Food and Agriculture Organization of the United Nations

Aquaculture Newsletters

December 1996 Number 14

Aquaculture Newsletter

(December 1996, Number 14)

Editorial

Improving the Database for Sustainable Aquaculture Development

Many countries do not have sufficiently developed information systems to allow them to prepare proper policy instruments and plans for the sustainable development of aquaculture. As a result, policy-makers and planners often operate with poor information, with a high degree of uncertainty about the impact of the selected policy directions and development plans. National databases need to be established (or strengthened), maintained and updated to provide sufficient relevant information in support of policy formulation and development planning. Data bases on production, production economics, markets and trade, employment, main information sources, etc. form part of such information systems. New types of data sets dealing specifically with resource use and resource degradation, as well as social and economic conditions, will also have to be developed gradually to monitor and assess the sustainability of development activities.

Some valuable information is available at the national level, but it is often dispersed among institutions, collected on different, often non-compatible databases, and is generally in need of collation, evaluation and updating before it can be put to effective use in planning. In strengthening the information base, it is essential to ensure the relevance of the information to local needs and to the purpose at hand, and to take into account any constraints that can limit or prevent the utilization of the information.

In view of this, and to help countries organize the information they need, the Fisheries Department of the FAO is devoting increasing attention to the development of specific data bases and information systems in collaboration with FAO Members and national and regional institutions. This will be linked increasingly with on-going efforts in capacity building which are being pursued through networking at the regional level. The GFCM Mediterranean Aquaculture Networks and supporting information system (SIPAM), highlighted in a previous issue of this newsletter, is an example. A mission is in the field at this time to prepare plans for the establishment of an aquaculture information network in Sub-Saharan Africa, and a preliminary consultation will be held in Asia, early in 1997, to review existing aquaculture-related data bases and assess the need for a SIPAM-type system, amended as necessary to meet national and regional needs. The possibility of linking the information system to a regional aquaculture network, managed in collaboration with existing regional institutions, will also be discussed. A mission is also planned in 1997 to review and strengthen the SIPAL system for Latin America, a precursor of SIPAM developed under the regional project AQUILA II. The Department is also continuing to refine the use of GIS for strategic analysis of aquaculture potential on a regional and continental basis, and is assisting interested Member Countries to develop a capacity in this methodology and to put it to use in aquaculture development planning at the national level.

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Aquaculture Newsletter

(December 1996 Number 14)

Aquaculture Development and Resource Limitations in Egypt[1]

[1]Based on a unpublished FAO mission report (1994); article published with the permission of the Government of Egypt.

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Background

Fisheries (and aquaculture) in Egypt is an important component of the agricultural sector and a significant source of animal protein. It accounts for 3.9% of agricultural production and 14.1% of total livestock and poultry production by value (FAO, 1994). The sector directly employs about 164, 000 people, representing 3.07% of employment in agriculture. It also provides additional employment for 20, 000 people in supporting services and industries. Estimated total fish production in 1995 was 407, 141 metric tonnes (mt), of which 70.6% (287,456 mt) derived from marine and brackishwater fisheries, 14.2 % (57,872 mt) from freshwater fisheries and 15.2% (61,815 mt) from aquaculture (Figures 1a-b). Total fish supply was 547,952 mt (with imports accounting for 26% of supply), or an average of 9 kg per capita. Demand for food fish by the year 2,000 is estimated at 544, 000 mt (FAO, 1994). The Government's development plan for the sector aims at increasing production to 700, 000 mt per annum by the year 2000 and raising annual per caput fish consumption to 10 kg.

The state of aquaculture

There have been a number of reviews of aquaculture in Egypt (FAO, 1994; Barrania and Sadek, 1994; Balarin,1986; Sadek, 1984). This article reviews and updates selected aspects of the sub-sector with emphasis on resource limitations.

Aquaculture policies and plans: Government policy restricts aquaculture development to land not suitable for agriculture. Aquaculture is often a transitional activity, as part of land reclamation programmes. Water use for aquaculture is also restricted to irrigation drainage water of variable salinity, and water drawn from coastal and inland lakes. Use of water from the Nile and from irrigation canals for fish farming is prohibited. Use of ground water is permitted mainly for fish hatcheries.

The General Authority for Fishery Resources Development (GAFRD) no longer provides subsidised production inputs (feed, seed and fertilisers) to fish farmers or control fish prices. However, GAFRD prices for fish fry collected from the wild is a small fraction of that on the "free" market price.

Land is leased to farmers for a five-year renewable period at about Egyptian Pounds (EGP) 50/feddan/year (US$ 1 = EGP 3.3), and provided on "homestead" basis to unemployed college graduates (10 feddans each @ EGP 25/feddan/ year). A small proportion of the fish farms (10-15%) is privately owned. The Social Fund for Development provides loans to of EGP 10,000-30,000 to young graduates over a four-year period at 10% interest, with repayment beginning the second year. Otherwise, commercial banks are the only source of credit to fish farmers.

Aquaculture development is given high priority in the current five year plan (1992-93/1996-97), in the

context of development activities aimed at increasing production through demonstration projects and extension. These include: (a) the development of fish farms in various governorates , (b) the development of marine aquaculture, (c) the national project for the development of tilapia culture, (d) the development of *Macrobrachium* culture, and (d) expansion of fish production in rice fields.

Cultured species: The main cultured species (Figure 2) are tilapias - mainly *Oreochromis niloticus* (about 35% of total aquaculture production), carps - mostly *Cyprinus carpio* (35%), mullets -mainly *Mugil ramada* and *M. cephalus* (23%), African catfish - *Clarias gariepinus* (3%), gilthead sea bream - *Sparus auratus* (2%), and sea bass - *Dicentrarchus labrax* (2%). Tilapia, carps and mullets dominate up to water salinity of 4 ppt, with mullets making up the bulk of stocked fish at higher salinities. GAFRD estimates that about 50-60% of existing farms can no longer stock carps and Nile tilapia due to increased salinity (in excess of 15 ppt) of irrigation drainage water and coastal lakes the main water sources for aquaculture; Barrania and Sadek (1994) give a lower estimate of 28%.

Production and production areas: Egypt has the earliest recorded history of fish-farming in Africa, superseding even carp culture in the Far East. In 1994, it accounted for about 48% (by quantity) of total aquaculture production from Africa (FAO, 1996). Production, excluding culture-based fisheries, peaked at 60, 000 mt in 1989, decreased to 53,000 mt by 1994 and recovered to 61,815 mt in 1995 (Figure 1b). Fish culture in ponds accounted for 65% of total aquaculture production in 1995 (39,908 mt), fish culture in rice fields 32% (19,930 mt) and cage culture 3% (1,977 mt)
(Figure 3). The total area under pond culture in 1995, excluding illegal enclosures in coastal lakes, was about 160,066 feddans (67, 255 ha, @ 2.38 feddan per ha). Private farms accounted for 60,174 ha (89%) and government farms 7,081 ha, or 11% (Figure 4). About 46,348 ha (69% of total pond area) consisted of unlicensed farms; i.e. farms using arable land (Figure 4). Rice-fish culture is practised in 172,769 ha of rice fields, while cage culture in the Nile provided a modest production volume of about 198,000 cubic metres in 1995.

The area of licensed pond farms peaked in 1987 at 45,529 ha, then declined by about 77%, to 10,559ha, by 1993 (Figure 5). This was due to the rapid increase in reclaimed land in the early eighties and the utilisation of aquaculture as a productive but temporary means of desalinating new lands, which subsequently reverted to agriculture. The area of rice fields used for rice-fish culture peaked at 224,917 ha in 1989 and subsequently declined, fluctuating between 173,000 and 183,000 ha since 1991. In 1995, the rice- fish area (172,763 ha) was below that reported for 1987
(Figure 6).

Production systems and practices: A variety of production systems are in use, ranging from traps to intensively managed systems [from lake stocking to production in enclosures, ponds, cages and tanks, and rice fields]. The systems have been described in detail by Balarin (1986) and Sadek (1984). Recent developments include the establishment of commercial-scale coastal pond farms, expansion of cage culture in the Nile and intensive culture of tilapia in tanks.

The commercial culture of freshwater fish in cages was stimulated by modest capital investment requirements, the limited availability of land and water for pond fish culture and promising cost-benefit projections based on GAFRD pilot tests (25% IRR).

The coastal fish farms (4,600 ha) in the Damietta Governorate, which operate within a water salinity range of 20 to 40 ppt, are the main brackishwater-marine farms. They are well designed, with water depth of 1-1.5 m. Water (20 ppt) is drawn from Lake Manzala and drains by gravity into a common area which connects to the Mediterranean. Ponds are stocked predominantly with mullets; sea bass and sea bream are also stocked when fry are available. A 5-ha pilot shrimp (*P. japonicus*) farm is in operation at Sharm El-Sheikh, Sinai. There are no mollusc farms.

GAFRD is conducting tests on cage culture of finfish at Fanara (Bitter Lake) and similar trials by the private sector (Maryut Fish Farming Co.) are underway at Matruh, in the Northwest, on the Mediterranean coast.

Production rates in ponds vary with pond depth, use of inputs, water management and salinity. The use of production inputs is extremely variable even with the same production system, due to differences in water depth and salinity, pond productivity and the availability of water and seed. Average production of about 1.6 t/ha/year (maximum of 2.5 t/ha/year) is reported from some government and private farms using polyculture systems, fertilisers and supplementary feeds; about 300-800 kg/ha/yr from the majority of the area under culture; 115 kg/ha/yr from rice fields and 10 kg/m3/yr from cages in the Nile. Production in the coastal ponds of the Damietta Governorate varies from 250 to 1,200 kg/ha/year, depending on inputs and water (salinity) management.

Seed supply and hatcheries: The Government plays a major role in the production of fish seed. It produces about 88% of the fresh water fish seed supply (mainly mirror carp) and is the sole supplier of seed of marine finfish. Seed of carp and tilapia are produced and distributed by nine government and four private hatcheries. In 1994-95, about 22 and 302 million fry of tilapia and carps were produced, respectively. Fry of mullets, sea bream and sea bass are derived exclusively from the wild resource, from 12 GAFRD collection sites along the Mediterranean coast, Suez Canal and the Red Sea.

About 128 million fry of marine fish were collected in 1994-95, 95% (122 million) of which were mullets, 3% (3.7 million) gilthead sea bream and 2% (2.2 million) Mediterranean sea bass. Collected mullet seed consists largely of *M. ramada* (estimated at about 70-80%) and *M. cephalus* (15-20%). The inaccuracy of these figures is uncertain; estimates as low as 25% of reported figures have been suggested.

The price of seed varies from year to year according to supply and demand. There is also a great difference between GAFRD and "free market" prices; for example, in 1994, the GAFRD price for mullet seed (0.3 g) was EGP 6/1000 pieces, compared to EGP 80-150 on the free market.

There are no commercial marine finfish or shrimp hatcheries in Egypt. A pilot mullet hatchery, which also produces some Mediterranean bass and bream, is operational at the Maryut Fish Farming Company (MFFC), but is not yet producing at full capacity. The MFFC also operates a *Macrobrachium* hatchery which is used at present to supply stocking material to the farm. A small research hatchery for shrimp *(P. Japonicus)* has been established at the Suez Canal University's Mariculture Research Center at Al-Arish (Bardawil Lagoon, Sinai) through an EC project. Another shrimp *(P. japonicus)* hatchery is in operation at a private shrimp farm (pilot phase) at Sharm El-Sheikh, Sinai.

Feed, fertilisers and feeding: Most farms use minimal inputs due to shallow ponds and low stocking densities (less than 1 fish per square metre), dictated by limited and/or uncertain water supply. Originally, cotton seed oil cake, wheat or rice bran and pelted cattle feed were the only available feed ingredients. The production and use of pelted fish feeds is a relatively recent development.

