environmental impacts are inexorably linked to imports of living aquatic animals: both issues must be addressed in considering such imports, but exotic disease and pest exclusion should be treated as a separate function of quarantine.

4. Quarantine should operate from the basic axiom that all living aquatic animals and all products derived therefrom should be allowed entry unless they pose an unacceptable disease risk to national fisheries resources or the environment.

5. A conservative approach should be adopted in cases where insufficient knowledge exists in relation to disease risks posed by a particular import; a higher stringency of quarantine should be adopted where inadequate knowledge exists.

6. Particular countries or regions may enjoy a privileged position with regard to freedom from exotic pathogens and parasites of aquatic animals and greater levels of quarantine stringency may reasonably be imposed by those countries or regions to protect the status quo than might otherwise be indicated.

7. The likelihood of an exotic agent establishing in susceptible endemic hosts in the aquatic environment of the importing country should be regarded as a major consideration on which to base quarantine assessments.

8. Imports should be considered on an individual basis with quarantine commensurate with risks, considering source and destination of the import.

9. Individual countries may need to adopt, modify or vary guidelines to suit their own particular purposes: A minimum standard of quarantine should apply.

10. Quarantine should not be used as a non-tariff trade barrier. Valid disease concerns must be present in order to justify imposition of quarantine procedures.

11. Quarantine should serve to protect the natural environment and natural aquatic fauna, as well as serve to support and protect trade in aquatic animal species.

12. As far as possible, regional countries should attempt to harmonize aquatic animal health certification and quarantine practices and procedures to facilitate movements and introductions of aquatic animals and aquatic animal products.

Taking into considering the above principles, the importance and timely need, and as agreed at the FAO/NACA/AAHRI workshop in Bangkok, the Fisheries Department of FAO intends to launch a comprehensive programme in collaboration with NACA towards developing unified practical guidelines on minimal health requirements and quarantine for the responsible movement of aquatic species in the Asia-Pacific region.

[1] $ MR 2.55 = $ US 1

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# THE PRIVATE SECTOR: A POTENTIAL KEY ELEMENT IN THE DEVELOPMENT OF SMALL-SCALE AQUACULTURE IN AFRICA - LESSONS FROM MADAGASCAR

Frans van den Berg*

## Introduction

Many African countries have been trying, for decades, to develop aquaculture, with the assistance of bilateral and multilateral development agencies. The usual approach followed was the transfer of technology packages through the creation of government demonstration centres and extension services and the provision of fingerlings to farmers from government hatcheries. As we now know, success has been elusive; with some exceptions, aquaculture did not taken root as hoped, and donor interest in aquaculture development in Africa waned.

The history of aquaculture in Madagascar mirrored the African experience until 1989, when a new approach was introduced involving the private sector. This approach was developed, with assistance from UNDP/FAO, in the "Hauts-Plateaux" area, the highlands of Madagascar, which are good rice farming areas. The successful project was handed over to the government in 1994, following completion of the external technical assistance. Subsequent developments varied from the usual norm in Sub-Saharan Africa in that development did not collapse on cessation of external technical and financial assistance. Fish farming development is still underway with minimal government intervention. At present, (rice-)fish farmers (who practise rice-fish farming or fish farming in ponds, or both) buy their fish seed from local fish seed producers who also supply them with the necessary information on (rice-)fish farming techniques.

It has been argued that Madagascar is not a typical sub-Sahara African country. But, is it so different that we cannot repeat the success in other countries within Africa? Or are past disappointments in Africa hindering the launching of new efforts and the search for potential solutions?

## History

Freshwater aquaculture was launched in Madagascar in the fifties with the introduction of several tilapia species and common carp. The latter proved the more suitable fish, particularly for rice fish culture. Initially, as in other African countries, fresh water fish farming was taken up with great enthusiasm by farmers. However a sharp decline occurred in the sixties, mainly due to the lack of fingerlings and the lack of effective fish farming skills and extension services. In 1985 the government initiated a new effort to develop fresh water fish farming with the assistance of UNDP/FAO. The new initiative followed the classical approach of government support used in so many other African countries: two government fish stations were rehabilitated to serve as the main fingerling production and distribution centres and an extension service was created in the Fisheries Department with the recruitment and training of 60 field extension officers.

