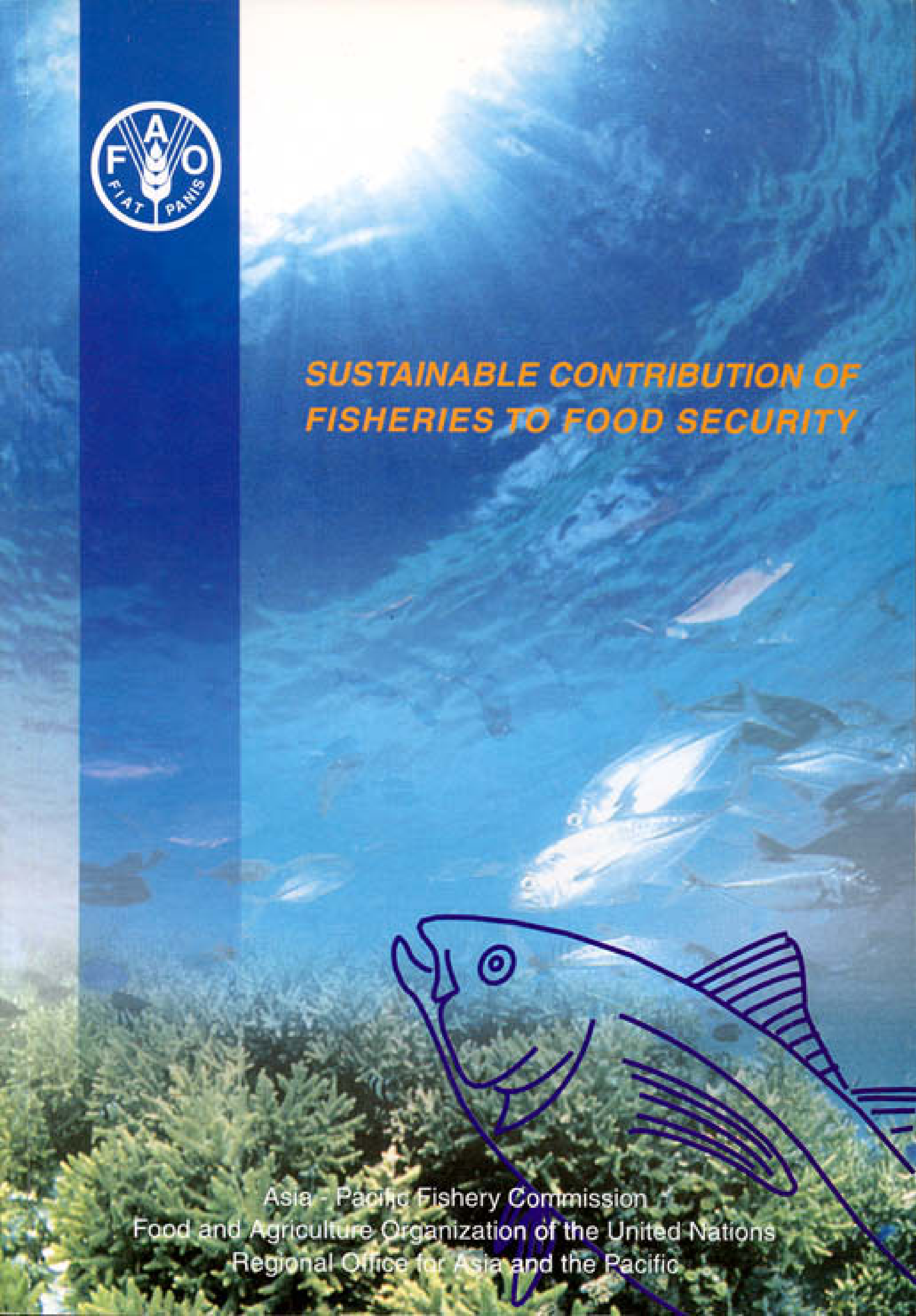
SUSTAINABLE CONTRIBUTION OF FISHERIES TO FOOD SECURITY



Asia - Pacific Fishery Commission
Food and Agriculture Organization of the United Nations
Regional Office for Asia and the Pacific

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Preparation of this Document

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This report covers the role of fisheries for food security in the Asia Pacific region. The contributions made by national/regional experts are gratefully acknowledged.

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PREFACE

Ninety-five States participated at the International Conference on the Sustainable Contribution of Fisheries to Food Security, hosted by the Government of Japan in cooperation with FAO at Kyoto, 4 to 9 December 1995. The conference noted a continuously growing world population and the need to secure enough food for the people in present and future generations as well as the significant contribution of fisheries to income, wealth and food security for all people especially those in low-income, food-deficit countries (LIFDCs). It also noted the FAO projection that demand for fish will increase faster than supply in the next decade and beyond. The estimated demand in 2010 was about 110-120 million tons against the estimated supplies from all sources of only 73-108 million tons. The conference adopted the Kyoto Declaration and Plan of Action on the Sustainable Contribution of Fisheries to Food Security, especially to address the supply issues in a sustainable manner.

The Kyoto Declaration recognized that the projected shortfall of supply of fish and fishery products by 2010 could substantially be reduced and the marine and inland waters maintained as a sustainable source of renewable food resources if a combination of measures is taken. The Declaration called for actions in conserving and managing fishery resources and fisheries as well as immediate actions to be taken by States, *inter alia*, for effective implementation of the FAO Code of Conduct for Responsible Fisheries, strengthening scientific research for sustainable development of fisheries and aquaculture, assessing the stock productivity and adjusting the fishing capacity to a level commensurate with long-term stock productivity, and increasing the available supply of fish and fishery products for human consumption, nationally and internationally.

The urgent need to ensure food security was further emphasized at the World Food Summit, organized by FAO in the following year, Rome, November 1996. The Rome Declaration on World Food Security stressed the importance of sustainable management of natural resources and the elimination of unsustainable patterns of consumption and production. The Plan of Action adopted by the Summit recognized degradation of land and aquatic-based natural resources and the need to restore and rehabilitate these resources in depleted and overexploited areas to achieve greater production. The plan of action therefore called for all States to collaborate to achieve sustainable world food security and availability of enough food for all.

In the Asia-Pacific region, fisheries play a significant role for food security of people in all levels, both nationally and internationally. In 1998, capture fishery production from this region accounted for half of the world production. Moreover, aquaculture production continues to increase in the last two decades. The production from aquaculture in Asia-Pacific reached 88 percent of the world aquaculture production of fish and shellfish and 99 percent of seaweed production in 1998. To continue such trends into the new millennium, all States in the region were urged to give due attention to the current problems and constraints in managing their fishery resources and fisheries and to find ways and means to reverse the negative trends as already observed in some countries in the region in order to bridge the gaps in supplies and demand for fish and fishery products.

The present study was carried out under the UNDP's RAS/95/01T project on Sustainable Agriculture and Food Security in Asia and the Pacific: Issues and Challenges, which was implemented by the FAO Regional Office for Asia and the Pacific since 1998. Four technical reports have been issued so far, namely, Poverty Alleviation and Food Security in Asia: Issues and Challenges; Land Resources; Role of Livestock; and Enhancing Forestry and Agroforestry Contributions. This fifth report reviews the sustainable contribution of fisheries in East Asia, South Asia, Southeast Asia and the Oceania by experts from each subregion. It is our sincere hope that the Member States as well as the Non-members and other regional fisheries bodies would seriously consider the current situation, the envisaged gaps in production and demand and the options available to adjust fishery policies and practices in their countries or areas of competence to ensure long-term sustained contribution of fisheries and aquaculture from this region to food security to all.

R.B. Singh
Assistant Director-General
and Regional Representative
for Asia and the Pacific

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THE SUSTAINABLE CONTRIBUTION OF FISHERIES TO FOOD SECURITY IN THE ASIA AND PACIFIC REGION: REGIONAL SYNTHESIS

by

M. Hotta

"No fish - no dinner ….."

"Give a man a fish and you will feed him for a day. Teach him how to fish and he can feed his family for ever ….."