GAFRD has established two feed mills for the production of supplementary fish, with current production of about 3, 500 mt/year. A few animal feed mills have also set aside production lines for fish feed. The Fish Research Centre (Suez University) has a feed mill (capacity of 0.5 mt/hr of sinking pellets) and the MFFC is constructing its own mill (with extruder) for marine fish feeds. Farmers also shop for ingredients independently and prepare their feeds through private feed mills, who advance them credit till harvest. Coastal fish farms also utilise seasonal supplies of small shrimp and sardines, when prices are low, for feeding bass and bream.

Poultry manure and cow dung are more widely used than inorganic fertilisers. The latter are largely produced domestically, thanks to an abundant supply of natural gas, through six public-sector companies with a total capacity of 5 million mt/year.

Development prospects

The key factor governing prospects for expanding traditional freshwater pond culture appears to be the conflict with agricultural development (i.e. the priority allocation of land and water resources to agriculture) and the lack of integrated planning (for resource management) between the two sectors. These and other constraints, which collectively call for a shift in aquaculture development strategy, are discussed below.

Production: Average production from ponds, excluding government freshwater fish farms, is low (about 550 kg/ha/yr) and has not improved much during the past decade. Opportunities and methods for increasing production from existing farms have been detailed in the reports of various missions and technical assistance projects. However, the short duration of land leases from GAFRD (5 years), which does not encourage capital investment; the shortage of necessary resources good quality water, and seed and feed/feed ingredients; and weak extension services have hindered progress.

A doubling or tripling of production from private pond farms can be achieved with sustainable semi-intensive systems and known technology if resource constraints are removed. Production of 1.0 -1.5 mt/ha/yr has been achieved by some private farmers in the Fayum area, where low salinity drainage water is abundant, pond water depth is 1-1.5 m, and farmers have the means to purchase seed and feed. Production could also be increased to the same level in coastal ponds, from the present average of 360 kg/ha/yr, if an adequate supply of marine fish seed can be assured and water salinity can be controlled within a range of 20-35 ppt.

Water and Land Resources: The expected increase in water consumption to 70,000 million m3 by the year 2,000, and the ever present threat of drought, have made water conservation a priority. Plans call for re-utilisation of low-salinity irrigation drainage water, introduction of water-saving irrigation technologies and recovery of operating and maintenance costs of irrigation networks, leading eventually to price incentives for more efficient use of water. In the absence of integrated resource management, these plans will diminish prospects for the maintenance of existing freshwater fish farms, let alone the expansion of fish farm areas, by limiting the availability of irrigation drainage water and increasing its salinity, as well as increasing the price of available low salinity irrigation drainage water.

Plans are already under way to re-utilise one third of the run-off water entering Lake Qaroun, and diverting 2 billion m3/year of run-off water now draining into Lake Manzala to Sinai. This will raise salinities in these lakes, forcing fish farms using lake water to shift to the culture of brackishwater/marine species and endangering the put-and-take fishery in Lake Qaroun (1,300 mt/yr).

The availability of land for fish ponds is also a major constraint to the expansion of freshwater aquaculture. The total area of pond fish farms has fluctuated widely as reclaimed land was made available for aquaculture temporarily then returned to agricultural use. If unlicensed farms now operating on arable land were to be shut down, aquaculture production would drop by 75%. There are no recent estimates of potential sites (non-arable land) for fish pond development which would be available on a permanent basis, or the nature and extent of the secure water supply. Furthermore, aquaculture development in and along the coastal lakes (Manzala and Burullus) must also await a final government decision on the long term plans for these lakes (e.g. use of Lake Burullus for freshwater storage; continued land reclamation in Lake Manzala).

Clearly, there is need for a more thorough information base on the long-term availability of land and water resources for pond culture, and the future of coastal and inland lakes, to enable formulation of a long-term aquaculture development strategy. There is also need for close co-ordination with the Ministry of Agriculture, the Ministry of Irrigation and other government agencies involved in land use, land reclamation and management of water resources. Generally speaking, however, the potential for horizontal expansion of stand-alone freshwater pond aquaculture appears to be poor. Development efforts should be focused on (a) increasing production from existing freshwater farms with assured water supply, using efficient, moderate-input polyculture systems, (b) incorporation of freshwater aquaculture into existing farming systems, (c) more intensive use of inland water resources, and (d) development of brackishwater and marine aquaculture.

There are opportunities for cage culture of fish in the Nile, irrigation canals and inland lakes. However, pollution problems due to high cage density and poor siting, and concern about potential navigation problems on the part of the Ministry of Irrigation must be resolved if cage development is to expand again underlining the urgent need for inter-sectoral planning . Current shortages of fish (tilapia and mullets) seed and suitable pelleted feeds also need to be addressed to enable expansion of cage culture.

With proper inter-sectoral planning and assured production inputs (seed and feed), cage culture could be expanded to inland water bodies (the Al-Rayyan depressions and the High Dam Lake). In addition, there are about 4,700 km of irrigation canals in Egypt, parts of which could be used for cage culture of fish, in co-ordination with the Ministry of Irrigation, which is already producing grass carp fingerlings in cages for stocking in canals for weed control.

Seed and Feed Resources: Demand for seed of mullets, particularly grey mullet, Nile tilapia, sea bass and sea bream exceeds supply. This is reflected in the price of seed on the "free market", which, in the case of mullet fry (0.3 g), has increased by 230% (from EGP 45 to 150/1 000 pieces) since 1988.

The seed supply of euryhaline and marine fish, particularly mullets, requires urgent action for a number of reasons: (a) The Government wishes to eventually protect natural fry resources to revitalise capture fisheries in the coastal lakes. [Banning the collection of wild fry at present would reduce aquaculture production by 27%, not including production from stocked inland waters.] (b) The current supply of wild mullet fry (about 120 million/year), even if not over-estimated, is still inadequate to meet demand (about 100 million fry will be needed for stocking coastal farms alone). (c) Mullets are well suited to semi-intensive culture based on enhancement of natural food production and supplementary feeding and, by virtue of their feeding habits, are admirably suited as components of polyculture systems with freshwater or marine shrimp and tilapias. (d) Expertise in hatchery production of marine finfish and shrimp is very limited in both the private and public sector.

Tilapia seed is in short supply. However, the problem can be resolved by the production of tilapia fry in the many existing GAFRD carp hatcheries and by demonstrating low cost fry production systems to farmers. In addition, investment in hatcheries could be stimulated by increasing the price of marine fish and tilapia fry to "free market" levels.

In view of the pressing need to develop hatcheries for tilapia and marine fish and shellfish, the Government has enacted a law permitting appropriation of private land for the establishment of commercial hatcheries by Government agencies and related bodies.

Aquaculture competes with agriculture for manure, but the supply of fertilisers does not pose a problem. The establishment of two fish feed mills by the GAFRD seems to indicate that competition with livestock for agricultural by-products has been somehow averted. Most protein in animal and fish/shrimp feeds is of plant origin as supplies of animal protein are limited and expensive. The use of animal proteins for fish feed would be, in most cases, in direct competition with its use for direct human consumption. There is need to improve the supplementary feed produced by GAFRD for freshwater fish and to prepare supplementary feeds for marine fish, based on local ingredients, at reasonable cost.

Marine Aquaculture: The high priority assigned by the GAFRD to the development of marine aquaculture in its current five-year plan is warranted by the obvious constraints to expanding production from freshwater aquaculture, and the keen interest of the private sector. However, development is proceeding without adequate planning. This has already lead to serious problems of water management and pollution in coastal ponds due to a faulty pond water supply and drainage system. The adoption of semi-intensive production systems in coastal pond farms is also being constrained by limited feed and seed resources, and production management expertise.

The potential for the development of marine aquaculture has not been properly assessed, and economically viable production systems are yet to be identified and validated through pilot production tests. Unless this situation is remedied, there is danger that failure of poorly planned ventures will discourage future investments.

A number of opportunities for marine aquaculture have been tentatively identified by external consultants. These include: (a) potential sites for various production systems along the Red Sea coast, (b) potential for the culture and stock enhancement of Mediterranean sea bass and sea bream in Bardawil Lagoon, Sinai (c) potential for development of semi-intensive marine fish farms in association with proposed channels

for improving the circulation of Lake Burullus, and (d) potential sites for land-based and cage production systems in the Matruh/Alamein area, and at Fanara, on the Bitter Lake. Though these studies provide valuable information, they contain little data on the social and economic feasibility of the proposed production models.

A number of development activities need not await the formulation of a marine aquaculture development plan. Most important of these is the establishment of marine hatcheries. Other activities include improvement of locally produced feeds, addressing water salinity and quality problems in coastal farms of the Damietta Governorate, and training programmes for fish farmers.

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Aquaculture Newsletter

(December 1996, Number 14)

Stocking as a Technique for Enhancement of Fisheries[1]

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[1][See related article in FAN 12, April 1996]

Introduction

Naturally derived fish production from inland and inshore marine systems is becoming increasingly limited for two reasons. Firstly native fish assemblages have been unable to adapt to the declining quality of the aquatic environment and secondly, many fish species fail to compensate for excessive fishing through natural reproduction. As a result of these two stresses catch from inland fisheries based on naturally reproducing fish populations is declining and catches in some coastal areas are likewise threatened. One response to this crisis has been to use stocking with selected species to mitigate the damage and to maintain or increase catches. In this way some conventional inland and coastal fisheries are being transformed from capture fisheries to a form of aquaculture.

There are diverging scenarios for the management of inland and coastal waters for fisheries based mainly on differences in social, cultural and economic factors. These differing views, which are simplified in Table 1, have implications for the ways in which the waters are managed and, in particular, for the development of stocking programmes and of aquaculture.

In developed countries stocking coupled with habitat maintenance became the major form of inland fisheries management relatively early in the present century. More recently, aquatic resource use is becoming increasingly subordinated to conservation. Production facilities are generally isolated in controlled fish-farms and the inland waters are destined mainly for aesthetic and recreational uses. Ideally in this regime stocking programmes are limited to low numbers of large fish in support of native species or restoration of endangered ones, but exceptions are common in lakes where capture fisheries are supported by large scale stockings and in some recreational fisheries which are still intensive and are maintained by high stocking rates with smaller fish. In the sea the collapse of many inshore grounfish resources is inducing some countries to compensate by stocking finfish, crustaceans and molluscs.

In developing countries there is a large food deficit, and inland fisheries are called on to maximize yields. As a consequence most inland waters reached their maximum potential under natural production some time ago, and rising demand is now pushing many tropical waters to maximize yields through enhancement. In many countries this process is now advanced with the development of infrastructure for the production of fingerlings for stocking. In other areas lack of funding and infrastructure is delaying the process despite there being adequate physical potential. In many cases there is a close integration between capture and culture through extensive and semi-intensive management of artificial water bodies and rice paddies.

Stocking programmes in both regimes have been pursued uncritically with little scientific evaluation of their success or failure. Whilst the primary motive for stocking was political, either to convince recreational fishermen that Government authorities were looking after their interests or to subsidize fishermen's communities which would otherwise have insufficient catch, the need for evaluation was not pressing. However, where stocking is used as a tool to maximize yields, outlay in stocking material is usually the major cost and thus a more rational approach to the use of resources can result in considerable savings.

Major stocking programmes

Although 94 countries have reported stocking to FAO as part of their fishery statistics only a few countries have documented the success or failure of their programmes. Examination of the scientific literature produces some 4, 847 references extracted from ASFA (1978-96) dealing with stocking of finfish, molluscs or crustaceans into inland or marine habitats most of which do not help understand the rationale of the stocking exercises. Most documented evaluation of stocking programmes appears in national or international reports and is drawn from very few countries including China, Cuba, India, Mexico, Poland, Russia and Sri Lanka for inland waters and Canada, Iran, Japan, Norway and the U.S in marine fisheries.