On first appearance the approach seemed very successful. By 1989, the Government, with the assistance of FAO, had increased its fingerling distribution from 350,000 to 850,000. However, by then it was realised that the success was based on an approach that could not be sustained by the government in the absence of external assistance. The production and transport of fingerlings involved substantial investment in human and financial resources by the public sector. And as distribution distances increased, distribution cost became prohibitive (up to three times the production cost of fingerlings). With the limited means available to the government a continuation of this approach could not be justified; an alternative approach had to be developed.

*Parts of this article were published in: Aquaculture policy options for integrated resource management in Sub-Saharan Africa, Pro. ICLARM Workshop 22-25 February 1994, Zomba, Malawi. Frans van den Berg is a former FAO Associate Professional Officer, Madagascar, UNDP/FAO/MAG/88/005.

### Privatization of fingerling production

With the assistance of the UNDP/FAO-MAG/88/005 project *"Promotion de l'aquaculture et privatisation de la production d'alevins"* (in 1993, this project was a component of MAG/92/004) located at the "Hauts-Plateaux", the Malagasy government elaborated a new approach to develop (rice-)fish culture, with the key role granted to the private sector. A network of private fingerling producers was set up gradually, and as a private producer became operational, fingerling distribution by the government in that area was discontinued. Within a period of four years, 72 fingerling producers were in operation with a total distribution of more than 1 million fingerlings (Figure 1). In 1992, 75% of the market was already served by the private sector.

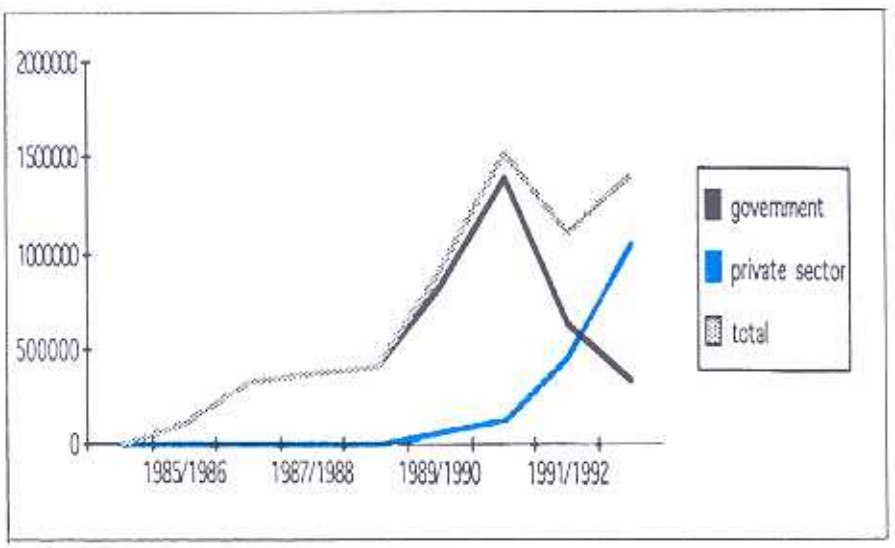



Figure 1: Total governmental and private sector sales of common carp fingerlings at the "Hauts Plateaux"of Madagascar 1986-1993

### Privatisation of the extension of (rice-)fish culture

The second element in the approach to achieve the government's objective of "sustainable development of (rice-) fish farming" was to include extension services for (rice-) fish farming in a marketing strategy for fish seed producers. The approach was accepted by the fingerling producers because it expanded their market -- with the increased production and revenue from (rice-) fish farming, due to improved know-how from extension, farmers were not only likely to continue purchasing from the same fingerling supplier, but would also tend to expand operations and recommend the supplier to other farmers. The provision of extension services also made them more competitive as new producers entered the market independent of the government.

Extension carried out by the private producer ranges from demonstration of his own (rice)-fish farming operations to the organization of meetings for other farmers. The level of extension depends on the capacities of the fingerling producer to learn the necessary extension skills and the relationship between farmers and the fingerling producer/extension agent. This takes time and support. In 1992, a beginning was made with the training of fingerling producers in marketing, teaching skills and extension methods. Additionally, a number of extension and training materials were developed. By 1993, during the final stage of the project, the majority of fingerling producers were already aware of the importance of extension and practised it using simple techniques. In addition, a growing number were sattempting the use of participative extension methods during farmer meetings.