Old Chinese Proverbs

1. Introduction

Since the World Food Conference of 1974, conditions of world food security have changed profoundly. Sustainable agricultural development, including the essential contribution of the fisheries sector, has become of utmost importance, both to ensure adequate supplies of food at affordable prices, and as the main source of economic and social progress for the rural poor. Food security is now dependent upon a set of circumstances that has political, social and economic dimensions at the national, regional and global levels.

In recent years the international community, national governments and development agencies have been giving more and more attention to these issues. These initiatives culminated in the World Food Summit, held in Rome in November 1996. The special role of the fisheries sector in this regard was examined at the International Conference on the Sustainable Contribution of Fisheries to Food Security, organised by the Government of Japan in collaboration with the Food and Agriculture Organisation of the United Nations (FAO) and held in Kyoto in December 1995. More detailed consideration of these concerns has now devolved regionally and nationally, and includes the ongoing UNDS-supported Review of Food Security Issues and Challenges in the Asia and Pacific Region. The present paper is a contribution to the regional debate on these issues in so far as the role of fisheries is concerned.

As illustrated simply but cogently by the above ancient proverbs from China, fisheries have from time immemorial played a very significant role in many countries and communities through the supply of food and the creation of employment and income. This is particularly the case in many developing countries where, on average, fish currently provide almost one-fifth of the total animal protein supply; in many parts of the Asia-Pacific region, the importance of fish to food supplies is even greater.

The present paper undertakes a brief examination of the overall world food situation, with special reference to conditions in the Asia-Pacific region. The recent trends and present state of the fisheries sectors in the region are then discussed, in particular the marine, inland water and aquaculture activities in three main sub-regions. The paper brings together the findings of the six case studies commissioned for this report, i.e. the East Asia sub-region (consolidating case studies of Japan, China and the Republic of Korea) Oceania (Oceania case-study) and the South and South East Asia sub-region (combining the case studies of South Asian and Southeast Asian countries). The analysis also incorporates relevant materials drawn from a number of other studies and publications (see Appendix 3).

The paper then proceeds to a review of the present role of fisheries in food security in Asia and the Pacific and to a consideration of existing and prospective policy issues in sustainable fisheries development and management in the region. The report concludes by setting out a number of recommendations for national and regional action to promote the role of fish in achieving regional food security.

2. The World Food Situation

The information presented to the 1996 World Food Summit presented a picture of encouraging but uneven progress towards greater world food security. The concept of food security used in its most general sense means a state of affairs in which all people at all times have access to sufficient safe and nutritious food to maintain a healthy and active life. This was the definition of "food security" endorsed by the International Conference on Nutrition, Rome, December 1992.

The main indicator for monitoring developments in food security is per-caput consumption, calculated on the basis of national food balance sheets and population data. This gives the average daily dietary energy supply (DES) in calories. The information available permits the estimates and projections set out in Table 1.

It has been estimated that those persons consuming 2,100 calories or less per day declined from 1,747 million in 1969/71 to 411 million by 1990/92. The number of persons classified as seriously undernourished has, however, fallen at a much slower rate, from 920 million in 1969/71 to recent levels around 840 million - in percentage terms, a decrease of 35 to 20 percent.

For a number of developing countries, the 1970s were a decade of improvement, faster than in the 1960s; rapid progress continued up to the mid 1980s and at a slower pace thereafter. Other countries, indeed whole regions, failed to make such progress and even experienced outright reversals, notably many African countries. In East and Southeast Asia, significant improvements were achieved in food energy deficiencies which fell from 41 percent of the population in 1969/71 to 27 percent by 1979/81 and 16 percent in 1990/92. The comparative figures for South Asia (33 percent, 34 percent and 22 percent) are rather less encouraging. Of special concern is the fact that in many cases these improvements were only achieved by means of increasing dependency by developing countries upon food imports from developed countries.

According to the evidence of the UN medium variant projections, population growth rates are likely to slow down, globally, from 1.57 percent per annum during 1990-95 to 1.20 percent by 2010-2015; the comparative estimates for Asia indicate a decline in the rate from 1.64 percent to 1.15 percent. Life expectancies, however, will continue to improve, globally, from a 1990/95 expectancy of 64.4 years to 69.9 years by 2010-15; in Asia, life expectancy over that period is likely to rise to 73.2 years, an increase of 8.7 years over current levels. The total world population is thus expected to continue to expand dramatically, both in the medium and long term. From the present level of some 5.7 billion people, the world population in the year 2050 could rise to 9.8 billion, of which 5.8 would be living in Asia (compared to the present 3.5 billion Asian people).

The growth in world food production is likely to be slower in the future than it was in earlier decades. A major negative factor is the inadequate growth in per-caput income and the continued prevalence of severe poverty in many countries. The implication is that, in many developing countries, per-caput food supplies may remain inadequate to allow for significant nutritional progress. The dependence of a large number of developing countries on food imports, especially of cereals, will most likely continue to increase.

The overall conclusion is that, globally, many of the food security problems of today will persist and some will become worse. Needless to say, these circumstances will not be evenly spread. Significant progress towards greater per-caput supplies of food can be expected in East Asia, as well as the Near East, North Africa and Latin America. Lesser but still welcome improvements may occur in South Asia, and the scourge of chronic malnutrition in terms of absolute numbers will tend to shift from that sub-region to sub-Saharan Africa.

This then is the underlying context within which the present and prospective contribution of the fisheries sector to world and regional food security must be viewed.

3. State of the Fisheries in the Asia-Pacific Region

Before examining the role of fisheries in food security in Asia and the Pacific, it is appropriate to review recent trends in the fisheries sectors of the regional countries. An analysis of regional aggregations of national developments is neither easy nor always useful. Even at the sub-regional level, consolidation of trends and events across a range of very varied countries and fisheries may be a rather artificial exercise. However, the sub-regional approach to analysis does facilitate the handling and examination of the enormous amount of data and other information regarding the fisheries of the many countries which comprise the Asia-Pacific region.

The discussion below therefore considers events and issues in the marine, inland water and aquacultural fisheries in three main groups of countries - those in East Asia, in South and Southeast Asia and in the South Pacific/Oceania.

3.1 East Asia

This sub-region encompasses the marine and inland water jurisdictions of the Democratic People’s Republic of Korea, Hong Kong SAR, Japan, Macao, Mongolia, the People’s Republic of China, the Republic of Korea, the east coast of the Russian Federation and Taiwan Province of China. The review will concentrate on the three most important fishing nations - China, Japan and the Republic of Korea.

This sub-region is one of the world’s greatest fish producing areas. The East China Sea, the Yellow Sea, the Sea of Japan and the eastern offshore waters of Japan are among the most heavily exploited waters in the world; aquaculture in the sub-region contributes more than 70 percent of the total global production. Fish consumption is generally high and the countries of the sub-region are very active international traders; the sub-region as a whole is a net importer of fish and fishery products.

Marine fisheries

Marine fisheries landings by local fleets of East Asia reached a total of 22.6 million mt in 1994. Another 1.9 million mt were caught in other marine waters. Total marine production in the sub-region has decreased over recent years, mainly as a result of the decline in pelagic fish landings, in particular the Japanese pilchard.

Fisheries in the East China Sea are, for the most part small-scale, although large trawlers are sometimes used. The demersal fish resources of the Yellow Sea are exploited by trawlers from China, the Republic of Korea, the Democratic People's Republic of Korea and Japan. All species are overfished, and the catch of particularly valuable species has declined recently. The Sea of Japan has a range of pelagic and demersal species, but these resources have gradually been overexploited by fleets from Japan, the Russian Federation, the Republic of Korea and the Democratic People's Republic of Korea.