Stocking with major carps has been the main policy for management of Indian reservoirs since the early 1960s. Programmes were initially unregulated, with no evaluation of their effectiveness, but where a more scientific approach has been adopted, yields and profitability have increased substantially. For example effective stocking policies raised production from 1.67 kg/ha in 1964 to 194 kg/ha in 1985 in one reservoir, whilst in another yields rose from 10 kg/ha in 1966 to 107 kg/ha in 1991. Total and the percentage of commercially valuable major carps in the catch were substantially raised in many other reservoirs (Sugunan, 1995).

In other parts of Southeast Asia (Thailand, Philippines, Malaysia, Indonesia and Sri Lanka) where natural productivity is about 20 kg/ha (Fernando, 1977) stocking in inland waters raised yields to over 100 kg/ha. In China, the very intensive stocking rates of 2,250-4,500 fish/ha of fertilised reservoirs have substantially increased in yields and profitability.

Reservoirs of the former USSR (Berka, 1989) have been managed by stocking since the late 1960s. Stocking rates and procedures were defined for various species of fish and accompanied by measures to improve fertility, the structure of the lake and the elimination of the pre-existing fauna. Yields were considered far higher in managed lakes at about 250 - 500 kg/ha than those left to natural processes.

Stocking is not universally effective however. Systematic studies of 60 Cuban reservoirs for up to 13 years (Fonticiella et al., 1995) showed that for species that breed naturally and for which adequate spawning substrates exist, stocking exercised little influence on fish catch. Sugunan (1995) also suggests that stocking has proved ineffective in some Indian reservoirs.

Origin of stocking material

Seed material for stocking extraction either comes from natural spawning from rivers and lakes or from aquaculture installations.

Natural production

Early stocking and aquaculture were based heavily on seed from natural sources and in several species, such as shrimp, milkfish, yellow tail and eel, stocking continues to be based on natural production today. The practice of extracting large numbers of young fish from rivers and lakes has caused concern to fisheries managers on the basis that this would damage the sustainability of stocks. Welcomme and Hagborg (1977) proposed that under normal conditions a considerable proportion of the young-of-the-year can be removed from floodplain rivers due to the overproduction of 0+ fish from such fluctuating systems. The situation in lakes and regulated rivers would appear more precarious due to the lesser flexibility in the dynamics of stocks from more stable systems. The sustained withdrawal of large numbers of fry from Chinese and Indian rivers over a period of several decades would appear to support the contention that river stocks can be used as a source of supply for stocking material. However, a combination of overfishing and environmental degradation have had impacts on the stocks. For instance, in Chinese rivers, fry availability and fish populations have declined substantially mainly due to the exploitation of the stock (Lu, 1994). The Ganges river provided 90% of the seed needed for carp aquaculture in 780000 ha of ponds and tanks in India in 1964, and by 1989 these numbered 3.7 billion individuals. At these levels of offtake the fisheries for the major carps were judged to be collapsing with a seed supply that was reduced

both in quantity and quality. At the same time the percentage of major carps in the catch and in seed supplies was declining in favour of minor carps (Natarajan, 1989). In 1995, seed collection apparently still formed a major industry in the middle and lower Ganges.

Hatchery production

While most early stocking was carried out with material of natural origin, a few species which could be induced to spawn through simulated natural processes were stocked from hatcheries even in the last century. Indeed, many of the early salmonid hatcheries in Europe and North America dating from the end of the last century were set up for stocking of sport fisheries rather than for the production of table fish. Early hatchery production concentrated on producing massive amounts of eggs or larvae, but as size at release is now realised to be an important factor in the success of stocking, release generally takes place at a more advanced stage. The development and spread of techniques for controlled, induced spawning in the 1950s and 1960s generally freed the aquaculture sector from natural sources of supply and at the same time provided an alternative source of seed for stocking a greater range of species.

Size of fish stocked

Two main factors influence the size chosen for stocking material, cost and survival. The penalty of high mortality acts against the stocking of fish at too small a size, while the increased cost of the stocking material with increasing size tends to favour stocking of early life stages, especially in slow growing species. The actual size chosen usually depends on an empirically determined balance between these two factors as well as on the life history of the fishes. Migratory and anadromous fishes such as salmonids are usually stocked at a small size (fry) to prepare for migration as their size increases, whereas cyprinids are generally stocked at a larger size (fingerlings).

Dynamics of stocking

The dynamics of stocking are apt to be particularly complex when fish are stocked into systems where there is also natural reproduction of the stocked species. Mortality may increase and growth rates decrease due to the addition of excess elements to the stock. Clearly these effects will depend on the relative proportions of stocked fish to those originating from natural reproduction. It is clear that where there is adequate natural reproduction stocking may well be superfluous, as in the case of tilapias in Cuban reservoirs (Fonticiella et al.,1995). In some fisheries, such as the Finnish coregonid fisheries and the Polish lake fisheries, stocking has made a long term positive contribution despite there being naturally reproducing stocks of the target species (EIFAC, 1983). In other lakes, for example in Thailand (Bhukaswan,1988), it has been impossible to evaluate the biological and economic success of stocking due to difficulties in separating stocked fish from natural production.

Analysis of the few data sets on stocked systems where the stocked species does not reproduce indicates an interplay of two main variables - the area of stocked system and the stocking rates. Thus:

i) *Yield is related to stocking rate*. Relationships between stocking rate and catch may be obtained for one lake, for example the Nanshahe reservoir in China where Yield in kg/ha is directly proportional to stocking density (Li and Xu, 1995), or for a series of lakes as in the case of Sri Lanka or Mexico. Relationships are usually assumed to be linear but some interpretations, such as that of Amarasinghe (in press), predict curvilinear relationships between stocking rate and yield, with an initial rise in yield but a later fall as density dependent factors come into play.

ii) *Yield per unit area is inversely related to the area of the stocked system*. Stocking has generally proved more effective in small reservoirs in many regions although larger water bodies are also stocked. Data sets from China (Li and Xu, 1995), Sri Lanka (Amarasinghe, in press) and Mexico (FAO, 1992, 1993) all show strong inverse relationships between reservoir area and yield per unit area which are linear on log-log scales. Fonticiella et al., (1995) found a similar influence of area in Cuba where there was a very strong correlation between stocking density and catch in small reservoirs managed semi-intensively but a lesser correlation in extensively managed larger water bodies. But...

iii) *Stocking rate is inversely related to lake area.* In nearly all countries practising stocking there is a tendency to stock fish at lower densities into larger water bodies. This is generally justified by a) the supposition that competition and predation will be greater in larger water bodies and therefore survival rates will be reduced, and b) that other aspects of enhancement such as fertilization, control of unwanted species or construction of artificial faunas are more controllable in smaller water bodies. If the first of these suppositions were true then the efficiency of stocking in terms of yield per unit stocked would be expected to fall as the size of the stocked water bodies increased. In none of the cases examined was there a correlation of this type and efficiency of stocking remained roughly the same over a vast range of reservoir areas. It must be concluded therefore that, at present, the practice of using small water bodies for intensive and large ones for extensive stocking depends more on the high number and cost of fingerlings needed for stocking the larger water bodies, and the difficulties of controlling other parameters, including poaching, in the larger reservoirs.

Although stocking in inland waters and that of marine systems are usually treated as separate topics, there is little biological justification for this division. Because of their size marine systems tend to be stocked at low levels relative to the whole area available. However, for species that are relatively sedentary, or those stocked and harvested from nearshore waters before moving out to sea, the stocking density related to the area of residence may be much higher than is apparent.

Summary of stocked system

The increases in productivity and the associated enhancement strategies at various levels of stocking are described in Table 2.

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Aquaculture Newsletter

(December 1996, Number 14)

The Use of Chemicals in Aquaculture: *A Summary Brief of Two International Expert Meetings*

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The use of chemicals is common in various aquaculture systems, as it is in many agricultural practices. However, with growing worldwide awareness of the need for responsible practices in aquaculture, governments and aquaculturists are increasingly 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/or environment. It has been recognized that there is a need to synthesize and disseminate information on the use and management of "aquachemicals", with emphasis on various aquaculture systems and species utilized. In order to address related issues and needs, two expert meetings on "aquachemicals" were held in May 1996 at the Aquaculture Department (AQD) of the Southeast Asian Fisheries Development Center (SEAFDEC) in Tigbauan, Iloilo, Philippines.

The Expert Meeting on the Use of Chemicals in Aquaculture in Asia, held 20-22 May 1996, was organized by SEAFDEC/AQD and the FAO Fishery Resources Division with support from SEAFDEC, FAO and CIDA's ASEAN Canada Fund. WHO headquarters covered the participation of a human health expert. Experts from several institutions and organizations active in the region were invited including the Network of Aquaculture Centres in Asia-Pacific, Fish Health Section of the Asian Fisheries Society, Japan International Research Center for Agricultural Sciences, and others. The meeting was attended by 27 participants and more than 70 observers, from the public and private sector in 20 countries.

Presentations included:

(a) general thematic reviews on a wide range of subjects including:

- use of chemicals in aquaculture: issues and challenges,
- antibacterial chemotherapy in aquaculture,
- ecological effects of chemical usage in aquaculture,
- transferable drug resistance plasmids in fish-pathogenic bacteria,
- use of chemicals in aquafeeds,
- human health aspects of use of chemicals in aquaculture,
- regulations on use of chemicals in aquaculture,
- use of organic manures, fertilizers, and soil and water conditioners in aquaculture, and

(b) country overview papers on the use of aquachemicals in Bangladesh, Cambodia, China, India, Indonesia, Japan, Laos, Malaysia, Pakistan, Singapore, Philippines, Taiwan (Province of China), Thailand and Viet Nam.

General information on relevant international initiatives and agreements was also presented, including:

(i) the Code of Conduct for Responsible Fisheries and its Article 9 on Aquaculture Development,

(ii) the FAO/WHO Codex Alimentarius Commission, its Joint FAO/WHO Food Standards Programme and

the Proposed Draft Code of Hygienic Practice for the Products of Aquaculture,

(iii) the Joint FAO/WHO Expert Committee on Food Additives (JECFA),

(iv) the Sanitary and Phytosanitary Agreement (Article XX of Legal Texts of the Uruguay Round adopted by Members of the General Agreement on Tariffs and Trade), and

(v) the International Code of Conduct on the Distribution and Use of Pesticides.

After the presentations, participants and observers met in working groups and plenary sessions to discuss the roles and responsibilities of both the private sector (manufacturers, suppliers, retailers, users of chemicals) and the public sector (government, line agencies and academia), in relation to the use of aquachemicals and possible avenues for improved collaboration among all parties concerned.

General findings from this expert meeting can be outlined as follows:

(i) A wide range of chemicals are being utilized in aquaculture, for numerous purposes and in different aquaculture systems. When discussing aquachemicals, it is important that clear distinctions be made between the many different aquaculture systems and species employed and the specific patterns of application of chemicals.

(ii) Many chemicals are essential for successful and efficient farm and hatchery management.

(iii) Generally, most chemicals used do not appear to carry significant potential for adverse effects on human health or environment, provided that they are applied in a technically appropriate manner.

(iv) Significant difficulties were experienced in the compilation of data on chemical usage in Asian aquaculture, and further efforts are urgently required to generate an adequate information base for management advice on safe and effective use of chemicals.

(v) There is a need to facilitate exchange of information and collaboration among manufacturers, suppliers, "middlemen" (salesmen, traders, etc.), importers, and users (i.e. aquafarmers) of chemicals.