This promising beginning of privatized extension and the successful implementation of privatized fingerling production show the potential benefits and positive impact of an enlarged role of the private sector in the development of rural fish farming.

### A small but qualified extension service

The strategy based on a network of private fingerlings producers requires only a small number of highly qualified government extension officers. Therefore the old extension network was dismantled and out of 60 extension officers 11 were selected and received specialised training for the proper installa-

tion of private fish seed producers. The advantages of a small number of extension officers are obvious: they can be thoroughly trained, receive regular field support, and be well remunerated and equipped without heavy costs to the government.

## The "Madagascar model": a feasible concept for Africa ?

A number of factors contributed to the failure of previous attempts to develop aquaculture in sub-Saharan Africa. One of these was the classic approach by bilateral and international agencies of making the recipient government the key element in aquaculture development. Weak institutional capacities and policy frameworks in the public sector, as well as limited resources and conflicting priorities usually could not sustain development momentum on termination of external aid. This was usually reflected in cessation of fingerling production/distribution and extension services. Extension officers usually lost motivation due to lack of payment, equipment and technical backstopping. In general, it can be said that most projects seem to have paid little attention to the sustainability of development approaches under prevailing local conditions.

The strategy for sustainable fish farming development in Madagascar, described above, was developed for a specific socio-economic and cultural setting. Also, the high population density of the "Hauts-Plateau" area provided a good market and facilitated extension. It is very likely therefore that this approach or solution may not be appropriate for other locations in sub-Saharan Africa. Nevertheless, the Madagascar model, or variations of the model, should be given due consideration in the elaboration of strategies for the development of sustainable small-scale aquaculture in Africa.

In the opinion of the author, it should be possible to establish private fingerling producers in sub-Saharan countries if farmers are carefully selected, with regard to their commercial awareness and position within the community, in order to assure social acceptance, and if assistance from the public sector is provided only to selected farmers at the outset. It is also essential to respect farmers' motives and to pay special attention to site selection criteria for fingerling production farms, particularly in relation to the market for fingerlings.

Privatization of extension (as part of a marketing concept) can also be feasible if farmers are convinced the process is profitable and actually practise the extension message (farming methodology) themselves, and if training in marketing and teaching skills is provided by the public sector.

In general, the development and implementation of a sustainable strategy for small scale aquaculture dictates some essential prerequisites. Some of these, which became evident in the course of the Madagascar project, included:

- acceptance, by governments and development agencies, of the reasons for failure of previous development efforts, and a willingness to invest in the search for more sustainable development strategies to realize the full potential for aquaculture development within sub-Saharan Africa.

- serious public commitment to develop aquaculture, and a willingness by governments to accept a limited role in the development process as a facilitator of private initiatives and a guiding force to ensure sustainable development.

- overcoming the constraint imposed by the often low priority assigned to aquaculture in national development plans due to its current low contribution to the national economy, compared to more established sectors, including capture fisheries. (Aquaculture is still in the development stage in most sub-Saharan countries; its evaluation at the macro-economic level at this time is therefore premature and will stifle development. The sector should be evaluated in terms of sustainability, its socio-economic value, its potential role in "household food security" and impact on overall farm production.)

- the development and testing of new strategies in the context of pilot projects, which maximize sustainability through proper attention to technical, cultural and socio-economic factors, and proper selection of target farmers, credit facilities, marketing and extension services.

- incorporating flexibility in project planning, to permit changes during implementation in order to deal with specific problems that could not be foreseen. This is a crucial prerequisite considering the pioneering nature of new approaches to development, which are also highly site specific.

- closer integration of fresh water fish farming with agriculture and agricultural development.

# NEW PUBLICATIONS

Report of the FAO Regional Expert Consultation on Aquaculture Health Management in Asia and the Pacific, Universiti Pertanian Malaysia, Serdang, Selangor D.E., 22-24 May 1995. *FAO Fisheries Report*. No.529. Rome, FAO. 24p.

An expert consultation to review the status and needs of aquaculture health management in Asia and the Pacific was convened in view of the priority placed by FAO and its members on sustainable development of aquaculture, the disproportionately large Asian contribution to aquaculture production and the apparent high losses of revenue due to diseases and health related problems. The consultation was jointly organized by FAO Fishery Resources Divisipon and the Fish Health section of the Asian Fisheries Society and convened at the Universiti Pertanian Malaysia, 22-24 May 1995. It brought together sixteen experts, fourteen from the region and two from outside but with extensive experience in the region.