The largest fleet in the sub-region is that of Japan. Over the last thirty years there have been profound changes in the Japanese fishery situation. Catches from marine waters by Japanese vessels rose steadily and substantially from 1965 (6.4 million mt) to 1985 (11.5 million mt). Subsequently, production began to decrease and by 1994 it had declined to 6.6 million mt, partly as a result of the gradual exclusion of Japanese distant-water fleets from the EEZ's of other coastal states and partly because of set-backs in offshore and coastal fisheries. Similar difficulties face the fishing industry in the Republic of Korea, whose marine catches - after rising from 816,000 mt in 1970 to almost 2.5 million mt by 1990 - have plateaued in recent years at around 2.2 to 2.3 million mt per annum; rising labour costs, depleted local resources and difficulties with distant water operations have been the main contributory factors.

In China, there has been an explosive expansion of fish production, particularly through inland water and aquaculture activities but also from marine fisheries (see Table 2). This extraordinary rate of growth followed fundamental changes in state policies, in particular the decentralisation of production system responsibilities and overall moves towards a market-orientated economy. It is notable that Chinese fishing capacity has expanded even faster than production. The heavy exploitation of most marine resources in Chinese waters and the strongly emerging consumer market have provided the impetus for China to develop a distant-water fishing fleet, first introduced in 1985.

Inland water fisheries

Production from freshwater capture fisheries in East Asia is dominated by China, which harvested almost 1.37 million mt in 1995 out of a sub-regional total of some 1.6 million mt. Environmental degradation, combined with overfishing, has affected capture fisheries in all major Chinese rivers, particularly in stretches downstream of significant pollution sources. This has resulted in significantly reduced yields and the loss of many commercially valuable species.

In contrast to the declining contribution of river fisheries, increased yields are being achieved through intensified exploitation of natural lakes and reservoirs, mainly from enhancement measures such as improved stocking, fertilization, the control of unwanted species, habitat modification, and environmental engineering of the water bodies.

Aquaculture

The sub-region accounts for almost three-quarters of the total world aquacultural production. Over the period 1984 to 1994, this sub-sector demonstrated a compounded yearly growth rate of 10 percent in volume and 11 percent in value. China is by far the most important producer, representing some 60 percent of total world aquaculture output. From 786,000 mt in 1970, China's harvest of cultured fish rose to over 3 million mt by 1985 and over 6 million mt in 1990 since which time production has more than doubled. This remarkable growth can be attributed to considerably expanded culture areas, the introduction of new species and new systems such as cage culture and artificial propagation programmes.

In contrast to China, which is characterised by finfish farming; low-stocking densities; and semi-intensive, polyculture, pond-based systems, Japanese aquacultural production patterns are restricted almost entirely to high-value carnivorous marine and diadromous species grown in intensive farming systems. The two major species are yellowtail and red sea bream. Aquatic plants constitute the second most important species group by weight and value. Molluscs and crustaceans are also produced. Given impetus by the constraints experienced in marine capture fisheries, aquaculture production in Japan grew from 600,000 mt in 1970 to over 1.4 million mt by 1994; a notable feature is the high value of many farmed products which are marketed fresh. A similar picture is evident in aquacultural development in the Republic of Korea where cultured shellfish and finfish have been of growing importance since restrictions on distant-water fisheries were imposed, and now yield between 350,000 and 400,000 mt annually. The seaweed harvest has also increased significantly, from some 400,000 mt in 1985 to over 750,000 mt in 1994.

Environmental concerns are becoming an increasingly important issue for future aquaculture development in the sub-region, as elsewhere. For example, the pollution of rivers, lakes and reservoirs and disease outbreaks in ponds cause considerable economic losses to Chinese aquafarmers and fishermen; environmental problems with high density coastal aquaculture practices in Japan, the Republic of Korea and Hong Kong SAR are also matters for concern.

3.2 Oceania

This sub-region covers the western and central parts of the southern Pacific Ocean. There are 16 independent states, two of which are developed (Australia and New Zealand) while the remaining states, together with a number of dependent territories of France, the U.K. and the U.S.A., are small island developing states (SIDS). The sub-region embraces vast areas of marine waters but accounts for only about 2 percent of total world fishery production. Nevertheless, the fishery sector plays a crucial role in the economies of the South Pacific states and territories. Fish consumption is relatively high, especially in some of the SIDS. Exports of fish, notably tuna, are of considerable importance.

Marine fisheries

The total domestic marine fishery production of the sub-region was 769,000 mt in 1994, making up almost 90 percent of total fish production. Almost 1 million mt of tuna is also harvested annually by foreign fleets. In the 1980s and early 1990s, regional production rose much more quickly than the global average, but has declined in recent years mainly as a result of restructuring in Australian commercial fisheries and changing management regimes in New Zealand. The bulk of aggregate landings originate from the fishing area of the south-western Pacific Ocean, mainly caught by New Zealand. Australia also fishes in the eastern Indian Ocean and the catch of the small island developing states (SIDS) is mainly harvested in the western central Pacific Ocean.

In the SIDS, the main types of fisheries are distinguished by their pattern of operation and the way they are administered. For industrial fisheries, tuna is the main target and distant-water fishing fleets from several countries outside the region participate through access agreements; in fact, Pacific island national fleets take only about 6.5 percent of the total catch of around 1 million mt. Small-scale coastal fisheries are divided between those targeting export products and those fishing for domestic consumption. The strong tradition of eating fish results in extensive involvement in subsistence fisheries. Export production includes high-value products, such as sea cucumbers, snapper and mother-of-pearl shells for specific markets. There is very little interaction between the export fisheries and domestic fish production, and the species exported are usually not part of the local diet. However, export species are also retained for the tourist industry which is estimated to account for three-quarters of the 110,000 mt caught annually for local consumption by coastal fisheries. In the Pacific island states and territories, industrial fisheries technology is of intermediate level. Lack of a trained work force and the infrastructure necessary to support sophisticated industrial fishing operations is characteristic in most states and territories in the region. Foreign fishing fleets operate in the South Pacific and a number of activities relating to conservation and management have been put in place for these fleets. In coastal fisheries, there are localised excess capacity problems, particularly around atolls and reefs.

Fishery technology and infrastructure in Australia and New Zealand are advanced and appropriate to a modern fisheries industry. These two states lead the world in deep-water trawling technology. Nearshore fisheries, harvesting methods and small vessel design also use extremely high technology. In Australia catches include a large variety of species - scallops, lobster and orange roughy being among the more important. New Zealand catches have recently been dominated by blue grenadier, as well as squid, jack and horse mackerel and orange roughy. Several stocks have recently shown signs of over-exploitation. The New Zealand marine capture fisheries now land around half a million mt annually, compared with 215,000 mt in 1980; recent output by Australia's marine fisheries has been around 200,000 mt p.a., an increase of about 40 percent since the nineteen eighties. Most assessments suggest that these levels are at about the maximum yield possible.

Inland water fisheries

From the point of view of food supplies, inland fisheries are of importance in only two countries of the sub-region, Papua New Guinea and Fiji, particularly in the highland areas of the former where other sources of animal protein are limited. The total inland capture fishery harvest in the South Pacific in 1994 was around 25,000 mt. In Australia and New Zealand, inland fisheries are also valued but as a recreational resource and not as a source of food security.

Aquaculture

Aquaculture production in the sub-region rose from 20,000 mt in 1984 to almost 75,000 mt in 1994, mainly owing to increases in New Zealand and Australia. The remaining Pacific states and territories contributed a mere 2,500 mt in 1994. The major increase from a single species was from mussel cultivation in New Zealand, which grew from 9,800 mt in 1984 to 47,000 mt in 1994. Other significant, rapid increases have been observed in the culture of salmon in New Zealand and of *Salmo salar* in Australia. Oysters and pearl oysters are other important species. Most aquaculture production is derived from coastal aquaculture.

3.3 South and Southeast Asia

This sub-region consists of Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka in South Asia and Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam in Southeast Asia. It includes some of the most productive fishing waters in the world, and output reached 19.5 million mt in 1994, 27 percent of the total world catch, compared with 9 million mt in 1974. Consumption of fish varies considerably from country to country, with especially high per-caput supplies in coastal areas of Southeast Asia and much lower consumption levels in the northern inland parts of South Asia. It is estimated that well over 10 million people are engaged in the fisheries; fish trade has expanded significantly over the last decade.