(vi) The roles and responsibilities of the public sector (i.e. government, academia) are significant with regard to management and regulation of chemical usage in aquaculture.

(vii) There are major constraints to the promotion of safe and effective use of chemicals in aquaculture:

- lack of trained manpower (e.g. lack of experienced fish health management specialists) and related capacity building schemes and support services to disseminate information on fish health management;
- the misapplication of some chemicals (e.g. the excessive prophylactic use of antibacterials) is often due to aquafarmers lacking access to information on appropriate use, or due to the lack of effective yet economic viable alternative management measures or suitable alternative chemicals which would help reducing the use of some potentially hazardous chemicals; promotion of certain chemicals by "middlemen" (salesmen, retailers, etc.) or drug companies may also play a significant role in the overuse of chemicals;
- insufficient understanding of mode of action and efficacy of certain chemicals (e.g. some chemotherapeutants and pesticides), especially under tropical aquaculture conditions;
- uncertainties with regard to legal and institutional frameworks to govern chemical usage in aquaculture; specific provisions are insufficient or even lacking; mandate and responsibilities of various line agencies in charge of public health and food safety, agriculture, animal health services, environment, etc., sometimes are not well defined; there are enforcement problems.

(viii) The use of chemicals in aquaculture may have significant implications for international trade of aquaculture products. Countries exporting aquaculture products, especially shrimp, are facing food safety requirements (e.g. maximum residue levels; banning of chemicals) which have been or are being formulated by importing countries. Controversy on these issues may increase due to activities by certain

pressure groups.

This first regional expert meeting on the use of chemicals in Asian aquaculture showed that collaboration among organizations and initiatives active in the region (e.g. SEAFDEC, FAO, CIDA, NACA, Asian Fisheries Society, Asian Institute of Technology, and others) can be very successful. Similar collaborative efforts should be further promoted, with emphasis on increased involvement of representatives of the private sector (pharmaceutical, pesticide and feed manufacturing industry, traders, and aquafarmers).

The findings of the regional SEAFDEC/FAO/CIDA expert meeting were discussed by an ad hoc meeting (24-28 May 1996) of the GESAMP1 Working Group on Environmental Impacts of Coastal Aquaculture with a view to address major environmental and human health issues related to the use of chemicals in coastal aquaculture as practised worldwide. The experts compared experiences and information available from coastal aquaculture in temperate and tropical environments. They reviewed groups of aquachemicals including antibacterial agents, pesticides, herbicides / algaecides, therapeutants other than antibacterials, feed additives, anaesthetics, hormones, soil and water treatment chemicals, fertilizers, disinfectants, and chemicals associated with structural materials.

Discussions dealt with issues of concern related to stimulation of resistance, health of employees, residues in seafood, residues in non-cultured organisms, toxicity to non-target species, persistence in aquatic environments and effects on sediment biogeochemistry. The group also examined major problem areas and possible solutions, particularly intensification, fish health management and access to information; residues and related assessment methods and enforcement issues; prophylactic use of antibacterials; quality assurance of chemicals used in aquaculture; lack of data on quantities of chemicals used; difficulties of effluent treatment; international trade; lack of information specific to the environment; lack of alternatives; and lack of regulatory controls. A set of guidelines for use of chemotherapeutants and pesticides in coastal aquaculture was formulated.

The proceedings of the regional SEAFDEC/FAO/CIDA expert meeting as well as the study report of the GESAMP Working Group are currently under preparation and are expected to be published in 1997. (GESAMP = IMO/FAO/Unesco-IOC/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on Scientific Aspects of Marine Environmental Protection).

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Aquaculture Newsletter

(December 1996, Number 14)

Legal Aspects concerning Aquaculture:

Some Food for Thought[1]

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[1]This is one in a series of articles on legal aspects of aquaculture. Previous articles can be found in No. 7, August 1994, No. 8, December 1994 & No. 11, December 1995 of this Newsletter.

Introduction

The Code of Conduct for Responsible Fisheries was unanimously adopted by FAO members in the 28th Session of the FAO Conference in October 1995. The Code was prepared in follow up to the outcome of the International Conference on Responsible Fishing, held in Cancun, Mexico in 1992, and on the recommendation of the FAO Governing Bodies. It provides a framework for national and international efforts to ensure sustainable exploitation of aquatic living resources in harmony with the environment.

Article 9 of the Code is devoted to aquaculture and comprises provisions relating to the responsible development of aquaculture in areas of national jurisdiction and within transboundary aquatic ecosystems, the use of aquatic genetic resources, and responsible practices at the production level. Governments around the world are becoming increasingly aware that one of the prerequisites for the development of responsible aquaculture is the existence of appropriate supportive legislation. This prerequisite is supported by sub-article 9.1 of the Code.

A wide variety of existing laws can and do affect aquaculture activities, either directly or indirectly, within any given country. There are also a number of legal issues which relate to or are originated by environmental concerns, which may complicate the growth of the industry. The present article attempts to highlight a few legal and institutional initiatives which have been taken in some countries for ensuring sustainable development of the sector without inflicting oppressive restrictions on the aquaculturist. They include improved authorisation processes, devolution of responsibility for resource management to local authorities, forms of user rights allocated to associations/co-operatives, and economic approaches.

Improved authorisation processes

Processes for the licensing of aquaculture activities in most countries are usually complex and involve a number of different institutions. Streamlining of approval procedures and an integrated consultation process would undoubtedly help to reduce bureaucratic complexities as well as transaction costs to governments and aquaculturists. A more serious problem perhaps is the fact that licensing systems sometimes lack specific instruments to help ensure sustainable development, which makes them less than ideal for protecting the environment; that is, they lack incentives and disincentives for promoting environmental protection. Because of this, new environmental tools have been and are being created and tried in several countries of the western hemisphere to supplement existing legal systems, to help achieve sustainable management of natural resources and compliance with environmental protection plans. Some of them, such as the "*voluntary agreements" or "eco-contracts"(e.g. Denmark)* or *"covenants" (e.g. Netherlands)* between Government bodies and industrial organizations could find an application in the aquaculture industry.

The rationale behind these agreements and arrangements is that an integrated and preventive pollution control cannot be achieved without close and active co-operation of the industry. They lay down binding objectives for the reduction of the use, the emission and disposal of specific potentially harmful products, substances and materials. As environmental action plans sometimes have objectives that are too broad to be of practical value, these "agreements" allow the definition of specific targets on a sector-by-sector basis. Government-industry agreements of this type help reduce the cumbersome bureaucracy involved in issuance of individual permits and the constant updating of such permits. The burden of reduction of pollution is shared among the members of a target group in a rather fair manner and the members preserve a certain freedom to set time frames for achieving targeted improvements in pollution control. Under these arrangements, companies appear to demonstrate more initiative in working out plans of action and mechanisms for their implementation, such as sharing costs of research, self-surveillance, etc., which reduces efforts and inputs from the legislators/regulators. The process of mutual surveillance among members of a group allows the institutions to concentrate on "environment protection-resistant or unfriendly" companies. At the same time, breaches or violations can be identified quickly and easily. However, these models are not universally practicable or applicable. They are enabled when the legal system of the country allows for this kind of "substitute" to national legislation; where a tradition of consensus-seeking and joint problem solving exists, and where associations or other groupings of the involved private sector are in place.

Devolution of responsibility for resource management to local authorities

In many countries, the present trend in national legislation is to devolve, where possible and appropriate, responsibility for resource management/control decisions to local authorities. The underlying reason is that those closest to the resource will make more appropriate management decisions, being better informed, with a much higher likelihood of acceptance by resource users and, therefore, a higher probability of implementation. This is the case since 1991 in *New Zealand* where the local authorities have practically all the legal power over access to and use of resources (specially marine and coastal resources). The central government has taken the role of adviser and is in charge of preparing the national policy statements which need to be taken into account by the local management plans. The latter are prepared at village and district level.

In the *Republic of Korea*, local and central fisheries authorities involved in planning and research consult and collaborate closely for the purposes of defining fisheries management policies, for issuing aquaculture licences, etc. Extension services have been set up in key aquaculture areas to maintain close contact with all elements of the sector. The extension services are responsible, among other things, for delivering monthly reports to the National Fisheries Administration and the National Fisheries Research and Development Administration concerning a variety of information collected from aquaculturists, co-operatives and aquaculture associations. In addition, the introduction of regulatory measures is usually accompanied by an educational program to help achieve the required acceptability and implementation of these measures by agriculturists.

Centralisation and decentralisation of authority have comparative advantages and disadvantages that vary from country to country depending on existing institutional factors. In addition, and in some instances, the high economic importance of some cultured species, and influential development interests, complicate the management and protection of the environment by local regulators and resource users.

Forms of user rights allocated to associations/co-operatives

Property rights often emerges as a key issue in the analysis of environmental problems associated with aquaculture. Studies have shown that the establishment of ownership and tenure systems are contributing significantly to the conservation and management of critical habitats and their resources. Where areas are owned and managed by the state, access may need to be regulated to avoid degradation, but the rationale behind restrictions and prohibitions is often not understood, and adherence to regulations is therefore often inadequate.

The granting of exclusive user rights to communities, co-operatives or other forms of association appears to enhance users' compliance with agreed regulations and the achievement of effective conservation and sustainable management of resources in a locality. In this regard, the combination of creating aquaculture associations or co-operatives and allocating exclusive "tenure" systems, articulated around concepts of self management, self implementation, self initiative and mutual surveillance, as practised in the *Republic of Korea*, may be a very effective approach. In view of these facts, there has been a trend in recent years to recognise that the principles which underpin traditional "regulatory" systems may be useful in promoting sustainable management and equitable allocation of natural resources for the purposes of aquaculture. For instance, in *Japan*, traditional fishing rights (including fish culture), originally controlled by village leaders, have now been transferred to village-based co-operatives.

In the future, planners and policy makers need to assess whether it is appropriate and useful to incorporate or recognise the customary rights of common ownership or common use in any new regime in order to attain the objectives of sustainable aquaculture and environment conservation. However, it is believed that management should not be left entirely to the discretion of the stakeholders; a basic supportive legal framework should be also be put in place to underpin and guide local management of resources.

In the process of introducing these "new" "tenure" systems, some countries (*e.g. United States of America, Madagascar*) have provided aquaculturists with the protection and benefits traditionally available only to terrestrial farmers, by amending their statutes to include aquaculture as a form of agriculture, for purposes of marketing, promotional activities and financing. As a consequence, aquaculture operations could be considered for loans, other credit facilities and insurance. Further, the setting up of co-operatives led to increased buying and selling powers through economies of scale, and provided tax advantages to qualifying groups.

Economic approaches

Economic approaches have been employed to secure environmental protection based on the rationale that economic incentives are more likely to bring about production decisions favourable to environmental protection than traditional regulatory approaches. Most of these interventions impinge on production aspects and, therefore, on revenue. In some countries, rental systems for aquaculture areas have been linked to production output, and thus to an underlying decision on how much production should take place in a given locality. Other countries (*e.g. Japan, Republic of Korea, Hong Kong, Denmark*) have placed tariffs on the basis of stocking density.

Tariffs on continuous production can also be found in some national legislation (*e.g. for cage culture of salmon in Scotland*). This is intended to encourage fallow periods for production sites either through discontinuous production or site rotation. In some cases, the tariff is designed to encourage a period of zero production until the acceptable ecological conditions of the aquaculture site have been recovered. However, considerable difficulties have been encountered in the establishment of tariffs.

