

# AQUACULTURE IN SOUTHEAST ASIA<sup>1</sup>

by

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## INTRODUCTION

The term aquaculture was coined to embrace all the activities of man, to produce any aquatic resource of economic value through husbandry during the whole or part of its life cycle. The resources can take the form all the way from a tiny plant, the algae, to a giant seaweed or from a micro-crustacean to a big fish. It may be reared in a small aquarium, a compact re-circulating tank system to big ponds or even in the open lake or sea.

Asia is supposed to be the seat of the oldest aquaculture dating as far back as 3,500 years ago. It is often mentioned that in South-east Asia, there existed long-established aquaculture industries (Ling and Rabanal, 1973). Such industries cover extensive areas estimated at two million hectares and producing annually over 4.5 million metric tons of fish. The investment can be equivalent to as much as US\$3,000 million.

The world production of fish averages about 60 million metric tons per year of which 6 million or 10 percent come from aquaculture (Pillay, 1976). The major part of the aquaculture production or over 80 percent come from Southeast Asia (Rabanal, 1974). Aquaculture supplies a consequential part of the fish production in China, India, Japan, Indonesia, Philippines, Thailand and Malaysia (Table 1).

It appears that further expansion of aquaculture still has high potential in this region. There still exist extensive areas of fresh

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and brackishwater swamplands, tidal flats and protected coves along the coast where aquaculture can be developed (Table 2). Man-made reservoirs, water development works, and irrigation systems have been established, under construction, or are planned to be built in many countries in this region. All these are potential sites for the development of the aquaculture industry.

### THE SITES FOR AQUACULTURE

Previously, impounded waters or ponds are the traditional sites for aquaculture production. Very recently, however, many variations or innovations have been introduced. From running water ponds developed raceway, and from raceways developed silos and re-circulating systems. Fishpens and cages which formerly can be dismissed as hobbies are now used for commercial production of fish. For instance, at least 20,000 tons of fish per year are produced from Laguna lake fishpens in the Philippines; and, in Vietnam and Kampuchea, fish cages are floated down the Mekong River to supply fish to the populous towns and cities of these countries. Hong Kong has assessed that at least 10,000 tons of valuable fish are being held in privately-owned cages along its Lamma islet and Japan produces 90,000 tons of yellowtail and seabream from marine cages. Open sea culture has developed rapidly, especially for shellfish and seaweeds and an extremely high rate of production is seen as possible; cockle, oyster and mussel culture are the most promising. Recently, in Singapore experimental, plots of mussel grown in hanging rope rafts produced about 2,400 tons per hectare per year. Similarly, the seaweed culture for *Eucheuma striatum* in the southern Philippines has been producing close to 200 tons of dried seaweed per year.

It has also been noted that in land areas with a rugged terrain where the soil is relatively water-tight and where there is adequate rainfall (2,500 mm or more per year), small reservoirs can be used as multi-purpose farm ponds and also for the production of fish. As there are many such areas in this region, the potential for aquaculture development using this type of site is extremely high.

### THE RESOURCES OR SPECIES USED

The different regions of the world have varied floristic and faunastic characteristics. This regional distribution of plant and

animal species has influenced the kind of resources used in aquaculture in different parts of the world. Finfishes or different species of fish used to be thought of as the only major cultivable resource. This idea is no longer correct. The microscopic *Spirulina*, a blue-green algae with 60 percent protein content is being cultivated in Mexico and a closely-related algae is being grown in Africa. Various species of large marine plants or seaweeds have been identified for their edible and industrial uses and they are now cultivated in many Southeast Asian countries notably in China, Japan, Korea and the Philippines. The other countries in the region such as Malaysia, Thailand and Indonesia are also interested. Improved technology of feeding and feed preparation and better knowledge of the biology of fish with high market demand have led to the development of culture techniques for groupers, sea bass, seabreams, yellowtail, puffer fish, marble goby, shrimps and prawns. In these cases, the economy of culturing species with long food chains is supported by the price customers are willing to pay. However, it must be borne in mind that in considering overall global need to produce food for the human population, mass production of resources with short or ecologically economic food chain should continue to draw the attention of aquaculture. The herbivores like the milkfish, mullet, and tilapia, should continue to be prominent culture species. The filter feeders like mussels, cockles, oysters and clams should receive more serious attention.

