Aquaculture in the Philippines has a long history and involves many species and farming practices in diverse ecosystems. Most of the production comes from the farming of seaweed, milkfish, tilapia, shrimp, carp, oyster and mussel. Aquaculture contributes significantly to the country's food security, employment and foreign exchange earnings. Aquaculture is growing much faster than capture fisheries. However, the global position of the Philippines in aquaculture production has fallen steadily from 4th place in 1985 to 12th place today. The Philippines now contributes only a little over one percent of global farmed fish production compared to five percent previously.

The future growth of Philippine aquaculture may not be sustained unless new markets are developed, market competitiveness is strengthened and farming risks are reduced. In this age of international trade and competition, the Philippine aquaculture industry needs to plan and implement a development and management programme with a global perspective. The Philippine government and the private sector are in the process of preparing a national fisheries development plan which includes aquaculture.

Aquaculture in the Philippines has a long history and involves many species and culture systems.

It is generally accepted that the earliest fishponds were brackish water growing milkfish, using naturally occurring fry from tidal waters. For a very long time, aquaculture in the Philippines was virtually synonymous with milkfish culture, specifically in brackish water ponds, relying totally on natural food. In the early 1970s milkfish farming expanded to include culture in bamboo and net pens set in Laguna de Bay - the country's largest freshwater lake. In the early 1990s milkfish culture in fish pens spread to shallow marine bays and estuaries, particularly in the Lingayen Gulf area. Milkfish culture soon spread to net cages which were fixed or floating in both freshwater and marine water. The culture of milkfish in cages depended upon and was
hastened by the development and marketing of commercial feed by the feed millers (Yap, 1999).

Shrimp has always been an incidental harvest in brackish water ponds for milkfish. Due to a marketing campaign in the mid-1970s, black tiger shrimp became popularised in Japan. As a trial shipment, 450 kg of black tiger shrimp were exported to Japan in 1975. Before the 1980s shrimp farming had already made some inroads in the Philippines, but the real boom in production began in the mid-1980s, as wealthy families in the Negros Province began converting their sugar plantations in earnest. They saw shrimp farming as a more profitable alternative to sugar. Shrimp became top marine product export from the Philippines, earning at its peak in 1992 approximately US$ 300 000 000. However, disease problems in the early 1990s caused a significant decline in production.

Mozambique tilapia (*Oreochromis mossambicus*) was introduced into the Philippines from Thailand in 1950. It was not well accepted by consumers in the 1950s and 1960s due to its dark colour, small size and poor image. (Guerrero, 1994). In the early 1970s the introduction of Nile tilapia (*Oreochromis niloticus*), a species light in colour, enhanced the image of tilapia and boosted commercial production. In the late 1970s and early 1980s, commercial tilapia production was advanced by the development of technologies for the breeding of Nile tilapia in floating net enclosures and the production of Nile tilapia in floating cages with feeding. The new technologies were transferred to the private sector for evaluation. 1988 was a landmark year (Yapp, 1999) during which the International Center for Living Aquatic Resources Management (ICLARM), began a programme to develop an improved strain of tilapia for low-cost sustainable aquaculture with funding from the Asian Development Bank (ADB) and the United Nations Development Programme (UNDP) and resulted in the production of Genetically Improved Farmed Tilapias (GIFT). The other collaborators in the GIFT Project were the Bureau of Fisheries and Aquatic Resources (BFAR), Central Luzon State University (CLSU) and Norway's Institute for Aquaculture Research (AKVAFORSK). During the same year, the British Overseas Development Agency (ODA) also funded the Genetic Manipulation for Improved Tilapia (GMIT) project. Both projects were conducted at the CLSU campus.

Common carp (*Cyprinus carpio*) was introduced into the Philippines from Hong Kong in 1915. Other species of carps were later introduced. Their culture in fish pens and cages started in the second half of the 1980s. The Philippine government has long tried to promote carp culture by establishing hatcheries in several regions. But they never became popular due to relatively low consumer acceptability. Many Filipinos do not find carp palatable, but bighead carp (*Aristichthys nobilis*) has recently become a dominant species in Laguna Lake fish pens (Yap, 2002a).