Tradable permits, most often used for air pollution, are another potential regulatory instrument. Such permits, are likely to be used to control the emission of nutrients to ambient waters in closed or semi-closed aquatic areas. In this case, the property right to emit nutrient-rich effluent would be divided into a number of units, their sum representing the maximum authorised level of emission for a particular site. The individual units would then be sold as permits for a specified quantity of nutrient output. This would tend to create a market for nutrient loading/emission credits in cases where licensed emission levels are not fully utilised by one or more polluters. This in turn would create a further incentive for pollution abatement and increased efficiency in production in a given site within the overall nutrient loading limits. Critical issues in this case relate to the assessment of the environmental capacity of a given water body to assimilate given or predicted nutrients loads, setting of critical loads and standards and the possible concentration of power, in the "license-to-pollute" market, in big producers.

Conclusion

FAO recognises that farmers, fishermen and forest dwellers - as ultimate users of many terrestrial and marine resources - need to be involved directly or through their organizations, in efforts to ensure sustainable resource use, including fisheries and aquaculture practices. Article 9 of the Code of Practice for Responsible Fisheries fully endorses this principle. All initiatives taken above show that laws can rarely produce the desired results without taking into account the "stakeholders" of the sector concerned. In addressing the need for regulations lawmakers must design and adopt laws tailored to their country-specific circumstances.

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Aquaculture Newsletter

(December 1996, Number 14)

Legal Aspects concerning Aquaculture:

Aquaculture in the GFCM countries. Its evolution from 1984 to 1994

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This article is based on a discussion paper and a special presentation by the author at the First Session of the Aquaculture Committee of the General Fisheries Council for the Mediterranean (GFCM), which was held at FAO Headquarters from 9 to 12 September 1996.

Volume of aquaculture production in the GFCM countries

The data analyzed in this article are derived from the Aquaculture Statistics prepared and published annually in the FAO Fisheries Circular FIDI/C815 (Rev.8) by the Fishery Information, Data and Statistics Unit (FIDI) of the FAO Fisheries Department. The published statistics are based on information provided by member countries and other relevant published information. The production figures presented here include all production from GFCM member countries, irrespective of the production site.; i.e. the figures do not refer exclusively to production on the Mediterranean coastline and near shore waters. For those that are not familiar with the FAO fisheries advisory bodies, the GFCM covers all the countries in the Mediterranean basin plus Bulgaria and Romania in the Black Sea basin.

Total production from aquaculture in the GFCM countries rose from about 634,900 t in 1984 to 770,684 t in 1994, which represents a 21 % increase in a decade (Table 1, Figure 1). This increase, though not spectacular when compared to other regions, is worth examining in more detail. Aquaculture in the GFCM area has been dominated since 1984 by three countries France, Italy and Spain, which contributed 84% of the total production in 1984. This percentage decreased to 80% in 1994 despite the increase in production, due to the entry of new countries into the aquaculture scene. In 1984, Spain was the leading producer, but with a production consisting mainly of mussels (93% of the total and with only 7 species reported). The French production was mainly oysters (58%) and mussels (27%) with 13 species reported, and the Italian production was also dominated by mussels production (62%) and rainbow trout (24%), with 12 species reported. In 1994, France had taken the lead from Spain and Italy, and although molluscs remained the main group in the three countries, the number of species farmed had increased to 28 in France, 21 in Spain and 14 in Italy. Moreover, in 1994 several countries which had little or no production in 1984 reported annual production levels between 100 and 1000 t in 1994. A dramatic increase in production occurred in Greece and Turkey, with production increasing 14 fold (to 35,500 t) in Greece, and by 7 fold (to 16,000 t) in Turkey.

Growth of aquaculture production in the GFCM area was slowed down by two main factors: the political and economic transition in Eastern Europe and the drastic fall in mussel production in Spain. Comparing the situation in 1984 and 1994, the first resulted in a net loss of over 26,000 t, and the second accounted for a decrease in production by some 100,000 t. In addition, a progressive saturation of the mollusc market, the main aquaculture commodity in the region by volume, contributed to the slow down in the growth rate of the sector.

Regarding commodities, molluscs were the prevailing group in 1994 with over 480,000 t of production

(Figure 2), but showed only a 4% growth over 1984. The production decrease of 90,000-100,000 t in Spain was compensated elsewhere by mussels as well as clam and scallop production. Red tides were the major problem for mollusc production in Spain. The production of the second commodity group, freshwater finfish, reached 225,000 t in 1994, an increase of about 47% over the 1984 figures. Here, rainbow trout accounted for 90% of salmonid production, which moved from 66,000 t in 1984 to 120,000 t in 1994. Carp production, a traditional practice in East European countries, decreased from the late 80s as a result of the political and economic changes in these countries. Another important group of freshwater species were the tilapias which had a rather steady growth in the decade, although their production is concentrated in Egypt and Israel.

Marine finfish attracted more attention in the GFCM region, with a fast rise of over 1050% in the decade, moving from 4, 500-6,000 t in the mid 1980s, when the main cultured species were mullets, to over 53,000 t in 1994, when the seabass/seabream group dominated the production with a total of over 37,000 t.(Figure 3). This rapid increase has been due to the mastering of seed production techniques for seabass and seabream, and more recently for flat-fish; the formulation of specialized feeds and the use of cages as the main rearing technique; combined with generous financing of infrastructure by the EU for its member countries and a very favorable market situation for aquaculture products in the late 80s to the early 90s. The growth of mullet production is noteworthy from 4,000- 6,500 t in the mid 80s to 12,500 t in 1994, which has been essentially based on wild seed and land-based grow-out facilities.

Crustaceans and seaweeds are recent entries in Mediterranean aquaculture and are still of limited importance. *Procambarus clarkii* dominates in crustacean production, but pilot tests have been carried out for penaeid shrimp, using extensive techniques in the northern shore and more intensive practices in the southern countries. *Gracilaria* is the main species of seaweed cultured in the GFCM area.

Economic and marketing data

The value of aquaculture production in 1984,1989 and 1994 is shown in Figure 4. The cumulative value of aquaculture production in the GFCM area is estimated from the data reported by the individual countries. The value in national currency is transformed to US $ using the estimated prevailing exchange rate for the year.

Aquaculture production value amounted to US $ 799 million in 1984 and increased to US $ 1,412 million in 1989 and US $ 1, 840 million in 1994 more than doubling during the decade, compared to a mere 20% increase in volume. However, the increase in value was faster in the first five years (78% compared to 32.5 % in the period 1989-94), which may be indicative of a progressive saturation of markets and a corresponding decrease in prices. By contrast, production volumes increased 11.3% between 1984 and 1989 and 9.1% between 1989 and 1994. The five most important aquaculture producer countries accounted for US $ 1, 539 million in 1994, or 85 % of the total production value from the area. The increase in production value differed among the main countries. It was almost threefold in France (from US $ 226 to 639 million) for a corresponding increase in production volume of 45%, and two fold in Italy (from US $ 174 to 374 million) for a corresponding production increase of 62% over 1984. In Spain, in spite of a decrease of 27% in production volume, production value increased by 17%. However, the more spectacular growth was experienced in Turkey and Greece where it was 30 and 20 fold respectively, going from US $ 5.7 million to US $ 161 million in Turkey and from US $ 6.6 million to US $ 120.5 million in Greece.

Table 2 and Figure 5 show the evolution of value of aquaculture products for the main commodity groups. The more important group in 1994 was freshwater fish with a cumulative value of US $ 717 million, followed by molluscs with US $ 642 million and marine finfish with US $ 408 million. In 1984, the ranking was the same with freshwater finfish valued at US $ 407 million, molluscs at US $ 378 million and marine finfish at only US $ 13 million. Within the major groups, in 1994, the salmonids were the first commodity group with US $ 387 million, closely followed by the seabass and seabream group and oysters (with US $ 372 and 335 million respectively).

Comparing these data with those of 1984, it is apparent that some commodity groups have increased their economic importance rapidly, while others showed a modest increase in economic importance, and one group decreased in value. The groups which increased rapidly are the seabass/ seabream group, moving from US $ 6 million to US $ 372 million, the "other bivalves" which consists mainly of clams (from US $ 1.9 to US $ 116 million), the flatfish (from US $ 0.03 million to US $ 20 million), marine finfish other than seabass/seabream and flatfish, which are mainly mullets (from US $ 6.5 to US $ 43 million), and the crustaceans (from US $ 0.4 to US $ 40 million).

The salmonids had a more modest growth in terms of economic value, moving from US $ 219 to 387 million, a similar situation to that of oysters (from US $ 141 million to US $ 335 million) and the cyprinids (from US $ 156 million to US $ 165 million). The only group which decreased in economic importance was mussels, which went down from US $ 235 million to US $ 188 million.

Separate data for trade in aquaculture in the GFCM countries are not collected by the FAO. Trade of aquaculture products is not systematically studied by other groups, and available information is mainly confined to the analysis of high value commodities such as seabass and seabream. In 1995, the SIPAM Regional Centre, using various sources, estimated the flow of marine aquaculture products in the Mediterranean for the year 1994. A characteristic of the aquaculture trade in the area was the convergence of exports from 10 Mediterranean countries on Italy due to the higher prices paid for choice species. Exports of seabass/seabream to Italy amounted to 15, 700 t. Italy was also a major target market for mussels and oysters, with imports of mussels from Spain and Greece (13, 700 t) and oysters from France (2, 500 t). A study prepared in 1995 for the SELAM network (see *FAN* No.13 for the description of the networks) on the distribution of 1993 imports among the three major consumer countries - France, Italy and Spain also showed that the main imported aquaculture products in France were salmon and mussels with 52, 000 t and 23, 000 t respectively, while in Italy they consisted of mussels and seabass/seabream with over 30, 000 t and 15, 000 t imported respectively. In Spain a total of 21, 000 t of aquaculture products were imported in the same year, with salmon as the most important species (17, 000 t), followed by oysters. There is little information available on trade in freshwater species except for trout. This lack of information is more acute in the case of the East European countries.

In a recent meeting of the SELAM network on marketing of aquaculture products held in Thessaloniki, Greece, in 1995, it was concluded that there was a shortage of reliable and accurate data on marketing of aquaculture products, and that available information was too scattered to allow a proper understanding of the market situation. It was obvious, however, that the main market opportunities in the basin were in the northern countries, where the market is still growing, compared to low consumption rates and limited markets in the southern countries. It was also noted that the evolution of supply, new regulations, consumption habits and economic environment have important implications for the aquaculture sector. The devaluation of the Italian Lira was cited as an example of changes which have obliged producers to investigate new market opportunities other than the once extremely remunerative Italian market. More marketing studies are required to guide the producers if the sector is to maintain the present growth rates. The need for better marketing information has not escaped the attention of producers associations, which are getting organized to improve the available data bases and to establish new ones. The SELAM meeting identified a market strategy consisting of the following points:

- diversification in fish size, species, and presentation of value added products,
- stock management to adapt supply to demand,
- application of identity and origin denominations for aquaculture products,
- publicity to enhance the image of aquaculture products,
- improvement of the relationship with the capture fisheries sector to obtain synergy rather than competition,
- local market development,
- introduction of Mediterranean aquaculture products in Central and Northern European markets.

In relation to trade of aquaculture products and development of technologies for new species in the Mediterranean, it is important to take into account that most of the species cultured in the region are also

supplied through capture fisheries. Both fish supplied by capture fisheries and the fish supplied through aquaculture enter the same market. This has an important bearing on prices. As aquaculture production accounts for an increasing share of the total supply, and as the total supply increases due to aquaculture produce, prices will come under pressure. Elsewhere such effects have been drastic, as in the case of Atlantic salmon, which is no longer a luxury product. A similar price depression has been experienced with seabass and seabream in the Mediterranean at a much lower production volume, due to the much smaller original market for these species, compared to Atlantic salmon. The smaller the original market for the species in question, the sooner market saturation and price depression can be expected. Those who plan the farming of new local species should take these factors under careful consideration.