### METHODS OF INCREASING PRODUCTION

There are various ways by which aquaculture production can be increased in the Southeast Asian region. As suggested previously, expansion in area is probably the simplest way of accomplishing this objective. Of the areas already developed, intensification is certainly a method to increase production. The technology of attaining these objectives are fast being discovered through research. These consist primarily in introducing certain inputs such as fertilizers, feeds, pesticides and increased stocking rates in the culture system. The high cost or unavailability of these items in many developing countries of the region may present constraints in accomplishing these objectives.

Recently, the introduction of non-conventional methods of production have gained much importance. These include the use of fishpens and cages, running waters, raceways, and re-circulating systems



and animal husbandry or plant crop-cum-fish culture. The development of these systems require the necessary technical know-how and capital investment and are therefore being conducted in areas where aquaculture industry is well-established. Due to the economy of space and time which these systems are particularly noted for, their increased use in the future may be expected.

### REGIONAL AND COUNTRY DEVELOPMENT

Aquaculture development in the Southeast Asian region may be conveniently divided into the following sub-regions:

- (1) China/Japan/Korea;
- (2) Indonesia/Philippines/Taiwan province, China;
- (3) Hong Kong/Malaysia/Singapore;
- (4) Thailand/Vietnam/Kampuchea/Laos;
- (5) India/Sri Lanka/Bangladesh/Burma/Nepal; and
- (6) Papua New Guinea/Australia/New Zealand.

#### *China/Japan/Korea sub-region*

This sub-region is the northern sector of the region characterized by relatively colder climate and higher technological development. The freshwater aquaculture in this area is well-developed and with very high production. Intensified monoculture for common carp, goldfish, eel, and trout are practised in Japan and Korea, and polyculture for the various Chinese carps is highly developed in China. Open sea mariculture is also well-developed for shellfish and seaweeds and for finfish in cages. The yellowtail and seabream cage culture in Japan is of commercial importance in the country. The utilization of water development resources with polyculture of carps in China is an important feature of the aquaculture industry in that country.

#### *Indonesia/Philippines/Taiwan province, China sub-region*

This sub-region is essentially a brackishwater pond culture area especially for the raising of milkfish and penaeid shrimps. The extensive mangrove swamps and tidal flats in the coastal areas in these countries are being utilized for this purpose. In Taiwan where these sites are limited, extensive reclamation of coastal tidal flats has been initiated.

Freshwater pond culture is also well-developed in this sub-region based on the Chinese polyculture system and influenced by nearby

Japan. More projects for the hatching and raising of penaeid shrimps are being established. Freshwater pond culture is not developed in the Philippines, but fishpen culture using milkfish in Laguna de Bay, the largest Philippine freshwater eutrophic lake, has attained commercial importance. Indonesia utilizes extensive management practice for its extensive brackishwater ponds but intensification and development of penaeid shrimp aquaculture in these projects have recently been initiated. There is very great potential for further expansion of this type of culture in this country. Indonesia also has well-developed freshwater aquaculture in many of its islands. Carps, gouramis and other cyprinid species are grown in this type of culture.

#### *Hong Kong/Malaysia/Singapore sub-region*

Hong Kong and Singapore have limited areas for the expansion of the aquaculture industry but Malaysia has the largest potential. Intensive aquaculture for high-priced species is the priority in the first two areas. Trapping ponds for the culture of penaeid shrimps is a distinct development characteristic of Singapore and Malaysia. In these three places, freshwater pond culture utilizing the Chinese carp polyculture system is well-developed. The development of fish cage mariculture in Hong Kong is worth mentioning. This has also been initiated in Singapore and Malaysia.

#### *Thailand/Vietnam/Kampuchea/Laos sub-region*

These countries are influenced by the Mekong River system from which emanates a common inland water ichthyo-fauna which is varied and rich. Thailand has natural and man-made reservoirs with rich fishery resources and freshwater aquaculture for carps and other cyprinids, for catfishes, and the giant freshwater prawn, are being practised. Brackishwater aquaculture for finfish is, however, undeveloped in this country. There is very limited development of aquaculture in Vietnam, Kampuchea, and Laos. The inland and freshwater resources are as rich as that of Thailand. There is a limited development of brackishwater aquaculture for penaeid shrimps being started in Vietnam.