The experts discussed three main thrust areas, namely (i) research, diagnosis and information, (ii) training and extension, (iii) quarantine and legislation. The experts agreed, *inter alia*, that there is an urgent need for an effective regional health management programme and suggested the above three thrust areas as its main components. Conclusions and recommendations for each of these areas were specified as well as workable approaches to fulfil the identified and prioritised needs. The report presents an overview and the final conclusions and recommendations of the consultation.

The sixteen technical papers presented at the consultation will be published shortly as a supplement to the report.

**Tave, D.** Selective breeding programmes for medium-sized fish farms. *FAO Fisheries Technical Paper*. No. 352. Rome, FAO. 122 p.

This manual has been prepared for extension workers and aquaculturists. It deals with methods for selective breeding programmes to improve cultured populations of food fish on medium-sized farms. The manual contains chapters on general principles, basic genetics, selection for qualitative phenotypes, selection for quantitative phenotypes, and how to conduct simple selective breeding programmes. A glossary and selected reading list are also include. The principles of quantitative and qualitative genetics are explained through examples of tilapia and carp breeding studies. The resources that are necessary for aquaculturists to possess in order to successfully implement selective breeding programmes are discussed and serve to help evaluate the prospects of success before starting a genetic improvement programme.

**Schumacher,A., J. Gropp, A.G.J. Tacon, V. Hilge and H. Rosenthal** (Eds.), 1995. Proceedings of the EIFAC Workshop on Methodology for Determination of Nutrient Requirements in Fish, Eichenau, Germany, 29 June-1 July 1993. *J. Appl.Ichthyol.* 11(3-4), 129-400.

The Workshop on Methodology for Determination of Nutrient Requirements in Fish was convened on the recommendation of the Sixteenth Session of the European Inland Fisheries Advisory Commission (EIFAC), Prague, Czechoslovakia, 15-22 May 1990. The objectives of the workshop were: (i) to collate existing data on nutrient requirements and recommend nutrient levels in diets for economically important finfish species and to identify gaps in our knowledge, (ii) to compare methods for the determination of nutrient requirements and to recommend guidelines to be adopted, and to specify further research needs, and (iii) to evaluate the existing methodological approaches for nutrient needs of fish within semi-intensive pond farming systems. The workshop was attended by 121 participants from 27 countries, and international, intergovernmental and non-governmental agencies. The proceedings of the workshops have been published in a special issue of the *Journal of Applied Ichthyology* and include 28 main papers and nine short communications.

Kumar, D. Aquaculture extension services review: India. *FAO Fisheries Circular* No. 906. Rome, FAO. 1996. 72p.

India, a vast country of 3,207 million km² and with a coastline of 8,085 km, is unique in its physical geography, climate and land and water resources. It has a population of about 900 million of which about 40 % are fish eaters. Out of a total fish production of 4.4 million tons, aquaculture contributes about 1.35 million tons. the country has great potential for further development of aquaculture in both freshwater and brackishwater areas.

The government is assisting aquaculture development through various programmes such as Fish armers' Development Agency (FFDA), brackishwater Fish Farmers' Development Agency (BFDA), bilateral and multilateral assisted projects. Indian Council of Agricultural Research (ICAR) through its various specialized agencies contributes to aquaculture research and development.

Aquaculture development is the responsibility of the State Governments. However, the Central Government is responsible for providing overall policy guidelines for the development of the sector. The Fisheries Division of the Department of Agriculture and Cooperation under the Ministry of Agriculture is the agency for coordinating aquaculture development in the country. Its responsibilities include planning, programming, monitoring, implementation and evaluation of development programmes. At field levels, aquaculture programmes (both Central and State) are implemented by the State Fisheries Departments.

The most important centrally sponsored Agency for aquaculture extension services is the Fish Farmers Development Agency (FFDA), which is a District level organization for the development of freshwater aquaculture. To-date, 375 FFDAs have been established. They have brought 0.359 million ha of ponds/tanks under aquaculture with average production of over 2,000 kg/ha/yr. Similarly, for brackishwater aquaculture development (mainly shrimp), Brackishwater Fish Farmers Development Agency (BFDA) has been established. So far, 34 such BFDAs have brought 11,000 ha under shrimp farming.