For the farmed species in the Mediterranean, the total supply of seabass from capture fisheries in the Atlantic and the Mediterranean is 3, 100 t while for seabream the total supply is about 6, 450 t. In the case of seabream there is a possible level of replacement with sparids of similar color in some Mediterranean countries and, therefore, these species should be considered together to some extent for marketing purposes. In the case of the seabass/seabream group, the relatively low supply from catches, and the rapid increase of aquaculture production explain the strong impact on prices in recent years. The mullets, which are another important group of marine finfish, are somewhat more difficult to analyse as a good part of the supply comes from coastal lagoon fisheries and extensive forms of aquaculture and it has been difficult to separate the captured and cultured production in the statistics. However, this seems to be a more stable group pricewise, mainly due to the reported catch amounts of about 55, 000 t which has provided a certain price stability. Amongst freshwater species, salmonid catches are in many cases a product of juvenile stocking and thus aquaculture is also partly involved in fisheries production. For cyprinids, fisheries production is estimated at 41,280 t in GFCM countries. Mollusc production comes almost entirely from aquaculture for mussels and oysters, with fisheries accounting for only some 3, 200 t of oysters and about 36,000 t of mussels.

Major trends

From the analysis of the evolution of aquaculture production volume and value in the GFCM area, the following major trends appear:

The supply of freshwater finfish, and the techniques for their production, are rather stable, in spite of the decrease of cyprinid production in the East European countries in the last five years. There is a strong chance of recovery and expansion of carp production in Eastern Europe, following the transitional period, due to the availability of experienced producers and to the consumption habits of the local population.

There is a relative market saturation for mussels and, to a lesser extent, oysters, both of which are facing increasing environmental problems. There is also a rapid increase in production of new, relatively high value species like scallops and clams.

There has been a rapid decrease in the price of high value seabass and seabream as a result of high production volume and a relatively small market. This market related trend has motivated interest in diversification of the marine finfish produced, to exploit new market opportunities.

Information from various sources point out that cages have become the choice technology for production of marine finfish. The adaptation of offshore cage technology in the Mediterranean holds promise and it is being tested in several places. The foreseeable opposition which may arise in case of a proliferation of cages in the nearshore waters should push the industry in the medium term to an increased use of offshore cages, if economically viable, which in turn is also going to change the type of companies involved in fish farming due to the much higher capital requirements of offshore cage culture. The offshore environment is also being tested for mussel culture in France, with some promising results which have still to be optimized from an economic standpoint. The advances in hatchery technology for industrial (over 2 million fry per year for marine finfish) and semi-industrial production of seed for marine finfish have liberated the sector from dependence on wild fry. The technologies developed for hatchery production of seabass and seabream are being tested and adapted for other species to expand the range of farmed species, and this is a trend which is expected to continue and expand.

Aquaculture Newsletter

(December 1996, Number 14)

Projects and other Activities

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FAO Expert Consultation on the Enhancement of Inland Fisheries

An Expert Consultation on Inland Fisheries Enhancement is to be held under the auspices of FAO in Dhaka, Bangladesh on 7-11 April 1997. The Overseas Development Administration (UK) is making a significant contribution to the consultation in terms of advice on technical content, sponsoring the participation of some of the experts, undertaking logistical support for the meeting and financing the publication of the report and contributed papers.

The consultation is aimed at promoting better understanding of how the various technical, socio-economic and cultural factors involved in implementing inland fisheries enhancement programmes must fit together to achieve success.

Global demand for fish is increasing at a time when most large-scale marine and freshwater fisheries in the larger water bodies are largely fully exploited. However, there are substantial potential growth areas which have so far been relatively neglected. Foremost amongst these is intensification (or enhancement) of fish production from currently under-utilised existing inland water bodies, including natural lakes, reservoirs, farm and community ponds, irrigation canals, and perennial or seasonal water bodies in floodplain depressions. These resources are often too small to be of interest to large commercial fishing operations, but they provide incomes and, most essentially, contributions towards the family diets of very large numbers of small-scale and subsistence fishermen.

The potential for enhancement of fish production from such waters has been considered a priority area of activity by the Inland Water Resources and Aquaculture Service of FAO for some time. A number of appropriate management strategies have been identified. Experience in the implementation of these strategies has been built up to varying degrees in different parts of the world through field projects and syntheses of the literature. As with all development concepts, successful implementation depends not only on the proper choice of technical approach but on consideration of appropriate socio-economic organization to suit local conditions.

The outcome of the Japan/FAO International Conference on the Sustainable Contribution of Fisheries to Food Security, Kyoto, Japan, 1995, has given further impetus to enhancements in two ways. Firstly, the Kyoto Declaration recognised four specific avenues for the enhancement of fisheries that, in brief, are (i) stocking and restocking (ii) assisting fishers to organise themselves (iii) promoting community management schemes and (iv) establishing user rights in open access. Secondly, the Kyoto Action Plan calls for the rapid transfer of know how in enhancement. The consultation encompasses these four avenues.

The Consultation is expected to produce:

- Recommendations on the most appropriate enhancement strategies for promotion in each region. These will be as specific as possible, covering technical aspects (identification of appropriate species for

stocking, cage culture etc.), organizational approach (feasibility of community management, family ownership etc) and economic questions (sources of credit, distribution of benefits etc.).

- Conclusions about the realistic role of government, bilateral and multinational agencies in promoting the selected enhancement strategies, and their interface with the private sector, in each region or country represented.

- Identification of individual and institutional expertise in relevant technical and social fields within developing countries as sources for TCDC exchanges.

- Where international funding is considered necessary, outline proposals for potential regional/national programmes and projects will be prepared.

The Expert Consultation will involve about 20 participants broadly spanning technology, culture and sociology, economics and administration. Geographically, South Asia, Latin America and Africa will be represented.

Each participant will prepare an experience paper and a concise summary of it will be presented at the meeting. The Expert Consultation will be of four days duration with the first one and a half days for the presentations, the second one and a half days for group discussions and the final day for synthesis and reporting. A field trip to enhancement sites will occupy a fifth day.

The report of the meeting as well as the experience papers will be published as FAO documents and widely distributed.o

International Symposium on Marine Ranching

The Symposium took place on 13-16 September 1996, in Kanazawa, Ishikawa Prefecture, Japan *[see earlier article in FAN No.12 (April 1996): 18]*. It was attended by representatives from over 20 countries, participants in the Japanese International Cooperation Agency (JICA)-sponsored course on marine ranching and the Japanese Overseas Fishery Co-operation Foundation(OFCF) training course for management of fishing for sustainable development, ICLARM, and SEADEC. Nine formal papers were presented. Dr. D. Bartley of the FAO Fisheries Department presented a paper on current issues, opportunities and constraints to marine ranching. The report of the meeting will be published with support from FAO and the Japanese Trust Fund GCP/INT/643/JPN.

The Symposium was extremely informative in that it provided a timely forum for distribution of information on the Japanese programme of marine ranching. Japan is expending considerable time and expense to enhance the coastal fisheries within its EEZ. The country sees this as a necessity in light of its recent ratification of the United Nations Convention on the Law of the Sea (UNCLOS) and the resulting restriction of its foreign fishing rights. The Japanese contributions to the Symposium were extremely valuable and demonstrated what could be done when there is co-operation among all stakeholders of a resource.

Two issues dominated the discussion - the cost effectiveness of the enhancement efforts and the protection of aquatic biological diversity. Concerning cost effectiveness, Japanese participants presented analyses that demonstrated that the ranching of several marine species is profitable if the cost of hatcheries and habitat improvement is excluded. The Japanese assume that it is the function of the government to offset the cost of hatchery construction, habitat improvement and other maintenance costs associated with ranching because of previous governmental policies that promoted industrialisation, often at the expense of the aquatic sector. It was noted that there is still a need to reduce the cost of producing stockable fish.

Genetic resource management was also discussed, both in terms of protecting aquatic diversity and maximising output from the hatchery. Guidelines on these issues were requested by several participants.

Discussion also addressed how best to transfer this technology to developing countries. Cost-benefit analysis and the conservation of native biological diversity were cited as the two primary concerns to address before transferring the technology. It was also noted that the fishery management regime in place will be important and that "western" style (i.e. open access) resource management may need to be adapted toward the Japanese model and the model of many rural areas where management includes local community involvement, property rights and customary marine tenure principles. It was also noted that in small island states (and probably other rural developing areas) fish storage and processing facilities are often lacking, but that many products from invertebrates require minimal or easy processing and can be stored more easily and taken to market in large lots very infrequently. Thus species choice for stocking in these areas should consider post harvest handling as a criterion.

Dr. Bartley pointed out that accurate data on stocking will be required from FAO Members in order for FAO to assess accurately the trends and contribution of stocking to world fisheries production. More complete data on stocking programmes in both marine and freshwater are needed for this Purpose.

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

The original schedule and venue of the meeting were amended from 10-12 June 1996, Manama, Bahrain to 1-3 October 1996, Cairo, Egypt (see earlier article on p. 19, April 1996-No. 12 issue of this Newsletter). The meeting took place in the premises of the FAO Regional Office for the Near East (FAO-RNE) and was attended by eight participants from five member countries-Bahrain (2), Islamic Republic of Iran (1), Kuwait (3), Kingdom of Saudi Arabia (1) and the United Arab Emirates (1). Six participants from Egypt attended as observers; FAO was represented by four officers, one from FAO-RNE and three from Headquarters, Rome.

The meeting consisted of an organizational session and three technical sessions. Concerning organizational matters, participants discussed and adopted terms of reference for the Ad Hoc Working Group (WG) as well as operational guide lines which emphasized self-reliance and collaboration with other groups and regions.

Technical sessions focused on three topics: (a) review of the status of aquaculture sector in the Gulfs Area and identification of main constraints and needs, based on country reviews prepared by participants and a regional overview by Dr. Z. Shehadeh (FAO, Rome), (b) a preliminary discussion on marine ranching and stock enhancement, including a review of stocking activities in the area, based on a review paper by Dr. D. Bartley (FAO, Rome) and presentations by Bahrain, Kuwait and Islamic Republic of Iran, and (c) a presentation of SIPAM, the French acronym for the Information System for the Promotion of Aquaculture in the Mediterranean, by Mr. S. Coppola and Mr. M. Bendag (FAO, Rome and SIPAM Regional Centre, Tunisia), and discussion on the utility of a similar system in the Gulfs Area.

On the basis of discussions on regional constraints and related needs, the WG identified the following priorities in support of aquaculture development:

- establishment of an aquaculture information system
- marketing and cost analysis
- training
- feasibility studies on species of regional interest aimed at attracting investors into the sector
- seed production
- coastal area management including examining the effects of aquaculture on the coastal environment
- feed production stressing local production from local products
- integrated farming systems stressing the efficient use of water.

The WG recommended that these priority issues should be raised at the 9th session of the IOFC Gulfs Committee for possible inclusion as agenda items at the next intersessional meeting of the WG. Technical members of the WG will provide their representatives to the 9th Session with appropriate background material and will identify specific national priorities from the above list so that they may be included on the

agenda of a proposed intersessional meeting of the WG. The WG also recommended that resource managers, directors of fisheries, ministries, and research institutions involved in aquaculture research and development should strive to facilitate the exchange of information and researchers among the member countries.

In light of the fact that the Group is newly established, the WG felt that there should be an intersessional meeting in one year. A main agenda item for this meeting should be preparation for the establishment of an aquaculture information system for the Gulfs Area. FAO should prepare a proposal for such an information system, based on the existing SIPAM model, for presentation at the intersessional meeting.