#### *India/Sri Lanka/Bangladesh/Burma/Nepal sub-region*

India has well-developed fresh and brackishwater aquaculture industries. But the rest of the countries have very limited development. Freshwater aquaculture in this sub-region is based on polyculture of the Indian major carps. Brackishwater aquaculture utilizes



penaeid shrimps, as well as finfish species, like the mullets. The production of seedfish is an industry by itself. Recently, the Chinese major carps were introduced.

#### *Papua New Guinea/Australia/New Zealand sub-region*

This is the southernmost fringe of the region which is almost outside the area, but because of the peculiar development of aquaculture in this sub-region, it is worthwhile mentioning. Aquaculture *per se* is not allowed by law in Australia and New Zealand for the reason that it might interfere with existing wild water sport fisheries for cold water species in these countries. However, during recent years, there has been continuous clamor to lift this prohibition. Mariculture for oysters and other sea products is very much encouraged and in fact, Australia is exporting cultured oysters in commercial quantities. The raising of penaeid shrimps is being developed. Other species of shellfish are being tried such as for mussels in New Zealand. There is no known development for the aquaculture industry in Papua New Guinea but there is great interest in this work in this country.

### TRENDS, CONSTRAINTS AND PROSPECTS

#### *Trends*

As mentioned above, some of the countries are rapidly expanding the areas used for aquaculture. Intensification of management in existing areas are also being practised as inputs become available. The tendency to utilize resources or species with long food chain has come about as a result of the high market demand for such species and techniques being developed for their culture.

#### *Constraints*

The major constraints can be summarized as technological, financial, manpower and environmental.

**Technological constraint.** — Research should come up with solutions for the technological problems of the industry to put it on a sound technical basis. These include the problems of seed supply, proper use of intensification inputs, reduction of mortalities, improvement of stock through breeding, etc.

**Financial constraint.** — Financing for the aquaculture industry is coming in very slowly in recent years. The World Bank, the Asian Development Bank (ADB) and other financing institutions have realized the importance of this source of production and are giving it some support. However, it does appear that the funding allotted is still not adequate but more important is the fact that the funding does not seem to filter down to the very base of the industry where the financial need is highest. Some mechanism still has to be devised to accomplish this objective.

**Manpower constraint.** — The manpower requirements for aquaculture is closely related to the technological problems. Well-informed and practical manpower to run the industry is required. The remuneration for this manpower has not been attractive so that there has been a decline, not only in the number but also in the quality of available personnel required as managers, extension workers, and fish farmers. Unless these difficulties are solved, the availability of manpower will remain a problem.

**Environmental constraint.** — Aquatic pollution in the region is on the increase and is still rising rapidly. There are concrete examples of aquatic resources that have been affected by this constraint:

(1) The natural runs of *Macrobrachium rosenbergii* in many rivers in Thailand, but particularly in the Chao Phraya and Mae-long rivers have practically disappeared due to water pollution. Similar occurrence is being felt in Palembang, South Sumatra province, Indonesia.

(2) The extensive oyster grounds in the northwest coast of Hong Kong has shrunk in area and declined greatly in production due to contamination in the area.

(3) The center for milkfish fry nurseries north of Manila, Philippines, with over 200 hectares has practically been eliminated due to pollution and has had to be dispersed to other fish pond areas in the country.

(4) Rice-fish culture which once occupied large areas in Japan and Indonesia has decreased greatly in area and still continues to decrease due to pollution through agricultural pesticides.



(5) Oil spills have, on specific occasions, affected aquaculture fisheries in Hong Kong and Singapore.

(6) Coastal and seabed tin mining in parts of Malaysia, Thailand and Indonesia adversely affect the potential areas for aquaculture development.

(7) Land reclamation in Manila Bay, Philippines and in Singapore will certainly affect existing oyster and mussel farms and fishponds.

The above lists are but a few specific examples of environmental modifications which affect aquaculture development. Undoubtedly there are more of these occurrences actually happening or are bound to happen in the near future unless proper vigilance is taken to prevent them.

#### Prospects

The prospects of aquaculture industry in the Southeast Asian region is bright because of the following basic considerations:

Availability of areas for expansion; increase in number of resources for development; early solution of the seed problem; technical capability for regional intensification of the industry; increasing availability of financing for aquaculture; and increasing social and economic roles of aquaculture.

The availability of areas for expansion in the region has previously been mentioned. Research and the industry itself has continued to identify additional resources or species that can be used for aquaculture. In this development, both technical knowledge of the species and the economic demand for the product are being considered.