Seaweeds belonging to the genus *Caulerpa* are all eaten fresh in many parts of the Philippines. *C. lentillifera* was the first species to be commercially cultivated in brackish water fishponds in Mactan Island in the early 1950s (Yap, 1999). As a response to strong world demand for phytocolloid carrageenin, the farming of *Eucheuma* was developed in the 1960s. The Bureau of Fisheries Research Division conducted trial farming off Mindoro Island and elsewhere. After initial success, family plots were established in Tapaan Island, Siasi, and Sulu and later in Sitangkai, Sibutu Island. It was intensified in 1973 when a mutant cultivar, which could double itself in volume every 20 days, was discovered and the strain became known as the "tambalang" variety. The success of *Eucheuma* farming in the Philippines has catapulted the country into the world's largest producer of the carageenophyte seaweed (Yap, 1999). The red algae *Gracilaria is* also eaten in the Philippines, but is mainly used as a source of agar. Its commercial cultivation in brackish water ponds probably started after the success of *Eucheuma* farming in 1973.

Oyster farming began as early as 1931 when an oyster farm was established in Hinigiran, Negros Occidental employing the broadcast method of culture. The practice has now spread to many parts of the country including Mindanao. Mussel farming began in 1955 when the BFAR oyster farming station in Binakayan, Cavite set up a demonstration mussel farm (Yap, 1999).

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**Human resources**

According to the 2002 Census of Fisheries of the National Statistics Office, there was a total of 226 195

FAO Fisheries and Aquaculture Department
aquaculture operators working in: fishpond operation (126 894), seaweed farming (73 549), fish pen operation (5 325), oyster farming (3 041), mussel farming (2 422) and others (14 964). Seaweed industry leaders estimate that almost 180 000 families are directly dependent on seaweed farming. There is no available data on gender and employment in the aquaculture sector, but women are an integral part of production and post harvest activities. The various grow-out and hatchery systems require skilled labour and technical personnel. There are important links with the various sectors supplying the inputs: fry/fingerling production/gathering and trade, fertilizer and chemical supply, supply of construction materials and feed ingredients, and feed manufacture, transport and storage. Many people work in the associated sectors: post-harvest processing, transport and storage, marketing and financing. Highly trained staff are involved in research, development and extension. The few studies available on some farming systems give some kind of picture of the human resources in aquaculture.

According to a 1995 assessment of the milkfish industry (Dureza, 1995), most traditional milkfish farmers were not aware of proper milkfish farming practices. However, progressive, educated and well-read milkfish farmers are willing to explore new technology to improve production and profitability. They employ semi-intensive and intensive milkfish culture systems, and some of them even carry out milkfish hatchery. In milkfish breeding and hatchery technologies most technicians lack the necessary skills and knowledge to carry out such activities. Those involved in milkfish processing do not have adequate knowledge of how to process value-added products.

A 1996 study of tilapia grow-out pond operators showed that farmers had an average age of 47. Small farm (below 4.43 ha) operators are on average younger (44 years old), with a high percentage 30-40 years old. Large farm (4.43 ha and above) operators are older (51 years old). The average number of completed years of education of small and large farm operators is 10 and 11 years, respectively. About 41 percent of the large operators and 47 percent of the small operators have a college degree.

The high profitability of tilapia farming is partly due to the high level of technical efficiency of farming operations. The average level is 83 percent. Large growers are more efficient (88 percent) than small growers (79 percent), and this is linked to their higher level of education (Dey et al., 2000b). According to a 1994 study of tilapia hatchery operators, the average length of formal education is ten years. Many operators have completed college (41 percent) and only a few lack formal education (5 percent). Most operators are owner-operators (92 percent) with a few leaseholders (3 percent) and tenants (5 percent). They have on average ten years experience. About 79 percent of the operators consider tilapia hatchery operation as their primary occupation, with 56 percent and 23 percent respectively engaged on a full-time and part-time basis (Bimbao et al., 2000).