<u>Marine fisheries</u>

Total marine catches in the sub-region have grown substantially, from 9.1 million mt in 1984 to over 13.4 million mt by 1994. Southeast Asian nations accounted for 10 million mt in 1994. Indonesia, Thailand, the Philippines, and India produced almost three-quarters of the total sub-regional output of marine fish. The fisheries are mainly characterised by multi-gear, multi-species operations principally using small traditional craft.

In 1994, 64 percent of marine production (or 7.9 million mt) came from the western central Pacific. Some of the main species were scads, sardinellas, tunas, snappers, shrimps and mackerels. Another 3.7 million mt were caught in the eastern Indian Ocean and 2.4 million mt in the western Indian Ocean, with mackerels, shad, shrimps and oil sardines among the major species. However, many regional landings were classified as “unidentified” in fishery statistics.

Small pelagic species are more important as food in this region than in any other. They accounted for somewhat less than one-third of the landings in 1994, followed by demersal species and tuna. Although Penaeus shrimp catches make up less than 10 percent of the total weight, it is by far the most valuable species group exploited. Cephalopods currently provide only a small fraction of the total catch, but production has grown significantly at an annual rate of 11 percent over the last ten years.

Most known fish stocks are approaching full exploitation. Coastal demersal species have generally been heavily exploited, whereas offshore resources may have been less intensively fished to date. The general lack of catch and effort statistics makes it difficult to assess these stocks, but it is believed that small pelagic stocks are still less heavily exploited in certain waters. Most stocks of Penaeus shrimp appear to be fully exploited or over-depleted. Tuna stocks vary but in many areas they are fully utilised.

<u>Inland waters</u>

The yield from the sub-region's inland water capture fisheries increased only slightly from 1984 to 1994, from 2.2 million mt to 2.4 million mt. This sub-sector suffers considerably from very heavy fishing pressure, growing environmental degradation and, in some places, conflicts with other land and water users.

About a quarter of the total catch is taken from the extensive inland water fisheries of Bangladesh, where production reached 570,000 mt in 1994. Some countries have recently undertaken large-scale stocking programmes, and the increase in freshwater fish production in Bangladesh is partly owing to fisheries enhancement. India and Indonesia have considerable inland fisheries resources and together contribute 35 percent of the total sub-regional output. All of the fish catches of landlocked Laos, Bhutan and Nepal, as well as most fish supplies in Cambodia, come from inland waters.

From the point of view of food security, it is important to note that as catch statistics for inland waters in many countries do not include subsistence fishing, total production figures as well as the relative importance of freshwater fish in food supplies may be underestimated. In Thailand, for example, it is estimated that direct consumption by fishermen and their families may amount to a quarter of the reported catch.

Aquaculture

In many parts of the sub-region, aquaculture has been practised for generations through traditional systems well integrated into the surrounding activities. In recent years, total aquaculture production in the sub-region increased spectacularly from 1.8 million mt in 1984 to 4.4 million mt in 1994. The increase in value over the same period was even more notable - US$ 1,570 million to $ 9,240 million. In volume, the main producers are India, the Philippines, Indonesia and Thailand. Finfish are the main species in volume, followed by crustaceans, aquatic plants and molluscs. Crustaceans represented more than 50 percent of the total value in 1994.

Total production of farmed finfish was 3 million mt in 1994, mainly from freshwater. The bulk of freshwater production is a polyculture within traditional semi-intensive pond-based farming systems that contributes a low-priced source of food fish for mass domestic consumption, especially in India. The principal species cultivated belong to the cyprinid family. Other species are cultivated in pens and cages (e.g. tilapia) or in coastal ponds (e.g. milkfish).

Farmed shrimp culture has developed dramatically over the last decade, and production in 1994 was 692,000 mt. The region contributes 75 percent of the total world production of cultured shrimp, the giant tiger prawn being the most popular species cultivated. The major shrimp-producing countries are Thailand and Indonesia, principally for export.

4. Role of Fisheries in Food Security in the Asia-Pacific Region

As already noted, food security means that food is available at all times, that all persons have access to it, that it is nutritionally adequate in terms of quantity, quality and variety and that it is acceptable within a given culture. When all these conditions are present, a population can be considered to be “food secure”. However, it is not sufficient for a nation as a whole to be regarded as food secure while groups within it remain chronically insecure.

It is generally recognised that the root cause of food insecurity is poverty. The people who are most susceptible to food insecurity are those living in rural areas, including fishing and fish farming communities. In many parts of Asia and the Pacific, fishing communities are still underprivileged socially, economically and politically, despite being the primary producers of fish. The eradication of poverty and attainment of food security for all are thus being given high priority by governments across the region.

Fish and rice constitute the traditional diet of most Asian and Pacific peoples. Thus fish has long played an important role in regional food security by providing nutritious food which includes protein, essential amino acids, fish oils and essential micronutrients such as calcium, iodine and certain vitamins. Fisheries also make a significant contribution to the process of improving food security through the opportunities the sector provides for employment and income to millions of people, either directly or indirectly.

In some countries, the foreign exchange earnings generated by fisheries, and increasingly, aquaculture are also making a growing contribution to the economy; it should be noted, of course, that foreign exchange earned from the export of fishery products may not necessarily be devoted directly to improving food security but may be diverted to other purposes. It is also significant that in an increasing number of Asian and Pacific countries, supplies of food fish for domestic consumption have been boosted only by recourse to large and growing imports.

Table 3 shows the evolution of total and per-caput supplies of food fish in the Asia and Pacific region from 1970-93. During this period, the total annual domestic production of food fish expanded by a remarkable 30 million mt. However, such was the rise in the quantity diverted to non-food uses (from c. 3 million mt in 1970 to between 7 and 8 million mt annually over the last decade or so of the period) or consigned abroad as exports (a growth from 1.6 million to 6.5 million mt p.a.) that a very substantial expansion in imports was necessary, first simply to maintain, and more recently to augment per-caput supplies for a rapidly increasing regional population. It is a measure of the welcome improvement achieved in the contribution of fish to overall regional food security that, despite these pressures, average per-caput supplies rose from 9 kg in 1970 to almost 14 kg by 1993, a 54 percent increase. This outstrips the growth attained on a world wide basis, global per-caput supplies having risen over the period from 10.8 kg to 13.4 kg, an improvement of 30 percent.

The aggregated regional figures presented in Table 3 of course hide the very considerable variations which exist sub-regionally and nationally in the pattern and importance of fish supplies. (See also Table 4 for data regarding the contribution of fish to supplies of protein). In East Asia, for example, per-caput consumption of food fish is - with the exception of China - extremely high and even in China there has been a dramatic, almost four-fold, increase in per-caput supplies. In Southeast Asia fish is a very important item in the diet. In South Asia, fish consumption varies from the world’s highest per-caput level in Maldives to among the lowest in Pakistan and parts of northern India; for the sub-region as a whole, consumption has been static in recent years. In Oceania, fish consumption is high in Australia, and especially New Zealand, while subsistence fisheries make an important contribution to often high levels of per-caput supplies in many of the small island developing states.

A more detailed examination of the contribution of fisheries to food supplies and to food security at the sub-regional level is presented below.

Very substantial changes have occurred in both total and per-caput supplies of food fish in East Asia (see Table 5). The sub-region accounts for about a third of the world's total fish consumption. Average annual per-caput food fish supply has virtually doubled since 1970 to reach 22 kg, notwithstanding a growth in the sub-region's aggregate population to 500 million persons; with respect to food security, fish provides about one-quarter of the total animal protein intake in the sub-region.

In Japan, fish is one of the most widely distributed foods. Per-caput consumption is extremely high, reaching 70 kg annually, and represents some 40 percent of total animal protein intake. However, the role of fish in the diet has declined over the last two decades, especially among younger generations who tend to eat more meat than before, partly as a result of a shift in preference and partly because of the increased availability and price competitiveness of meat following import liberalisation. Nevertheless, self-sufficiency in food fish supplies has declined sharply, from 86 percent in 1985 to 61 percent in 1994 and the high levels of per-caput consumption have been maintained only through considerable and rising imports.