Hatcheries to propagate seedlings for cultivable species which normally are obtained from wild sources have now been established in the region. Hatcheries for penaeid shrimps are in existence in Japan, the Philippines, Taiwan province of China and Thailand and hatcheries for milkfish and other salt water species have been established in Hawaii, Taiwan province, and the Philippines. Both Hawaii and Taiwan province have been able to produce fry of the grey mullet while work on milkfish are being intensified.

Intensification of methods of production are being adopted subject to the availability of inputs in the different countries of the region. The use of locally available supply of these inputs is the prime con-

sideration for the development of an economically viable aquaculture industry.

Financing for aquaculture is increasing and it is hoped that it will continue to increase as the industry expands. It is also expected that the mechanics of dispersing the funds where they are most needed will be further developed.

Aquaculture will continue to develop because of its social and economic impact on the community especially in this region. It is an industry which could be handled by a family unit either as a part-time or full-time occupation. It is an alternative source of income and employment to offset the declining catch of subsistence fishermen or the inadequate production of marginal farmers. Likewise, it is also a source of the protein diet of thousands of families in rural areas in this region.

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TABLE 1

Estimated Southeast Asian Production Through  
Aquaculture in 1975  
(After Pillay, 1976)

FINFISH	TONS	MUSSELS	TONS
China, all provinces excluding Taiwan Province	2 200 000	Korea, Republic of	5 578
Taiwan, Province of China	81 236	The Philippines	182
India	490 000	New Zealand	150
Japan	147 291	(2.5%)	5 910
Indonesia	139 840	CLAMS	
The Philippines	124 000	Korea, Republic of	24 920
Thailand	80 000	Taiwan, Province of China	13 898
Bangladesh	76 485	The Philippines	33
Sri Lanka	7 659	(100%)	38 851
Malaysia	6 559	SCALLOPS	
Hong Kong	4 019	Japan	62 600
Burma	1 500	(100%)	62 600
Singapore	680	COCKLES AND OTHER MOLLUSCS	
Nepal	400	Malaysia (cockles)	28 000
Korea, Republic of	169	Taiwan, Province of China	1 243
(84.4%)	3 359 838	Korea, Republic of	733
		The Philippines	11
		(100%)	29 987
SHRIMPS AND PRAWNS		SEAWEEDS	
India	4 000	Japan	502 651
Indonesia	4 000	China, all provinces excluding Taiwan Province	300 000
Thailand	3 300	Taiwan, Province of China	7 347
Japan	2 779	Korea, Republic of	244 795
Taiwan, Province of China	549	(100%)	1 054 793
Singapore	105	GRAND TOTAL (81.2%)	4 894 690
Korea, Republic of	30		
(94.3%)	14 763		
OYSTERS			
Japan	229 899		
Korea, Republic of	56 008		
Thailand	23 000		
Taiwan, Province of China	13 359		
Australia	9 200		
The Philippines	782		
New Zealand	700		
(54.7%)	332 948		

TABLE 2

Estimated Areas Utilized and Potential Sites  
for Aquaculture in Southeast Asia<sup>1</sup>  
(After Rabanal, 1974)

Country	Area utilized (ha)	Potential sites (ha)
Bangladesh	76 485	476 000
Burma	2 920	6 477 000
China	700 000	*
India	611 915	2 730 000
Indonesia	299 283	6 000 000
Hong Kong	1 500	2 100
Japan	508	*
Kampuchea <sup>2/</sup>	350	15 000
Korea	75 260	452 000
Laos	180	20 000
Malaysia	91 343	375 000
Nepal	77	2 750
Pakistan <sup>3/</sup>	30 780	682 000
Philippines	171 400	493 600
Singapore	789	*
Sri Lanka	10 000	278 000
Taiwan	39 234	53 800
Thailand	216 792	4 187 000
Vietnam <sup>4/</sup>	95 000	500 000
TOTAL	2 423 816	22 744 000

\* - No available data

1/ - This is a preliminary evaluation from all available sources; data in some countries are incomplete or not available.

2/ - Includes production of 1 000 fish cage units. The potential sites consist of mangrove only; freshwater areas very extensive.

3/ - Estimate for this country was made before Bangladesh was separated.

4/ - Includes production of 5 000 units of fish cage. Potential areas include mangrove only; freshwater sites very extensive.