A 2001 study of shrimp (Penaeus monodon ) brackish water pond operators in Pampanga (where 40 percent of shrimp is produced) revealed that a large majority (84 percent) consider fish farming to be their primary professional activity. The educational level is relatively low. Two thirds of the operators have only received a primary education, and only 12 percent have attended college (Irz and McKenzie, 2002).

### Farming systems distribution and characteristics

In 2002 the total harvest area for milkfish production was 281 727 ha. The five major provinces for production were Balucan, Pangasinan, Capiz, Iliolo and Negros Occidental.

Most milkfish production was from brackish water fishponds (84.37 percent) and the remainder from marine fish pens (3.91 percent), marine fish cages (3.62 percent), freshwater fish pens (3.56 percent), brackish water fish pens (1.89 percent), brackish water fish cages (1.40 percent), freshwater fish cages (1.23 percent) and freshwater fishponds (0.01 percent).

The total harvest area in 2002 for shrimp production was 77 172 ha. The five major producing provinces in 2002 were Pampanga, Zamboanga Sur/Sibugay, Lanao del norte, Bataan and Bohol.
The entire production of shrimps comes from brackish water fishponds.

Tilapia production in 2002 covered a total harvest area of 30 221 ha. The top five tilapia-producing provinces were Pampanga, Batangas, Bulacan, Laguna and Sultan Kudarat.

Most tilapia production came from freshwater fishponds (53.88 percent) and the remainder from freshwater fish cages (37.85 percent), brackish water fishponds (6.75 percent), freshwater fish pens (1.40 percent), brackish water fish cages (0.06 percent), brackish water fish pens (0.04 percent) and marine fish cages (0.01 percent).

In 2002 the total harvest area for carp production was 3 519 ha. The five major provinces for production were Rizal, Lanao del Norte, Metro Manila, Pampanga and Bukidnon.

Most production of carp came from freshwater fish pens (96.31 percent) and the remainder from freshwater fish cages (2.50 percent) and freshwater fishponds (1.19 percent).

In 2001 the top five seaweed-producing provinces were Tawi-tawi, Sulu, Palawan, Zamboanga City and Bohol. The total harvest area for seaweed was 21 281 ha. All seaweed production came from open coastal waters.

In 2002 all oyster and mussel production came from open coastal waters.

Most of the fishponds in the Philippines are brackish water ponds (239 323 ha) developed out of mangrove swamps. Land is a premium commodity in the Philippines, so it is rare to convert good agricultural land into fishponds because this would lower the market value of the land (Yap, 1999). While much of the country’s arable land is already being utilized for agriculture, vast areas, particularly marine waters, are still under-utilized with respect to aquaculture. With over 17 460 km of coastline, 246 063 ha of swamplands, 200 000 ha of lakes, 31 000 ha of rivers and 19 000 ha reservoirs, the Philippines has one of the most extensive water resources in the world. With the intensification of fishpond production and increasing utilization of coastal waters for cage and pen aquaculture, there is now increasing demand for feeds as opposed to fertilizers. The supply of most locally available feedstuffs is already limited. Seasonal availability and natural disasters compound this problem. The industry continues to be dependent upon the use of imported raw materials such as fishmeal and soybean oil meal (Cruz, 1997).

Aquaculture species cultured include milkfish (Chanos chanos), Nile tilapia (Oreochromis niloticus), Mozambique tilapia (Oreochromis mossambicus), common carp (Cyprinus carpio), bighead carp (Aristichthys nobilis) and others, walking catfish (Clarias batrachus), North African catfish (Clarias gariepinus), snakehead murrel (Channa striata), giant gourami (Osphronemus goramy), barramundi (Lates calcarifer), grouper (Epinephelus spp.), orange-spotted spinefoot (Siganus guttatus), vermiculated spinefoot (Siganus vermiculatus), spotted scat (Scatophagus argus), giant tiger prawn (Penaeus monodon), other penaeid prawns: Indian white prawn (Penaeus indicus), banana prawn (Penaeus merguiensis), greasyback shrimp (Metapenaeus ensis), mud crab (Scylla serrata, Scylla oceanica), giant freshwater prawn (Macrobrachium rosenbergii), lobsters (Panulirus spp.), slipper cupped oyster (Crassostrea iridea, Saccostrea spp.), green mussel (Perna viridis), abalone (Haliotis asinine), and seaweed (Eucheuma spp., Gracilaria spp., Caulerpa spp.).