First International Symposium on Stock Enhancement and Sea Ranching

The Symposium will be convened at the Radisson SAS Hotel, Bergen, Norway, on 8-11 September 1997. It is hosted by the Norwegian Sea Ranching Program (PUSH) and sponsored by the European Commission (Programme FAIR), the Hordaland County Council and the Institute of Marine Research, Bergen, Norway. Co-sponsors include FAO, the Japan Sea-Farming Association, the World Mariculture Society and the International Centre for the Exploration of the Sea. An International Scientific Committee of 15 persons from 8 countries and from the FAO (D. Bartley) provides the convenor (E. Moksness, Norway) with advise on the technical aspects of programme.

The Symposium has been organised to provide a major forum for discussion of stock enhancement by scientists and managers from around the world. Its main objective is to bring scientists and managers together to exchange knowledge about the process and consequences of stock enhancement and sea ranching, and to identify the most important priorities for future research. It will enable participants to learn from the collective global experience and to develop rigorous, responsible approaches to assessing the merits of stock enhancement. Future symposia will be reconvened every four years to keep scientists and managers abreast of development in the field.

The organisers invite papers on stock enhancement and sea-ranching that contribute to knowledge of the application, cost-benefit and ecological impact of these fisheries management measures. Contributions on marine fish, crustacea, molluscs and salmonids are welcome. Papers should make a contribution in one of the following areas:

- the fitness of hatchery-reared juveniles for life in the wild,
- strategies for tagging and releasing juveniles into the wild and measuring their contribution to fisheries,
- ecological and genetic interaction between wild and enhanced populations of fish crustacea and molluscs, including introduction and transplantation of non-native species or genetically modified organisms (GMO)
- risks of introducing diseases and parasites
- method of assessment, monitoring and management of populations
- economic viability of stocking programmes
- the decision-making process, i.e. to use or not to use enhancement as a management tool,
- right of access issue: who has the right to harvest an enhancement resource? What problems are likely to occur?
- organization models.

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COLOMBIA

A new TCP project "Análisis de Componentes Estratégicos del Sector Pesquero y Acuícola Colombiano: Formulación de Políticas "(Analysis of strategic components of the fisheries and aquaculture sectors in Colombia: Policy Formulation) " has been approved by FAO. The project, of eight months duration, will be implemented by the Instituto de Pesca y Acuicultura (INPA). The fisheries sector has experienced rapid changes in Colombia with a rather fast growth which has moved the total production from 57, 500 mt in 1983 to nearly 109, 000 mt in 1991. The contribution of the various fisheries sub-sectors to production has also changed, moving from inland fisheries to marine fisheries and aquaculture. The Government believes, however, that the development potential of shrimp culture and rural aquaculture is much higher than the present levels of production indicate.

The country has recently established the INPA , with assistance from FAO, as an institution for the management and development of the fisheries sector. The new project is expected to assist the Government in the formulation of a strategy for the main strategic sub-sectors (tuna fisheries, shrimp culture, small scale fisheries, rural aquaculture and use of discards). For shrimp culture, the aim of the government is to study the present status and the perspectives for development, as well as the impact on shrimp fisheries, and to elaborate strategies to facilitate the consolidation of the sub-sector in the short and medium term. For rural aquaculture, there is need to define a national strategy to consolidate and optimize on-going activities in terms of technical viability and economic profitability. The project's work plan calls for the preparation of high level strategic studies using a participative approach for their identification, preparation of study methodologies, implementation of the study, as well as evaluation of conclusions and recommendations. For aquaculture a totally new study will be implemented for shrimp culture, while in the case of rural aquaculture the project will update previous studies. FAO will provide a fisheries economist who will co-ordinate the project and an international shrimp culture expert; the rural aquaculture component will be implemented through local consultants under the supervision of the project coordinator.

CYPRUS

In the context of the TCP/CYP/5611 "Supporting Services to Aquaculture Development" which was described in the previous issue of this newsletter *(No.13 (August 10): 24)*, two missions have taken place to support the components on fish diseases and inspection and control of fish and fish products. Dr. R. Subasinghe from Headquarters visited the country from 1 to 7 September 1996 to define the assistance needed for the implementation of the fish disease component. None of the notifiable diseases listed in the OIE International Aquatic Animal Health Code were found to be present in Cyprus. Regarding institutional matters, there is good collaboration between the Department of Fisheries and the Veterinary Services, which should facilitate co-ordination in the future. However, the lack of training and experience by the veterinarians put recently in charge of fish diseases, and the lack of suitable facilities for work on aquatic animal health, limit the potential assistance that the veterinarian services can provide to the aquaculture industry in the island. The mission recommended initial training in aquaculture for the two veterinarians in charge of fish health, and training in health management the biologist in the Fisheries Department. The recruitment of an additional veterinarian in the Department of Veterinary Services, to share the responsibilities of the two officers, was suggested.

The potential risk of introduction of the new Noda Virus (Viral Encephalopathy in sea bass) to Cyprus makes the strengthening of expertise on aquatic virology imperative; specific training in aquatic virology for one staff is required. It was also recommended that the facilities available in Nicosia for work in virology of terrestrial animals be also used for work on fish virology, rather than setting up a new laboratory. It was further noted that the Dept. of Veterinary Services has no capabilities in aquatic animal histopathology which are considered essential for diagnosis of aquatic animals, and specific training in this field was needed. Dr. Subasinghe recommended tight control on the imports of *Penaeus monodon* from Asian farms into the country because of the high risk of introduction of viral diseases.

The training programme for the veterinarians of the Dept. of Veterinary Services was also defined, with recommendation for three location: the Fish Diseases Laboratory at Eilat, Israel, University of Stirling and the Istituto Zooprofilattico delle Venezie, Dipartimento di Ittiopatologia, Udine, Italy. Regarding the

consultants to be provided by FAO, it was recommended that two visits by two different specialists should be contemplated instead of one.

A second mission by Mr. Carlos Lima dos Santos of the FAO Fisheries Industries Division was carried out to identify the training needs of the government and industry personnel in the area of fish technology and inspection and quality control, and to identify assistance needs in the area of organization and implementation of a modern national fish inspection and quality assurance programme. Landing places as well as fish farms, packing plants, fish processing plants, cold stores, fish retail shops and fish markets were visited. Findings indicated the urgent need to improve the present standards, in particular for fish retail shops and processing plants. Training needs for fishermen, owners of fishing vessels, and transporters of fish were also defined.

1ST SESSION OF THE GFCM AQUACULTURE COMMITTEE

The Aquaculture Committee of the General Fisheries Council for the Mediterranean (GFCM) was established by the 21st Session of the GFCM in 1995 and met for the first time in Rome from 9 to 12 September 1996. The meeting was held thanks to a generous contribution from the Italian Government, which hosted the meeting in the FAO premises. A total of 11 countries sent delegations to the meeting; observers from the International Centre for Mediterranean Agronomic Studies (CIHEAM), UNEP Mediterranean Action Plan (MAP PAP/RAC), EC DG XIV, the Federation of European Aquaculture Producers (FEAP), and the Russian Federation also attended. The meeting was chaired by Prof. S. Cataudella, head of the Italian delegation.

The Committee first reviewed and adopted its draft terms of reference, which focused on the provision of a forum for discussion on aquaculture development in the Mediterranean and the supervision and guidance of the work of the networks created by Mediterranean Regional Aquaculture Programme, Phase II (MEDRAP II). The second item of the agenda was a discussion on the status of aquaculture in the GFCM countries, which followed a general presentation on aquaculture development trends in the region by the Committee's Technical Secretary, Mr. M. Pedini, and national reports by the delegations. An important point emerging from the presentations was that in the last decade there has been an increase in production which, though modest in volume, was important in terms of value. Production has diversified, but the urgency behind the diversification process is much more pronounced today than it was five years ago. The industry is experiencing problems linked to marketing of high value species and to the impact of expanded production on prices. These problems have fuelled research programmes to optimize production efficiency. Environmental problems and growing concerns about environmental impacts of aquaculture development are also having a negative impact on the industry. In Eastern Europe, the on-going economic changes are posing a formidable challenge to the industry, which requires legislative support and the creation of new markets for the traditional freshwater products. The measures being implemented by the EU on quality control and the duties imposed on the imports of products from non-member countries were also seen by both member and non-member countries as challenges to the industry. In member countries, the need to comply with the new regulations may imply a reorganization of the industry in the near future with mergers of companies and creation of groups providing services for quality assurance to smaller farms. The EC policy in favour of better quality control and campaigns to increase fish consumption also represents a drastic departure from past EC assistance which was centred mainly on the construction of facilities.

An important decision of the Committee, in respect of future sessions, was the recommendation to include representatives from producers associations in the national delegations, although it was recognized that the composition of the delegations was a national prerogative. The Committee also endorsed the policy of the GFCM and FAO in favour of networking in the light of the problems highlighted by the countries, particularly the difficulties being experienced by smaller countries in providing all the required services for the development of the sector.

Following the discussion on the status of aquaculture in the region, the representatives of the four Mediterranean aquaculture networks TECAM, SELAM, EAM and SIPAM *[see article in FAO Aquaculture*

Newsletter No. 13 (August 1996): 13-17] presented the progress achieved to date and the activities planned for 1996-1997. CIHEAM (co-ordinator of TECAM & SELAM) indicated that, based on the results and reactions to activities carried out so far, there is a great interest in training activities, and that the scarcity of researchers in the southern countries could limit co-operation with countries of the northern shore. The Committee considered the work of CIHEAM highly satisfactory and proposed that in addition to the activities programmed for 1997, an activity on offshore cage infrastructure and another on legal aspects of aquaculture development be considered. In the case of EAM, concern was expressed about the limited programme, due to the low level of funding for the network from MAP PAP/RAC. It was recognized that the programme, which had been designed at the last meeting of the EAM Co-ordination Committee, was over-ambitious in relation to available resources, and that a prioritization of the activities was necessary. Guidance on appropriate environmental impact assessment and monitoring techniques was flagged by several delegations as a very urgent topic, and an increase in training activities of the programme was also suggested. The Committee approved the work carried out in the framework of SIPAM and recognized the general interest in the system and the efforts of the Tunisian Government in the network. It was requested that a longer programme of work, covering 1997 and 1998 be prepared and presented to potential donors in the region to secure additional resources for the network activities. The need to reinforce the national centres, especially in the main producing countries, was highlighted.

The Committee was in favour of consolidating the networks by integration of the various activities, as this would result in considerable synergy. The delegation of Bulgaria also indicated that a closer collaboration with the networks being established in the Eastern European countries was required. The delegation also expressed interest in being linked to the SIPAM network in the near future. The delegate from France offered to explore the possibility to hold an inter-session meeting in France, in late 1997, to reinforce co-ordination among the four networks.o

LAOS

The report on the findings and recommendations of the UNDP-funded project LAO/89/003 " Development of Fish Culture Extension" was issued last summer. This project was a continuation of LAO/82/014 "Rehabilitation of Fish Seed Farms and Fish Culture Development", with a budget of $ 1.1 million from UNDP. It became operational in 1992 and was completed in June 1996.

Laos is a landlocked country with an area of 236,000 square km, 80% of which consist of mountains and dense forests. It is sparsely populated at with a total population of 4.3 million inhabitants. Fish consumption is low at about 7 kg/caput/year and capture fisheries in the Mekong River basin are declining. This has highlighted the importance of aquaculture, with 8,000 ha of fish ponds already in operation. Accordingly, the sub-sector plays an important role in the Government's policy to attain food self-sufficiency, as an integral part of the livestock sub-sector programmes.