In addition, aquaculture extension services are provided by ICAR through various programmes such as Krishi Vigyan Kendra (KVK), Trainers' Training Centres (TTC), National Demonstration Programme (NDP), All India Coordinated Research Project (AICRP), Operational Research Projects (ORP), Lab to Land Programme (LLP), Marine Products Export Development Authority (MPEDA) and Department of Bio-Technology (DBT). Also, various Non-Governmental Organizations playing an important role in providing aquaculture extension services. At the village level, rural institutions such as 351 Zila Parishad, 53,000 Panchayat Samittees and 0.22 million Gram Panchayat control the public waterbodies and lease them for aquaculture development.

## UPCOMING EVENTS

### International Symposium on Marine Ranching, Ishikawa 1996

The symposium is scheduled for 13-16 September 1996, in Kanazawa, Ishikawa Prefecture, Japan. It is organized by the Ishikawa Prefecture, Japan, in collaboration with the FAO Fishery resources Division, as a follow up on the outcome of the International Conference on Sustainable Contribution of Fisheries to Food Security, organized by the Government of Japan and the FAO Fisheries Department and held in Kyoto on 4-9 December 1995 . The main objective of the symposium is to enhance international understanding of the current status, future prospects, important development issues, and transfer of technologies in marine ranching. The symposium will review current developments in marine ranching in Japan and two or three advanced countries, and hopes to establish the basis for future international cooperation in addressing the major development issues in this field.

The tentative agenda includes three main panels: (i) the current status of fish seed production and fish farming, (ii) improvement of fishing grounds and marine ranching facilities, and (iii) issues associated with marine ranching.

Additional information may be obtained by writing to:
Fisheries Department, Ishikawa Prefecture
2-1-1 Hirosaka, Kanazawa, Ishikawa Prefecture 920-80
Phone: +81-762-23-9252
Fax: +81-762-23-9479
E-mail: suisanka@nsknet.or.jp
www: http:/www.nsknet.or.jp/ishikawa/fish/

## First Meeting of the *Ad Hoc* Working Group on Aquaculture, Indian Ocean Fisheries Commission - Committee for the Development and Management of the Fishery Resources of the Gulfs (IOFC Gulfs Committee)

During its Eighth Session, in December 1994, the IOFC Gulfs Committee recommended the establishment of additional working groups, including one on aquaculture. Nominations of experts to the working group from member countries (Islamic Republic of Iran, Iraq, Kuwait, Saudi Arabia, United Arab Emirates, Qatar and Oman) and preparations for its first meeting have nearly been completed. The Government of Bahrain will host the meeting which will take place during 10-12 June 1996. The experts will review the status of aquaculture development in the region through country papers, identify development priorities, needs and capacities in the region, and explore the potential for regional collaboration. In response to the interest expressed by a number of countries, the Working Group will also hold a special discussion on Marine Ranching and Stock Enhancement.

## International Expert Meetings on the Use of Chemicals in Aquaculture

The use of chemicals is common in various aquaculture systems. With worldwide growing awareness of the need for responsible practices in aquaculture, governments and aquaculturists are concerned with the effects of the use of chemicals in aquaculture, especially with those which appear likely to be hazardous to man, cultured stock and environment. There is an apparent need to synthesize and disseminate information on the use and management of "aquachemicals", with emphasis on various aquaculture systems and species utilized.

Two expert meetings on "aquachemicals" will take place in May 1996 at the Aquaculture Department of the Southeast Asian Fisheries Development Center (SEAFDEC) in Tigbauan, Iloilo, Philippines. The meetings are being organized by SEAFDEC and the FAO Fishery Resources Division with support from SEAFDEC, FAO and CIDA's ASEAN Canada Fund; WHO is covering the participation of a human health expert, and other participating organizations include the Network of Aquaculture Centres in Asia-Pacific (NACA), Japan International Research Center for Agricultural Sciences (JIRCAS) , Taiwan Fisheries Research Institute (TFRI), and the International Center for Living Aquatic Resources Management (ICLARM).