The seven major aquaculture species in the Philippines are:

1. Seaweed (mainly Kappaphycus and Eucheuma spp.).
2. Milkfish (Chanos chanos).
3. Tilapia (mainly Nile tilapia Oreochromis niloticus).
4. Shrimp (mainly giant tiger prawn Penaeus monodon).
5. Carp (mainly bighead carp Aristichthys nobilis).
6. Oyster (slipper cupped oyster Crassostrea iridea).
7. Mussel (green mussel Perna viridis).
In 2002 seaweed made up 66.9 percent of total aquaculture production. The remainder was from milkfish (17.3 percent), tilapia (9.1 percent), shrimp (2.65 percent), carp (1.36 percent), oysters (0.94 percent), mussels (0.87 percent) and others (0.88 percent) (Bureau of Agricultural Statistics, 2004). Seaweed, giant tiger prawn, milkfish, oyster and mussel are endemic to the Philippines, while tilapias and bighead carp have been introduced.

The farming of the seaweed *Eucheuma* started in 1960s as a response to strong demand for phytocolloid carrageenin on the world market. Milkfish farming has been going on for centuries, and giant tiger prawn was a secondary harvest. Commercial farming of giant tiger prawn started in the 1980s as a response to export demand, mainly from Japan. The production of seaweeds and milkfish continues to grow every year, while giant tiger prawn production declined in the mid 1990s because of disease and has remained low ever since.

Tilapias were first introduced into the country in 1950 (*O. mossambicus* from Thailand). Subsequent introductions of various species followed. Genetically improved tilapias e.g. GIFT (Genetically Improved Farm Tilapia) and GMT (Genetically Male Tilapia), which have been developed in the Philippines, are now starting to contribute significantly to fish food production in the country.

**Practices/systems of culture**

Aquaculture in the Philippines is carried out in diverse ecosystems (freshwater, brackish water and marine) using various culture systems with different degrees of intensification. For example, milkfish is cultured in brackish water ponds, fish pens in freshwater lakes, fish pens in shallow bays, fixed or floating lake-based cages, and sea-based cages. Probably no other aquaculture species is produced under a wider range of environment and culture systems.

The level of development of aquaculture in the Philippines varies greatly from one species to another. It ranges from almost zero technology for spotted scat, to genetic manipulation for Nile tilapia. Within species the culture system ranges from extensive earthen pond systems yielding only 500 kg per hectare, to highly intensive marine cages capable of harvesting as much as 50 000 kg in an area measuring no more than 300 m², as is the case with milkfish (Yap, 1999).

Most milkfish production comes from brackish water fishponds.

Shrimp farming in the Philippines uses a variety of systems which are affected by the climate, availability of capital, site location, sources of water supply, the marketing of harvested products and the availability and cost of farm inputs. Shrimp farming follows the traditional, semi-intensive and intensive system (Corre, 1995).

Most tilapia production comes from freshwater ponds and cages. In the semi-intensive monoculture of Nile tilapia in one-metre deep earthen ponds (0.25-1 ha), fingerlings (0.25-0.5 g) are stocked at 3-5/m². With fertilization/feeding, yields of 4-8 tonnes/ha/crop of three - four months are obtained for fish weighing 150 - 250 g at harvest (Guerrero, 2002). In 100 m² floating cages, Nile tilapia fingerlings (1.6 g) are stocked at an average of 67/m² and grown for five months with feed. An average yield of 540 kg/cage/crop is obtained and the fish weigh 175 g each (Dey *et al.*., 2000).

Most of the carp recently produced is bighead carp from freshwater pens of Laguna Lake, the country's largest lake. Bighead carp does not require expensive feeds and very high production can be achieved in a small area (Yap, 2002).