The fisheries sector in Japan also contributes to food security through employment and income generation, with over 300,000 fishermen engaged directly in production and some 1.34 million persons working in processing, marketing, transport, and related industries. Fish exports are now relatively small but remain of high economic value, earning US$ 1,200 million in foreign exchange in 1994.

Many of the developments in Japan described above can be observed in the Republic of Korea where fisheries also make an important contribution to diet and livelihood. Per-caput consumption of food fish has rapidly and substantially increased and now exceeds 50 kg per annum. Again, with domestic production of fish remaining fairly stable in recent years, increased imports have been necessary in order to maintain the high levels of consumption. As in Japan, these developments and greater supplies of other foodstuffs (especially red meats) have led to a decrease in the percentage of fish as a source of animal protein in the Korean diet, from around 70 percent in the 1970s to 45 percent by 1994. In addition to contributing to food supplies, the fisheries sector provides employment and income to the rather rapidly declining number of people who are directly involved in fisheries or aquaculture (estimated at around 200,000 persons) plus a much larger number in secondary, supporting industries.

Fisheries are playing an increasingly important food security role in China. As already noted, the growth in Chinese production of aquatic products has been quite remarkable. From around 4 kgs per caput in the late 1970s, food fish supplies have sharply risen to a reported 20 kgs per caput in 1995. Important variations in consumption nevertheless continue to exist. In the southern part, particularly in Guandong province, the average per-caput supply exceeds 40 kgs p.a., whereas fish consumption in isolated areas of the northeast is negligible. Aquaculture output, especially freshwater pond products such as carp species, plays a predominant role in satisfying domestic demand.

Over 11 million people are now reported to be engaged in fishery production, either full or part-time, about 7 million of them in aquaculture; fishery workers earn more than aquacultural labourers. Fish exports also make a valuable indirect contribution to food security in China; exports of fish and fishery products earned US$ 3,290 million in foreign exchange in 1995, a ten-fold increase over export values in the early 1980s. Fishery product imports have also grown (US$ 1,268 million in 1995) but, in volume terms, are mainly fish-meal.

To assess the importance of fish as food in Oceania, it is necessary to distinguish between Australia and New Zealand on the one hand and the Pacific islands on the other.

In Australia, the gradual increase in per-caput fish consumption, attributable to increased perceptions of fish as a healthy, desirable food; better products and marketing; and growing personal income has been made possible mainly by a notable rise in imports. (See Table 6). The tremendous growth in the New Zealand fisheries has, however, essentially served a booming export trade, particularly to Australia; much of the increase in domestic per-caput consumption reflects a growing demand for shellfish.

In Australia and New Zealand, fish has grown in importance as a component of animal protein intake, from 4.7 percent to 6.2 percent. In addition to export earnings, the fisheries sectors also contribute to overall food security by offering valuable employment opportunities. In 1995 the sector in New Zealand employed a record 10,000 persons, just over half being in the processing sector. Direct employment in the Australian capture sector was estimated to be 14,000 in 1990; the number of employees in the secondary sector is unknown.

Fish is culturally and nutritionally an important source of food throughout the Pacific islands area and fisheries play a central role in many aspects of food security. The diet of the Pacific islanders depends heavily on fish and most states and territories derive a high proportion of their animal protein from fish, ranging up to 69 percent for Kiribati and with almost all states deriving over 25 percent from this source. Actual fish consumption is difficult to estimate, however, because of the limited statistics available and the unknown contribution from unrecorded household catches. Subsistence fisheries yield perhaps four times larger catches than the commercial harvests, provide a major source of protein for residents of coastal rural areas and outer islands, and contribute directly and significantly to household food security.

The contribution of the fisheries to food supplies is particularly important in a region where there is already a very heavy dependence upon imports of food. The licensing of foreign fishing vessels to operate in the waters of Pacific island countries forms a notable source of revenue (estimated at US$ 56 million in 1993), which has implications for programmes to enhance the food security situation.

Fish makes a significant contribution to food security of most countries in Southeast Asia. With the exception of Laos and Cambodia, where supplies consist almost entirely of freshwater fish, the average annual per-caput consumption of fish and the percentage of fish in all animal protein intake is generally higher (and in some cases, very much greater) than average world levels. At the same time, the rate of increase in per-caput supplies over the last twenty years or so has not been as rapid as in some other parts of the Asia and Pacific region (See Table 7).

The majority of Southeast Asian people, especially those living in rural areas, prefer whole fresh fish. A wide range of traditional processed products is also available at local markets, including fish sauces and cured fish. In Singapore and Thailand the consumption of shellfish and crustaceans is gaining in popularity in response to growing affluence.

In recent years, there has been a great improvement in facilities for fish storage, handling, and product development and marketing in the major fish producing and processing countries of Malaysia, Indonesia, the Philippines and Thailand. High quality and high value fish and crustaceans, including tuna and shrimps are being produced, frozen, filleted or canned, increasingly for export. New products such as fish cakes, squid rings, extruded sticks and fish balls have been developed for sale in local urban supermarkets.

It is estimated that about 4 million people are engaged, full or part-time, in the primary activity of capture fisheries or fish farming. Four to five times that number are employed in secondary industries such as processing, distribution and trade. The fisheries sector also makes an increasingly important contribution to the economic wealth of a number of Southeast Asian countries through export earnings from international and, particularly, intra-regional trade. The total value of fish and fishery product exports of Southeast Asian countries, in particular Thailand, Indonesia and Singapore (which together accounted for over 80 percent) reached US$ 7,700 million in 1994, a near fourfold increase in ten years; export earnings thus considerably exceed the costs, also rapidly rising, of fish imports (US$ 1,976 million in 1994).

Per-caput fish supplies in the South Asia sub-region are only about one-third of those for the Asia and Pacific region as a whole (see Table 8). Moreover, again compared with the region as a whole where per-caput supplies increased by almost 55 percent from 1970-1993, per-caput availability in South Asia rose by less than a third. The major exceptions are Maldives, where fish is virtually the only source of animal protein and apparent consumption is the highest in the world, and Sri Lanka where per-caput supplies approximate the average for the Asia and Pacific region.

Nevertheless, fish plays an important role in food security throughout most of South Asia, notably as a condiment with rice which, together with other cereals and vegetables accounts for well over 80 percent of the total protein supply. The most significant increase in fish supplies, both in total and per-caput amounts, has been in India where domestic production, particularly from aquaculture, rose from 1.75 million mt in 1970 to 4.3 million mt by 1993, permitting a growth in per-caput consumption from 2.8 kg to 4 kg, notwithstanding a very substantial increase in the population. A similar development, albeit from a very low base, can be observed in Pakistan where per-caput supplies doubled over the period 1970-93. In Bangladesh, successive cyclones and floods have constrained the growth of both agricultural and fisheries output. Fish plays a very minor dietary role in land-locked Nepal, despite an encouraging rate of growth in output from both freshwater capture fisheries and aquaculture.

Fisheries provide not only food but also employment, much of it part-time, and income for approximately 5.5 million fisherfolk in South Asia. Especially in India and Bangladesh, many are engaged in inland water fisheries and aquaculture. In Maldives, virtually the entire population might be considered one traditional marine fishing community. As elsewhere in the Asia and Pacific region, the primary harvesting sector supports and is supported by a range of fisheries-related activities such as processing, distribution and trade which provide employment for perhaps a further 20 million persons.

The importance of fish trade in the sub-region varies from country to country. With the exception of Sri Lanka which buys notable quantities of fish from Maldives, India and Bangladesh, there are few imports into the sub-region. Exports, however, have grown in importance, particularly in India, Pakistan, Bangladesh and Maldives; in the latter, exports of fish and fishery products, although relatively small, contribute a quarter of the nation's GDP.

5. Demand and Supply Prospects

The foregoing review demonstrates how the fisheries sector plays, albeit to varying degrees, a valuable role in the food security situation in most countries in the Asia and Pacific region. The future demand for food fish in the region and the prospects for sufficient supplies to satisfy these requirements and thus maintain or indeed increase the contribution of fish to food security must next be considered, together with the major issues involved in achieving such a development of the fisheries in a sustainable manner.