The project had two main objectives to improve annual food intake and to increase the income of the aquaculture farmers, and to develop technical manpower in the country as a means of strengthening the central and provincial fisheries administrations. The difficult relief of the country and the scarcity of public financial support for aquaculture development in rural areas favoured an extension approach based on demonstration sites in selected target areas. Target district and villages in the 10 provinces where the project operated were selected on the basis of an RRA survey conducted before the start of the project. A total of 402 target farmers were identified in the 10 provinces of the project and were monitored until the end of the project. The expatriate staff of the project included one Chief Technical Adviser, Dr. S. B. Singh, who was stationed at the project's main centre in Nonteng, Vientiane prefecture, and two UN Volunteer specialists stationed at sub-centres in Savannakhet and Xiengkhouang. The project team worked under the overall supervision of the Directorate of Livestock Veterinary Department.

Following an analysis of existing farming practices, a programme was initiated to improve production by adapting improved practices in a progressive manner. The main farming systems included pond culture, integrated farming with livestock (generally pigs, chicken and ducks), rice-cum-fish culture and fish seed production. Before the project, pond culture was characterized by very high stocking densities (20,000-

30,000 fish/ha) of small fry in poorly prepared ponds. The results were low survival and low production. The project introduced better practices of pond preparation and advocated lower stocking rates (5,000/ha) with larger fry. The result was an increase of production from 50-200 kg to 1,000-2,000 kg/ha and an improvement in survival rates from 10-30% to 70-90%. Better integration practices increased production in target demonstration sites from 100-500 kg to 1200-2500 kg/ha. The work of the project in improving rice-cum-fish practices involved modifications of the rice fields, to provide aquatic environments more suitable for fish production, which resulted in increases of production from 30-50 kg/ha to 300-600 kg/ha. Fish seed production was traditional for common carp, tilapia, and *Puntius gonionotus*. The project improved the performance of the target farmers and also introduced the breeding of Asiatic carps, the fry of which command a better price in the country than the species mentioned above.

A review of the project's impact in 1995 showed that as a result of production improvement demonstrated through the 402 target farmers, a total of 2,333 farmers had started aquaculture practices in an area of over 625 ha. Income improvements brought by the adoption of better farming practices were estimated as seven fold previous levels.

In the area of capacity building, the project conducted 30 training programmes in various subjects, including seed production, for a total of 868 farmers. Training of public sector staff involved study tours to Thailand and Vietnam and TCDC arrangements with China, Vietnam and Myanmar. The training programme also involved the preparation of extension materials including six leaflets, two pamphlets and one poster, as well as a technical manual incorporating technology packages for various farming systems. The report concludes by proposing a new project to maintain the momentum generated and to consolidate the work initiated. The project rationale takes into consideration the limited capacity of the Laotian government to support aquaculture development and extension, and the success achieved by the completed project through direct training of target farmers. For future expansion of the sector, seed production by rural farmers is a major priority area. o

SIPAM

Upon request of the Italian Fisheries Director General, Italy has now joined the Information System for Promotion of Aquaculture in the Mediterranean (SIPAM). Italy was the last major producing country of the region which was missing in the system . The Italian SIPAM national centre will be managed by the Istituto Centrale Per La Ricerca Scientifica e Tecnologica Applicata Al Mare (ICRAM) (Central Institute for Applied Marine Scientific and Technological Research) where a special unit is being created for this purpose. As part of the agreement with Italy, two regional meetings will be sponsored in 1997, in which the progress of the SIPAM system will be reviewed by the national co-ordinators, and the new versions of the software will be presented and discussed. The first meeting is tentatively planned to be held in Italy at the beginning of 1997. The two meetings will be held back to back with technical meetings of an ICRAM project called "Oservatorio dell' Acquacultura Mediterranea (Observatory of Mediterranean Aquaculture)" where the supply and demand situation for Mediterranean seabass and seabream, for which Italy is the main market, is monitored.

Following the programme established by the First Meeting of the SIPAM Co-ordination Committee in Tunis last January, two missions to Malta and Morocco were launched to install the last software version of the system and to train the national staff in the use of the SIPAM system . These missions have been implemented in the framework of the FAO Technical Co-operation among Developing Countries (TCDC) Programme. Under this programme, which has been signed by all the developing countries of the GFCM Region, the beneficiary country covers the board and lodging costs of the mission (visiting experts), while the releasing government (providing the experts) maintains the salaries and benefits of its national experts. FAO covers the travel costs and provides a modest supplement to per diem expenses. In the case of the two above mentioned missions, assistance to Malta has been provided through the Government of Cyprus, by provision of two staff members of the national (Cyprus) SIPAM centre, while assistance to Morocco has been provided through the staff of the SIPAM Regional Centre in Tunis.

The SIPAM system has also been presented to the countries of the Gulfs Area in the framework of the

first meeting of the IOFC/ Gulfs Committee *Ad Hoc* Working Group on Aquaculture, held in Cairo from 1 to 3 October 1996. The presentation of the system was carried out by the system designer (FAO) assisted by the aquaculturist/data manager of the SIPAM regional centre in Tunis. The Working Group requested that a similar system be established in the Gulfs Area and recommended that FAO prepare a proposal for this purpose to be reviewed at a special inter-session meeting be held in 1997.

VENEZUELA

A new Technical Co-operation Project has been approved by FAO for Venezuela to deal with genetic improvement of tilapias in the country. Aquaculture is a growing sector in Venezuela since tilapia culture started on a commercial scale in 1991. Tilapia production expanded to 400 t in 1992, and to an estimated 1 500 t in 1995. A total of 140 farmers were culturing tilapias in 1995, with farm sizes ranging from 10 ha to 500 m2, reflecting the varied socio-economic interest in this form of aquaculture. However, problems have been experienced with the production of high quality seed, in particular all male red tilapias, which has prompted the Government to request assistance from FAO for the genetic improvement of parent stocks.

The project includes the following activities: an evaluation of the status of tilapia culture in the country, the adoption of the most suitable technology for broodstock production, training of public and private sector technicians, an analysis of the economics of the use of improved stocks, extension and preparation of extension materials (including the production of a video) on the use of improved broodstock and seed, analysis of environmental impact of the project, and a campaign to raise awareness about preservation of biodiversity. The project will select breeders from stocks available in the country and will also import adult stocks as required. The economic analysis component will study the pre and post project situation in order to produce an evaluation of impact. FAO will provide three consultants and will support the operation of the project with visits of the Headquarters' Fishery Resources Officer in charge of genetics and biodiversity. The project will organize four courses in the country two on genetic improvement of tilapias (one practical and one theoretical), one on biodiversity in tilapias, and another on the economics of genetic improvement of tilapia. Four missions are foreseen which will conclude with a national seminar in which the results and conclusions of the project will be presented.o

VIET NAM

A Technical Co-operation Project TCP/VIE/6611 with Viet Nam on "Integrated Snail Management in Rice" commenced in April 1996. The objective of the assistance is to help the Government of Viet Nam to limit damage and prevent further spreading of an introduced aquatic snail pest of rice, with a view to developing a long-term management programme. Main components of the assistance are (i) the systematic collection and analysis of data to monitor the spread of infestation and the success of control activities, (ii) the incorporation of a `snail management' module in Farmer Field Schools of the national FAO-supported Integrated Pest Management Programme for Rice, and (iii) the promotion of the use of carps in rice fields (rice-fish farming) and communal waters for the biological control of snails. In addition, specific biological control agents need to be identified in the snail's native habitat in South America, and, as part of the project, opportunities for institutional linkages with Latin America to develop a long-term sustainable solution to the snail problem have been explored. The project so far has received services from three international consultants on information systems, biological control, and fish breeding as well as technical support missions from the Inland Water Resources and Aquaculture Service (Dr. M. Halwart), Department of Fisheries.

Aquaculture Newsletter

(December 1996, Number 14)

New Publications

Ziad H. Shehadeh, Fishery Resources Division, FAO

Garibaldi, L. 1996. List of animal species used in aquaculture. *FAO Fisheries Circular*. No. 914. Rome, FAO. 1996. 38p.

With the contribution of aquaculture to world food fish and shellfish supply steadily increasing, and the mass of information available on the different species cultured increasing dramatically, the FAO Inland Water Resources and Aquaculture Service of the Fisheries Department identified the need to gather accurate information on the most important species cultured world-wide. This list represents the first step toward a more complete publication which will eventually include information on taxonomy, biological characteristics, culture techniques, reproduction, feeding, diseases, natural range and habitat, regions where farmed and aquaculture status for the most important species.

A total of 262 fish, crustacean and mollusc species, representing the most important animals used in aquaculture world-wide are listed. The list has been derived primarily from species reported by Member Countries to FAO in the aquaculture production statistics, with the addition of other species reported in other sources as being important. The information provided for each of the listed species includes: family, scientific name, environment, total production as reported by FAO, geographic distribution, and production by continent. Under geographic distribution, the list distinguishes between native and introduced species. All data are summarised in a final table.

Paperna, I. 1996. Parasites, infections and diseases of fishes in Africa - An update. *CIFA Technical Paper*. No. 31. Rome, FAO. 220p.

This document is an update of CIFA/T7, 1980, a publication by the same name and author. The text has been rewritten to accommodate new inforation and conceptual changes in our understanding of fish pathogens, their effects on fishes and new approaches to therapy and control. The document compiles and consolidates existing information on diseases and infections occurring in African fish. The text also incorporates information on diseases found in species of African fish farmed outside Africa, and general aspects of fish pathology relevant to warm water aquaculture. Information includes diagnostic aids(keys and illustrations), data on the effects of pathogens on fish, they way pathogens are transmitted and where possible, suggestions for therapy and control.

Potipitak, K. 1996. Aquaculture extension services review: Thailand. *FAO Fisheries Circular*. No. 910. Rome, FAO. 46p.

This is one of a series of publications on aquaculture extension services in selected countries of Asia where aquaculture development is believed to have had some positive impact on the socio-economics of rural communities. Tree earlier circulars dealt with the Philippines, Nepal and India.

The circular is divided into six sections: (i) general background - providing information on climate , geography, land and water resources, demography, utrition/health, main exports, employment in fisheries, status of capture fisheries (inland and marine) and of aquaculture, (ii) aquaculture institutions - including development and management, research, and education and training, (iii) production and market economics, (iv) aquaculture extension services including organization; policy, planning and programmes;

methods and systems; transfer of technology; input supplies and subsidies; control mechanisms; extension and research linkage; NGOs in extension, (v) Conclusions and (vi) References.

FAO. 1996. Revue du secteur des pêches et de l'aquaculture: République Centrafricaine. *FAO Fisheries Circular* No. 912. Rome, FAO. 33p.

This is one of a series of national reviews prepared by the Policy and Planning Division of the FAO Fisheries Department. These reviews cover four major topics: (a) a general review of the economy (the macro-economic environment, and the role of fisheries in the economy), (b) the fisheries and aquaculture sector, (c) fisheries administration and services, (d) planning framework (macro-economic policy, sectoral policy and development plan) and policy tools (statistics, fishery legislation, taxation, management systems) and development projects. The documents also list major references used in the preparation of the review.

FAO. 1996. Feasibility of freshwater prawn hatcheries in Sindh Province. Technical Cooperation Programme (FI: TCP/PAK/4559) Technical Report. Rome, FAO. 73p.

The report is based on the work of an FAO consultant, fielded on the request of the Government of Pakistan with support from the FAO Technical Cooperation Programme, during the period November 1995-January 1996 (*see related article on Pakistan, p.26., August 1996 , No. 13 issue of this newsletter*). The report includes and assessment of the technological framework, the general environment for freshwater prawn farming in Sindh (climatic conditions, aquaculture experience, grow-out sites and resource availability for prawn farming), economic viability of freshwater prawn farming, and potential sites for Government freshwater prawn hatchery and demonstration farm. It concludes with recommendations for the establishment of a hatchery and demonstration centre, including technology and design, costs and project establishment.

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