Oyster and mussel farming takes place in open coastal waters. The methods commonly used for oyster culture are bottom, stake and hanging either from a rack or raft-rack. The stake method is the most commonly used. In terms of productivity, the hanging method is the most productive, followed by the stake, then the bottom method. Bottom and stake methods are used in shallow (intertidal) areas, whereas the hanging method is used in deeper areas (Gallardo, 2001).

For seaweed production farming methods can be classified under two: farming in shallow waters and farming...
in deep waters. The stake or bottom method is used in shallow waters. Monoline, raft and spider web methods are used in deep waters. Farming in shallow waters is the simplest and the cheapest to start with. However, it is more susceptible to "ice-ice disease" and grazing by small pelagic fishes. Farming in deep waters means increased production capacity and yield, and higher value of the seaweed species produced. One of the disadvantages is the higher start-up capital required.

**Sector performance**

<table>
<thead>
<tr>
<th>Major Species</th>
<th>Production (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seaweeds</td>
<td>894 857</td>
</tr>
<tr>
<td>Milkfish</td>
<td>232 161</td>
</tr>
<tr>
<td>Tilapia</td>
<td>122 390</td>
</tr>
<tr>
<td>Shrimp</td>
<td>35 493</td>
</tr>
<tr>
<td>Carp</td>
<td>18 151</td>
</tr>
<tr>
<td>Oyster</td>
<td>12 569</td>
</tr>
<tr>
<td>Mussel</td>
<td>11 646</td>
</tr>
<tr>
<td>Others</td>
<td>10 908</td>
</tr>
</tbody>
</table>

Total | 1 338 175

Source: Bureau of Agricultural Statistics, 2002

In 2002 average yields of milkfish from brackish water pond, pen and cage were 0.71 tonnes/ha, 56.19 tonnes/ha and 171.37 tonnes/ha, respectively. Shrimp from brackish water ponds gave average yields of 0.46 tonnes/ha. Tilapia from freshwater ponds and freshwater cages gave average yields of 3.37 tonnes/ha and 18.34 tonnes/ha, respectively. Carp from freshwater fish pens, fish cages and fishponds yielded on average 5.44 tonnes/ha, 2.52 tonnes/ha and 1.72 tonnes/ha. Seaweeds from open coastal waters gave an average yield of 42.05 tonnes/ha.

The graph below shows total aquaculture production in Philippines according to FAO statistics:

**Market and trade**

In general, there are four types of middlemen engaged in marketing aquaculture products in the country: brokers, wholesalers, wholesalers-retailers and retailers. Manila is the biggest market for aquaculture products. A high percentage of products from the three major island areas of Luzon, Visayas and Mindanao are channelled to brokers. In the process, substantial trading within the same level of the marketing channel takes place, especially among brokers, wholesalers and retailers, resulting in higher landed prices of aquatic products that puts them beyond the reach of urban poor consumers, even those in Manila (Olalo, 2001).

Milkfish producers usually sell their produce to a broker with a 5 percent margin inclusive of mark-up and marketing costs. The broker then sells to wholesalers at a margin of 10 percent. Wholesalers distribute to "viajeros" (travellers), and the "viajeros" to the retailers in the wet fish markets. Both the wholesalers and "viajeros" get a 15 percent margin (BFAR, 2004a). The supply chain is also similar for tilapia (BFAR, 2004b).

Seaweed and shrimps are the two major exports from aquaculture. Seaweed is exported in two forms: raw seaweed or carrageenin. In 2002, the country exported 32 098 tonnes of raw seaweed valued at US$
34 135 000 and 7 928 tonnes of carrageenin valued at US$ 38 618 000. The major buyers of raw seaweed in 2002 were France (21.3 percent), the Republic of Korea (16.4 percent), China (14 percent), Hong Kong (12.2 percent) and United Kingdom (12.1 percent). The major buyers for carrageenin were Denmark (20.1 percent), United Kingdom (15.4 percent), France (12.1 percent), Canada (7.8 percent) and the United States (7.8 percent) (BAS, 2004e). In 2002 shrimps were exported mostly fresh/chilled/frozen (98 percent) to Japan (53 percent), the Republic of Korea (20 percent) and the United States (9 percent) (BAS, 2004b).