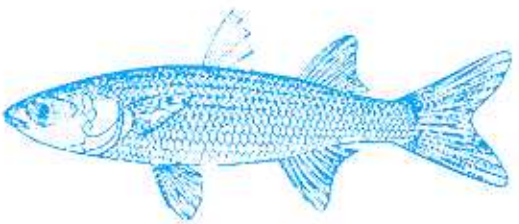
The first meeting (20-22 May 1996) is focused on aquaculture as practised in the Asian region, and will include (i) general reviews on use of antibiotics, ecological effects of chemical usage, generation of drug resistance in sediments/tissues and water, use of chemicals in aquaculture feeds, human health aspects of use of chemicals in aquaculture with special emphasis on food safety and food quality assurance, regulations on the use of chemicals, and use of organic manure, fertilizers, and conditioners, and (ii) presentations of national reports covering 14 Asian countries. The findings of this regional meeting will be directly fed into the meeting (24-28 May 1996) of the GESAMP[1] Working Group on Environmental Impacts of Coastal Aquaculture which will address major issues related to the use of chemicals in coastal aquaculture as practised worldwide.

Additional information can be obtained from:

Ms. Celia L. Pitogo
Chairperson, Local Organizing Committee
AQUACHEM Meeting
SEAFDEC Aquaculture Department
5021 Tigbauan, Iloilo, Philippines
Tel: + +63-33- 335-1009
Fax: + + 63-33- 335-1008
E-mail: tms-seafdec@phil.gn.apc.org

Mr Uwe Barg
FAO Fishery Resources Division
Tel: + +39-6-522-53454
Fax: + +39-6-522-53020
E-mail: uwe.barg@fao.org

([1] *GESAMP = IMO/FAO/Unesco-IOC/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection*).



## FAO Expert Consultation on Small Scale Aquaculture Development, Rome, Italy, 28-31 May 1996.

Attempts at establishing aquaculture in rural areas in which it has no traditions, particularly Africa south of the Sahara and Latin America, have been largely disappointing and characterized by poor sustainability of development projects . The causes are complex and have been discussed in many fora. More recent development attempts have been based on quite different development approaches and new methods for identification of target groups, and project identification, implementation and monitoring. To date, little effort has been made to synthesize and assess the implication of the findings of these pioneering development efforts in the interest of providing guidance for future action. The expert consultation, organized by the FAO Fishery Resources Division, will attempt to fill this gap.

The consultation will bring together selected experts from various regions to analyze and derive policy implications from existing knowledge and previous findings. It will focus largely on conceptual issues and is likely to be the first step to more extensive technical consultation, or other follow up activities, at the regional and international level. The following broad themes will be addressed on the basis of critical discussions of keynote papers: (i) defining objectives and indicators, and identifying target groups, (ii) the implications of integrating small scale aquaculture within agriculture and rural development, (iii) the institutional context: roles of the public and private sectors/ other institutional mechanisms and (iv) options in research methodologies/approaches and mechanism for extension based on research results. The consultation will be held in FAO headquarters, Rome, Italy on 28-31 May 1996.

# STUDIES AND PROJECTS

## FAO/NACA Survey and Analysis of Aquaculture Development Research Priorities in Asia

The study, which is a collaborative effort between the FAO Fishery Resources Division and the Network of Aquaculture Centres in Asia-Pacific (NACA), follows up on the results of the informal round-table discussion on aquaculture research priorities in Asia. The round-table discussion, was convened by the FAO Fishery Resources Division at the FAO Regional Office for Asia and the Pacific (RAP), Bangkok, Thailand, 1-4 February 1994, on the request of the SIFR Secretariat, to consider various strategies for a study of demand-driven aquaculture research priorities in Asia and agree on a cost effective approach. The discussion was attended by the EC/ASEAN Aquaculture Development and Coordination Programme (AADCP), NACA, the Asia Institute of Technology (AIT), the Asian Fisheries Society (AFS) and RAP;ICLARM and SEAFDEC could not attend.

The long term objective of the FAO/NACA study, which is being implemented by NACA, is to increase the contribution of applied research to the sustainable development of aquaculture and to facilitate regional and sub-regional research cooperation by bringing the attention of national governments and development agencies to specific opportunities for such cooperation. The immediate objectives of the study are: (i) to collect and analyze information on aquaculture development plan, priorities and constraints; development-oriented research needs and priorities; and research capacities; (ii) to prepare a synthesis of the situation in the region, (iii) to extract the regional and sub-regional research priorities that could be dealt with by groups of national institutions linked through activity oriented networks, and (vi) to prepare a draft action plan to implement regional and sub-regional research programmes based on the priorities indicated above.