The demand for food fish in the East Asia sub-region is almost certain to remain high and indeed increase, in both volume and per-caput terms, in some areas. An exception to this might be Japan, where fish consumption is already high and population growth close to zero. Nevertheless, the composition of Japanese fish consumption is expected to continue to change from lower-value to higher-value products. The sophisticated nature of fish consumption attitudes in Japan has an important bearing on domestic production strategies which need to focus on those types of products where Japanese producers have a clear competitive advantage over foreign suppliers, for example, ranched products which can be marketed as "fish from the wild" rather than cultured products.

Future fisheries development in Japan will be guided largely by market factors, especially the ability of the domestic industry to compete with foreign suppliers. Japanese fisheries are unlikely to grow significantly over the coming decades. Modest production gains from culture and ranching are likely to be offset by a further decline in the long-distance fleets, and the country will have to continue to rely on imports to satisfy its high demand for fishery products.

Similar considerations apply to the Republic of Korea. Given a continuing rise in personal income which might boost per-caput demand for fish even further, to say 60 kg, and further population growth, the total need for food fish could be as high as 3 million mt by 2010. Taking into account non-food needs and the Republic's important export trade in fish and fishery products, a total supply requirement approximating 3.9 million mt can be envisaged, compared with recent domestic production levels of around 2.7 million mt p.a. The Republic is presently liberalising its trade regulations on fishery products and imports could well increase significantly in the future. As regards domestic production, priority is being given to enhancing the national fishing zones through the construction of artificial reefs and release of fingerlings. A further expansion of aquaculture output can also be anticipated.

In China, the expected continuation of both rapid economic growth and expanding fish production will enable per-caput consumption to increase even further. An official target for domestic fish production of 32 million mt by the year 2000 has been released, and the aim by the year 2010 could be as high as 40 million mt. Significant growth potential exists for freshwater aquaculture, principally through the rehabilitation of existing ponds, the utilisation of water-logged areas and the vast surface areas of paddy fields. The growing number of hatcheries will enable this potential to be realised. Traditional marine capture fisheries do not appear to offer any significant growth potential. Coastal fish resources need to be carefully managed and future increases in landings will probably depend on distant-water fishing. However, strong economic growth is expected to generate enough purchasing power to satisfy any domestic demand-supply gap with a further growth in imports.

In Oceania a distinction must again be made between the small developing island states of the Pacific and the developed states of Australia and New Zealand. Opinions vary as to likely developments in the Pacific Islands. The sub-regional study prepared by Gillett, Preston & Associates considered that the near certainty of continued population growth will engender an increase in demand for food fish of some 60,000 mt (i.e. c. 55 percent); however, in view of the limited coastal resources of most of the countries, per-caput supplies are likely to decrease, leading to increased dependency on imports and declining diet quality, thus creating a deteriorating fish security situation. Other observers take a more optimistic view, arguing that the region's fisheries resources are probably capable of meeting a somewhat increased demand for fish, although it is likely that additional amounts of pelagic species will have to be consumed, particularly in urban areas and in other areas of high population concentration. Marketing and distribution systems will need to be improved in order to move fish more quickly and efficiently both among states and territories in the region and within the states and territories themselves. Such a scenario would permit a contraction of fish imports and a small rise in exports, mainly of tuna.

Whatever the perspective, fish and fishery products will continue to play a fundamental social and economic role in the South Pacific. Fish for human consumption will remain the most important source of animal protein for many Pacific island communities, in particular for the most disadvantaged ones. The fisheries sector could be one of the primary vehicles for promoting economic development in the South Pacific. The promotion of sustainable fisheries and the implementation of regional and national arrangements to ensure that fisheries resources are utilised rationally are thus major social and economic policy issues in the South Pacific. The small island states recognise that effective regulation of both inshore and offshore fisheries resources is essential for long-term food and socio-economic security.

In Australia and New Zealand, per-caput demand for food fish could well rise to over 27 kg p.a., leading, in conjunction with population growth, to a total demand of about 700,000 mt by 2010. Supplies from capture fisheries are unlikely to increase very much, perhaps to around 750,000 mt p.a.; in the case of aquaculture, a continuance of recent trends in output would indicate the possible production of some 160,000 mt in 2010. Thus, if current developments with both exports and imports continue, there will be no negative implications for fish supplies or for food security.

The populations in South and Southeast Asia are rapidly growing, and fish is a customary source of animal protein in most countries in the sub-region. Demand is also expected to increase in response to rising incomes which will also boost intra-regional trade both for high-value products and low-priced fish for general consumption. By 2010, fish supplies will need to be increased by at least 5 million mt merely to maintain current per-caput consumption levels; the effect of economic growth on demand will even further increase requirements. The major growth in demand will be in Southeast Asia where consumption is already notably high. Solely to sustain present levels of personal consumption, some 12.7 million mt of food fish will be needed by 2010, an increase of 3.6 million mt over the 1991/93 average supply. In South Asia, a more modest increase can be expected to maintain current per-caput consumption levels, a 20 percent growth in supplies will be required, a total of about 7.8 million mt or 1.3 million mt greater than recent levels.

Marine fishery resources are generally fully exploited and offer few opportunities for sub-regional countries to increase their domestic supplies. Most of the pelagic fish, crustaceans and demersal species in coastal fishing grounds in the Gulf of Thailand, the Bay of Tonkin, the Bay of Bengal and the South China Sea have been fully exploited or depleted. Despite some moderately exploited fish stocks (e.g. anchovies, smaller tunas and cephalopods in the western central Pacific), it is unlikely that future demand will be met from significant increases in marine fish production. In fact, many heavily fished stocks will need to be rehabilitated urgently through drastic reductions in fishing effort. Aquaculture, and to a lesser extent inland fisheries, may provide considerable opportunities for further development to increase regional fish production, particularly in Bangladesh, Cambodia, India, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Thailand and Vietnam. Nevertheless, the region will probably need to rely more and more on imports of fishery products for its future supplies.

For many of the countries in the region, the central issue remains that of the management and sustainability of the marine resources. Coastal resources are generally severely overfished by an overcrowded small-scale fishery sector, where catch rates, fish sizes and quality and, in some cases, fishers' incomes, are declining. Conflicts between small-scale fisheries and trawlers in the coastal zones are frequent and fisheries administration is made more complicated by the lack of detailed stock assessment data. Coastal fisheries management is complicated further by the variety in both resources and exploitation methods used. Experience indicates that the current centralised state management systems in many countries are not able to regulate fisheries properly over the widely scattered fishing grounds. In some countries, a partnership between local communities and the central government is evolving to develop a community-based fisheries management system for local resources.

6. National and Regional Policies for Sustainable Fisheries Development

The foregoing review indicates that a number of very important issues must be confronted if the fisheries sectors in the Asian and Pacific region are to be able to satisfy the region's prospective demands for food fish and to maintain or even increase the contribution of fish to national and regional food security. Unless appropriate policies and programmes are designed and implemented, the combination of population increases and economic growth in conjunction with over-exploitation of the resources and serious environmental problems will place enormous strains upon the sector's capacity to fulfil its expected role in food security.

These challenges need to be tackled at the national, sub-regional and regional levels. Appendix 1 provides a résumé of the recommendations proffered in the sub-regional case studies for policies and actions to promote a sustained contribution by fisheries to food security in each relevant sub-region. The final part of this report presents some more generalised considerations, drawing substantially upon the policy frameworks discussed and approved at the 1995 Kyoto Conference on the sustainable contribution of fisheries to food security.

As a general background to these issues, it is noteworthy that in recent years the role of governments has increasingly been seen as one of creating an appropriate institutional and economic environment for each sector rather than intervening directly in the production and marketing of each commodity. These policies for the fisheries sector are now more and more confined to the actions required when private decision-making and market forces fail to provide the desired economic or social outcome. In particular, where access to fisheries is free and unrestricted, government intervention is frequently required to prevent over-fishing and resource degradation.