In order to promote global competitiveness, the Bureau of Investments (BOI) promotes the seal of origin for selected Philippine aquaculture exports such as shrimps, milkfish and tilapia. Under the memorandum of agreement between government and industry associations, only those producers who comply with international standards are accredited to protect the seal's integrity.

**Contribution to the economy**

Approximately 18 percent of the food fish supply currently comes from aquaculture. Milkfish and tilapia represent the bulk of aquaculture production. From 1998 to 2002, milkfish and tilapia production registered an annual average growth of 11.7 percent, compared to only 2.6 percent for capture fisheries. In 2002, the combined production of milkfish and tilapia of 364 289 tonnes represented 8 - 9 percent of total animal meat consumption. The prospects for further increasing aquaculture production are therefore enormous. In the last five years, abundant production from aquaculture has made farmed fish increasingly more affordable compared to wild-caught fish. Over a ten-year period, milkfish and tilapia prices increased by an average of 3.4 percent and 1.7 percent respectively, as compared to 7.3 percent for the small pelagic shortfin scad *Decapterus macrosoma* (Cruz, 2004).

According to the BFAR, 258 480 people have been employed in aquaculture since 1987. The industry estimates employment generation to be higher. In the seaweed industry alone, the Seaweed Industry Association of the Philippines (SIAP) claims that in 2002, 1 017 925 individuals were engaged in seaweed farming (Monzales, 2003).

In 2002 SIAP reported export earnings of US$ 138 438 853 from seaweeds. Seaweed farming does not require high investment, but the return on investment is high. The yield from a one-hectare seaweed farm can be as much as 48 tonnes (wet weight) in two months (Gurrero, 2003).

Apart from seaweed farming, oyster and mussel farming can also be a source of livelihood for coastal communities. Although it may not be the main source, it can contribute significantly to household income and food. Women and children can also participate (Gallardo, 2001). A productivity of 5 000 kg/ha in six - seven months for oysters is reported. Using nylon nets, a hectare of mussel farm in Manila Bay can yield 180 tonnes in four months (Guerrero, 2003). Seaweed farming and oyster and mussel farming are also widely recognized as "environment-friendly."

Thus, aquaculture can contribute significantly to food security, employment and foreign exchange generation. However, unsustainable aquaculture practices can also cause some serious ecological and socio-economic problems. The problems associated with the fish pen operations in Laguna Lake and fish cage operations in Sampaloc Lake were just some of the prominent examples in the past (Santiago, 2001). In marine cage/pen farming, a more recent disaster in 2002 in Bolinao, Pangasinan, was the first major episode in coastal waters in the Philippines where thousands of kilos of milkfish died. Losses to operators and coastal fishers were estimated to be in the order of US$ 10 000 (San Diego-McGlone, 2003).

**Promotion and management of the sector**

The BFAR under the Department of Agriculture (DA) is the national government agency responsible for the FAO Fisheries and Aquaculture Department
development, conservation, management, protection and utilization of fisheries resources according to the
Philippines Fisheries Code of 1998. The BFAR currently operates regional offices throughout the country.

The Local Government Code of 1991 and Fisheries Code transferred government supervision and licensing of all types of aquaculture to the Local Government Units (LGUs). The only licensing function left with the BFAR as far as aquaculture is concerned is the granting of Fishpond Lease Agreements for public land.

As part of the government's fisherfolk empowerment programme, Fisheries and Aquatic Resources Management Councils (FARMCs) have been created at national level and coastal municipalities. FARMCs advise the national government and LGUs on fisheries policy and planning.

The government has been increasingly engaging non-government organizations and people's organizations (POs) on fisheries co-management. Many of the NGOs in fisheries belong to the NGOs for Fisheries Reform (NFR). Many POs belong to Kilusang Manggisingdya (KM) and Pambansang Alyansa at mga Manggisingdya at Pamunuan ng Organisasyon (PAMPANO).