Indeed, throughout many parts of the Asia and Pacific region - as in many other regions of the world - the prime concern is probably the need to increase the supply of fish and the economic benefits from fishing by the introduction and enforcement of better management. Such management systems should aim at the stabilisation or restoration of over-exploited stocks by the reduction of excessive fishing effort and over-capitalisation, and the elimination of conflicts between groups of fishermen. Multi-species management should be promoted wherever possible; research in this regard should be improved, especially at the sub-regional levels.

In marine capture fisheries, the supply of fish and the economic gains could also be increased by further, energetic steps to reduce post-harvest wastage. What is required includes improved physical infrastructure, better extension and training services, more efficient marketing practices and the wider dissemination of fish processing and preservation technologies. Such developments might be allied with the increased use of presently under-utilised species.

Steps also need to be taken in many parts of the region to avoid further degradation of the aquatic environment. Such programmes are often best operated within the overall context of integrated coastal area management. These considerations apply equally to marine and to fresh water activities. In the inland capture fisheries sector, which is of considerable importance to a number of countries in the region, a policy of integrated catchment basin management is needed, involving a proper evaluation of the various resources concerned and an appropriate mix of regulatory and economic policy measures. Such considerations may include the need for the harmonisation of policies between provinces and between states sharing larger inland water resources. Attention also needs to be given to the enhancement of fish supplies from inland waters by expansion of stocking and other measures to improve yields.

Aquaculture is an increasingly important supplier of food and sustainer of food security in many Asian countries. Here again, considerable benefits may be gained by the better integration of aquaculture into overall rural and agriculture developments. Supplies of fish from aquaculture could also be further increased by wider application of technological advances and better disease management. Inter-country collaboration in applied research should be encouraged to promote the diversification and genetic improvement of cultured species. The wider application of semi-intensive production systems may also be appropriate in certain cases.

The implementation of the policies and measures described above will require a wide range of human skills, considerable financial resources and, in some countries, significant organisational changes. Thus, when linking such human, financial and institutional resources with the desired policy measures, the following needs are paramount:

- the introduction and enforcement of territorial use rights and other fishery resource allocation measures, within the overall framework of more conventional management regimes;
- the promotion of integrated coastal and/or catchment area management systems, within which the needs of the fisheries sector are properly accounted;
- the strengthening of institutional mechanisms and development of human skills;
- the devolution of management responsibilities to the lowest possible level and the encouragement of participatory, self-regulatory fishing communities; and
- the provision by governments of technical support and an institutional and legal framework within which the fisheries sector can independently prosper.

To complement and reinforce the actions of individual governments in their efforts to sustain the fisheries sector's contribution to food security, there are also important opportunities for inter-country, sub-regional and regional collaboration. Existing organisations and mechanisms for cooperation between countries in managing and conserving their shared fish resources need further strengthening. Such collaborative efforts should include:

- integrated assessments of the nature and extent of fisheries, thus improving the basis for multi-species and ecosystem management;
- joint programmes to develop and more widely use environmentally safe and cost-effective fishing gear and techniques and other initiatives to promote responsible fishing practices;
- greater exchange of information among research institutes, particularly to promote the sustainable use of under-exploited or neglected species for human food purposes; and
- further stimulation of inter-country cooperation in developing environmentally sound aquaculture and stocking programmes.

Further steps are also required to improve the provision and coordination of technical and financial assistance to developing countries in the Asia and Pacific region.

The urgency with which the above issues must be tackled and appropriate policies and programmes introduced and implemented is now self-evident. Unless appropriate actions are taken soon, there is a real danger that, in important parts of the region, the contribution of fisheries to food security and to economic welfare generally could fail to match expectations and the needs of the region's people. On the other hand, given an effective response to these challenges, there are opportunities to increase the supply of fish and to use the potential of the fisheries sector to generate higher economic and social benefits.

APPENDIX 1

SUMMARY OF RECOMMENDED SUB-REGIONAL POLICIES AND PROGRAMMES

Preparatory to this Report, a number of sub-regional and national case studies were commissioned (see Appendix 3). This appendix presents a résumé of the main recommendations in those case studies regarding desirable policies and programmes to sustain the contribution of the fisheries sector to food security.

East Asia

Case studies were prepared of the three major fishing nations in this sub-region, i.e. Japan, the Republic of Korea and the People's Republic of China.

1. Japan (M. Hotta)

The following policy measures and actions were proposed:

a) strengthening of fishery resources surveys in Japanese coastal waters;

b) improved fisheries management, including introduction of Total Allowable Catch systems to selected fisheries;

c) promotion of community-based fisheries management on a nation-wide scale;

d) restructuring of fishery production systems, using subsidies to encourage reduction of fishing effort and withdrawal of vessels;

e) expansion of culture-based fisheries through stock enhancement programmes, a wide variety of steps to further promote aquaculture, and stocking programmes for salmon fry;

f) establish a balanced use of marine waters by commercial fishing and recreational fishing; and

g) strengthen the monitoring, control and surveillance of activities by both domestic and foreign vessels.

2. Republic of Korea (Yong-Ja Cho)

The need to intensify or initiate efforts regarding the following issues was emphasised:

a) programmes to combat environmental degradation, including regulation of discharge of wastes and pollutants and other activities harmful to fish habitats, and promotion of responsible fishing practices;

b) encouragement of integrated coastal area development;

c) improved marketing policies and mechanisms to better reflect consumers' needs;

d) strategies to promote commercial/private technology development;

e) policies to promote fishing and fish farming communities;

f) facilitation of participation of professional trade and other non-government bodies in fisheries development and management;

g) development of human resource potentials and greater technology transfer;

h) promotion of international collaboration in fisheries management and utilisation including harmonisation of legislation, co-operative research and common policies; and

i) encouragement of pragmatic, problem-orientated research and development of a comprehensive fisheries information system.

3. People's Republic of China (Song Zhiwen)

The major policies identified to promote the further development and management of the Chinese fisheries included the following:-

a) Marine fisheries

(i) controls over the intensity of fishing effort;

(ii) restrictions on further entry to inshore waters and diversion of would-be fishermen to aquaculture, processing, transport etc.;

(iii) closed seasons for the East China Sea and Yellow Sea;

(iv) prevention of illegal fishing methods;

(v) restriction of fishing boats to their designated areas;

(vi) protection of the inshore environment allied with large-scale stocking and enhancement programmes;

(vii) strengthened enforcement of fisheries laws; and

(viii) preferential tax and financial treatment for distant water fisheries.

b) Freshwater capture fisheries

(i) improved use of water bodies and recognition of special needs of fisheries;

(ii) conversion of reclaimed land into lakes;

(iii) enforcement of licensing systems and other regulations;

(iv) protection of ecological environments from pollution; and

(v) stocking programmes for large water bodies.

c) Aquaculture

(i) further expansion of aquaculture water areas;

(ii) promotion of high-yielding technologies;

(iii) further integration of aquaculture with agriculture and animal husbandry;

(iv) research to improve variety bases, feed and fry quality, etc.;

(v) improved utilisation, processing and marketing systems for aquacultural products; and

(vi) better control over fish diseases and aquaculture-derived pollution.

4. Southeast Asia (D. Menasveta)

This case study presents a sub-regional policy framework for a sustainable contribution by fisheries to food security. The following issues are identified for priority attention:

a) a strong commitment by governments in the sub-region to the strengthening of fisheries management systems, in particular by reinforced monitoring, control and surveillance;

b) strategies for collaborative approaches to the management and utilisation of shared transboundary stocks in Southeast Asian waters;

c) augmentation of fish production by expanding fisheries into offshore or deep waters;

d) steps to sustain and where possible increase the contribution from inland capture fisheries, including integrated catchment basin management, control over pollution and environmental degradation, stocking and enhancement programmes and greater research and extension services;

e) further steps to boost production from aquaculture;

f) reduction of wastage from fish discarded at sea and during post-harvest practices;

g) further national and collaborative initiatives to deal with environmental and ecological issues;

h) cooperative programmes to enhance trade in fish and fishery products, including minimisation of tariffs and other barriers, collaborative efforts to improve product uniformity and quality, etc.;

i) strengthened research, in terms of quality and technical capabilities, with improved coordination of research activities; and

j) accelerated technology transfer and capacity building through human resource development and training, and encouragement of regular contacts and exchange of expertise.