The participation of the business sector in the development and management of the aquaculture industry has not yet been institutionalised or strengthened. There are several organizations involved in aquaculture, but the more active ones are the Fisheries and Aquaculture Board of the Philippines (FABP), Philippine Aquaculture Society/Society of Aquaculture Engineers of the Philippines (PAS/SAEP), Association of Philippine Aquaculture Feed Millers, Inc. (APAFMI), PHILSHRIMP, PHILFRY and Philippine Tilapia Inc. (PTI).

The governing regulations

The **Philippine Environment Code (1988)** provides the foundation for all measures dealing with the Philippine's natural environment, encompassing the management of air quality, water, land use, natural resources and waste. The Code, being a framework instrument, provides a chapter on fisheries and aquatic resources and requires the government to establish a system of rational exploitation thereof. The **Philippine Fisheries Code (1998)** provides for the development, management, conservation and utilization of fisheries and aquatic resources. The Code integrates all laws that are relevant to these issues. Chapter II, Article III (Sections 45-57) of the Code deals with aquaculture. The **Implementing Rules and Regulations (1998)** provide the procedures and guidelines for the implementation of the Code. The Code is further implemented by numerous Fisheries Administrative Orders (FAOs) on various specific subjects.

The Fisheries Code falls under the jurisdiction of the Department of Agriculture. Within the Department, the Undersecretary for Fisheries and Aquatic Resources is responsible for setting policies and formulating standards and for exercising overall supervision. The Bureau of Fisheries and Aquaculture Resources (BFAR) is the agency tasked with the management and development of fisheries and aquatic resources. The Code also creates a National Fisheries Research and Development Institute (NFRDI), which serves as the primary research arm of BFAR. The functions of BFAR are broadly defined and include - *inter alia* - the preparation and implementation of the National Fisheries Industry Development Plan, the enforcement of laws and regulations (except in municipal waters) and the monitoring and regulation of import and export of fishery and aquaculture products and of fish processing establishments.

The Fisheries Code also provides for the establishment of Fisheries and Aquatic Resources Management Councils (FARMCs) at various levels: national (NFARMC), municipal or city (M/CFARMC), and bays, gulfs, lakes, rivers and dams bounded by two or more municipalities or cities to be known as Integrated FARMC (IFARMC). The NFARMC serves as an advisory/recommendatory body to the Department of Agriculture in policy formulation and the preparation of the National Fisheries Industry Development Plan. The M/CFARMCs assist in the preparation of Municipal Fishery Development Plans and the enforcement of laws and regulations in concerned municipal waters, among other things. The IFARMC has a similar role to the M/CFARMC except that its reach covers more than just one municipality. **Fisheries Administrative Order No 196 (2000)** provides detailed guidelines on the creation and implementation of FARMC's.
Another basic act that is relevant to aquaculture is the **Agriculture and Fisheries Modernization Act (1997)**, which prescribes the measures to modernize the agriculture and fisheries sectors in order to enhance their profitability. Whereas the Fisheries Code prioritizes the management, conservation and protection of fisheries and aquatic resources, the Agriculture and Fisheries Modernization Act places priority on increase in production and encourages a rapid shift towards industrialization. The National Agriculture and Fisheries Council (NAFC) assists the Department of Agriculture in the monitoring and coordination of the agriculture and fisheries modernization process.

Finally, the **Reorganization Act of the Department of Environment and Natural Resources (DENR) (1987)** establishes the Environmental Management Bureau (EMB), encompassing the former National Environmental Protection Council, the former National Pollution Control Commission and the former Environmental Center of the Philippines. It also establishes a Protected Areas and Wildlife Bureau. It should be noted that the Fisheries Code contains a number of provisions in which the jurisdictions of BFAR and EMB intersect. Such intersections are express, such as the classification of rare, threatened or endangered species of aquatic flora and fauna or the classification of fishery areas, or implied, such as the formulation of an integrated coastal management framework and the setting, monitoring and evaluation of water quality standards.

For more information on aquaculture legislation in Philippines please click on the following link: [National Aquaculture Legislation Overview - Philippines](#)

### Applied research, education and training

The Southeast Asian Fisheries Development Center Aquaculture Department (SEAFDEC AQD) in the Philippines fills in many of the gaps in Philippine aquaculture research. Through a system of consultation and discussion with the industry and the local aquaculture R&D sector, SEAFDEC AQD sets priorities for its research and avoids duplication of work with local institutions. SEAFDEC AQD research outputs are published mostly in international journals (Yap, 1999).

Aquaculture R&D is co-ordinated (and to some extent funded) by the Philippine Council for Aquatic and Marine Research and Development Council under the Department of Science and Technology and by the Bureau of Agricultural Research under the Department of Agriculture.

There are several state universities and colleges engaged in aquaculture education and research. The Marine Science Institute, University of the Philippines and Central Luzon State University (both in Luzon), University of the Philippines in the Visayas and Mindanao State University have contributed significantly to aquaculture education and R&D in the country. All educational institutions in fisheries are supported by the State. There are more than 40 state colleges and schools of fisheries under the Commission on Higher Education, while seven are under the Technical Education and Skills Development Authority (Juliano, 2004).

The Bureau of Fisheries and Aquatic Resources has several aquaculture centres/stations throughout the country and they provide aquaculture extension services. Some private companies (e.g. feed companies) also carry out aquaculture research and extension.

### Trends, issues and development

From 1997 to 2001, aquaculture grew by an average of 6.4 percent annually, compared to 0.72 percent for municipal fisheries and 2.6 percent for commercial fisheries (Cruz, 2004). Seaweed production grew by an average of 7.04 percent during the period 1998 - 2002 (BAS, 2004e). The steady growth in seaweed production is attributed to the following (Mozales, 2003):

- Carrageenin is market driven, annual market growth from 5 percent to 15 percent, more applications are being discovered, hence increasing demand.
- Farming cost & investment is low and return of investment is high.
The Philippines has the best quality raw materials. The Seaweed Industry Association of the Philippines (SIAP) is active, identifies problems and finds solutions and works closely with government.

The present high growth in milkfish production can possibly be maintained due to the increasing use of sea cages and sea pens for milkfish culture. The growing popularity of value-added milkfish products in de-boned (or boneless) and smoked forms and their export potential will help to maintain the current growth pattern. The emergence of large commercial milkfish hatcheries in the Philippines is a positive development which can give the milkfish industry the extra needed push (Yap, 2002b).

The success of tilapia production in the Philippines is attributed to the following (Guerrero 1994):

- Government support for research and extension.
- Government moratorium on tilapia price and market intervention.
- Cooperation between Philippines government and private sector and amonge researchers.
- Cooperation and support of many international organizations.
- Introduction of new breeding stock (Nile tilapia).

However, continued growth of the aquaculture industry is threatened by factors such as considerably lower margins for farmers and increasing cost of farmed fish compared to chicken and pork. A serious obstacle to the aquaculture industry's efforts to become more competitive is the very erratic market prices brought about by the seasonal harvest of wild fish (Cruz, 2004). Over the last 20 years, the ranking of the Philippines in world aquaculture production fell steadily from 4th place in 1985 to 12th place. The Philippines now contributes only a little over one percent of world aquaculture production. The growth of the Philippine aquaculture industry in the coming years is likely to be unsustainable unless new markets are developed, market competitiveness is improved, and farming risks are reduced (Cruz, 2004). The Philippine Government and private sector are currently preparing the Comprehensive National Fisheries Industry Development Plan (CNFIDP). One of its components is Aquaculture Development and Management. Given international trade and competition, there is a need for the Philippine aquaculture industry to adopt a CNFIDP that is global in perspective (Cruz, 2004). The following recommendations are made (Cruz, 2004):

- Have a market-oriented framework of development.
- Develop new markets, both for local and for export.
- Promote technologies that will bring down production cost.
- Develop new species that are cheap to produce.
- Develop the processing and value-adding industries.
- Rationalize fisheries ordinances in support of the CNFIDP.
- Benchmark strategies against other countries.
- Promote and support private sector leadership and initiatives.

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