5. South Asia (K. Sivasubramaniam)

The major policy issues requiring attention in South Asia include the following:

a) encouragement of small-scale fisheries development by provision of subsidies and promotion of greater participation by fisherfolk in management decisions and practices;

b) better long-term planning of fisheries development, in particular, strategies for exploitation of offshore and oceanic fisheries;

c) measures to restrict the impact of over-intensive exploitation and environmental damage in estuaries and lagoons;

d) prohibition of illegal, destructive fishing techniques in coral reef areas;

e) greater priority to improved use of freshwater resources, including encouragement of traditional systems providing fishing rights to fisherfolk;

f) steps to ensure a more regulated, better controlled development of aquaculture and the more efficient use of technology and research findings;

g) attention to the need for greatly improved infrastructures and other facilities, including better anchorages and harbours, handling and preservation capacities, repair and maintenance facilities, etc.;

h) special emphasis upon post-harvest technology, in particular, better processing and quality standards;

i) avoidance of administrative overlap and duplication by placing all fisheries matters under one ministry; and

j) adherence to international conventions and agreements regarding the use of the world's fishing resources and the promotion of regional and sub-regional co-operation.

6. Oceania (Gillett, Preston and Associates Inc.)

The following policy issues and measures were identified; most of the items focus on the situation in the Pacific Island countries rather than New Zealand and Australia:

a) urgent action to introduce and strengthen the management and conservation of the inshore resources;

b) extension of harvesting capacities to near reef areas and, where possible, offshore areas;

c) programmes to widen appreciation of the contribution of fisheries to food security;

d) reassessment of the aquaculture situation in each country to seek possibilities of increasing the presently small contribution of aquaculture to food supplies;

e) steps to improve fish product transport and marketing;

f) re-evaluation of the benefits from development of export-orientated fisheries and the needs of domestic consumption;

g) attention to means of engendering greater benefits (in terms of food, jobs, income) from the large offshore tuna fisheries;

h) encouragement of the presently slow development of the private sector;

i) improvement of the structures and capacities of national fisheries agencies and administrations; and

j) enhancement of the role of sub-regional collaboration, notably through the Forum Fisheries Agency and the South Pacific Commission, especially in such functions as stock assessment, access rights negotiations, harmonised EEZ surveillance and legislation, technology transfer, etc.

Appendix 2

Statistical Annex

Table 1. Average per-caput dietary energy supplies (DES)

	1969/71	1990/92 (calories/caput/day)	2010 (projection)
World	2 440	2 720	2 900
Developed countries	3 190	3 350	3 390
Developing countries	2 140	2 520	2 770

Table 2. China fisheries production by sector (million mt)

Year	Total	Marine	Inland water	Aquaculture
1970	3.2	2.1	0.3	0.8
1975	4.5	3.1	0.3	1.1
1980	4.5	2.8	0.3	1.2
1985	7.1	3.5	0.5	3.1
1990	13.2	5.8	0.9	6.5
1995	28.4	10.9	1.6	15.9
1998	38.0	14.9	2.3	20.8

Table 3. Apparent food fish in the Asia and Pacific region

Year	Production	Non-food uses	Imports	Exports	Total supply	Population (millions)	Per-caput supply (kg)
	(million mt live weight)						
1970	22.59	3.08	1.16	1.62	19.02	2 120	9.0
1975	28.11	4.22	1.77	2.14	23.52	2 377	10.0
1980	31.25	5.65	2.33	2.99	24.97	2 610	9.6
1985	38.27	7.43	3.45	3.47	30.82	2 868	10.8
1990	46.43	8.43	5.73	5.35	38.34	3 144	12.2
1993	52.26	7.07	7.42	6.55	46.11	3 308	13.9

Source: FAO Fish. Circ. No. 821 (Rev. 3)

Table 4. Fish contribution to supplies of protein

Country	As % of animal protein		Country	As % of total protein	
	1970	1993		1970	1993
Maldives	93.5	89.3	Maldives	49.9	55.9
Korea DPR	66.4	65.2	Japan	24.7	26.0
Solomon Islands	65.9	58.8	Philippines	26.0	22.8
Indonesia	62.9	53.5	Samoa	16.7	21.4
Sri Lanka	52.1	51.5	Hong Kong SAR	18.0	18.7
Philippines	57.9	51.5	Korea DPR	10.02	16.5
Myanmar	49.0	47.6	Solomon Islands	27.7	15.9
Japan	55.7	47.0	Thailand	13.8	15.0
Korea Rep.	56.5	46.8	Korea Rep.	6.3	13.4
Bangladesh	49.9	46.7	Malaysia	13.1	11.2
Thailand	41.5	41.1	Papua New Guinea	12.0	13.4
Cambodia	37.9	38.6	Macao	10.3	13.1
Samoa	38.1	35.5	Fiji	10.2	12.4
Vietnam	49.4	35.0	Vanuatu	19.3	11.8
Papua New Guinea	33.6	34.9	Tonga	4.1	11.4
Hong Kong SAR	33.9	28.3	Sri Lanka	10.6	10.9
Fiji	28.4	26.7	Indonesia	8.7	9.6
Vanuatu	37.5	25.4	Singapore	12.2	9.2
Tonga	19.3	24.2	Vietnam	9.7	7.6
Laos	25.5	23.6	Cambodia	4.7	7.8
Macao	22.7	23.6	Myanmar	7.0	6.2
Malaysia	39.8	21.6	Bangladesh	6.6	6.0
China	27.8	21.5	Laos	4.0	3.7
Singapore	32.1	18.8	China	3.0	6.0
India	14.0	12.7	Brunei	12.3	5.8
Brunei	31.4	11.1	Australia	3.1	4.4
Australia	4.7	6.3	New Zealand	3.2	4.2
New Zealand	4.7	6.2	India	1.5	2.0
Pakistan	2.8	4.0	Pakistan	0.7	1.2
Nepal	0.7	3.2	Nepal	0.1	0.5
Bhutan	1.5	1.6	Mongolia	0.2	0.4
Mongolia	0.2	0.6	Bhutan	0.2	0.3
Asia & Pacific region	29.6	23.2	Asia & Pacific region	5.3	6.5
World	15.2	15.6	World	5.0	5.6

Source: FAO Fish Circ. No. 821 (Rev. 3)

Table 5. Changes in total and per-caput supplies of food fish in East Asia in 1970 and 1993

Country	Year	Production	Non-food uses	Imports	Exports	Total supply	Population (millions)	Per-caput supply (kg)
		(million mt live weight)						
China	1970	3.09	0.10	0.00	0.11	2.97	816.2	3.6
	1993	17.57	0.49	0.62	0.85	16.85	1 175.5	14.3
Hong Kong SAR	1970	0.14	0.00	0.08	0.01	0.20	3.9	51.0
	1993	0.22	0.03	0.43	0.29	0.34	5.9	57.9
Japan	1970	8.82	1.86	0.39	0.72	6.64	104.3	63.5
	1993	8.13	3.06	3.79	0.41	8.45	124.7	67.8
Korea Rep.	1970	0.75	0.00	0.02	0.16	0.57	31.9	18.0
	1993	2.65	0.33	0.38	0.42	2.31	44.1	52.3
Korea DPR	1970	0.47	0.09	0.00	0.00	0.38	14.6	25.9
	1993	1.78	0.75	0.00	0.03	1.00	23.0	43.6
Other[1/]	1970	0.61	0.03	0.11	0.11	0.46	14.5	31.4
	1993	1.42	0.00	0.81	0.81	0.77	20.8	37.1
Total[2/]	1970	13.88	2.01	1.11	1.11	11.22	9 856.4	11.4
	1993	31.77	4.66	2.81	2.81	29.70	1 354.0	21.9

Source: FAO Fish. Circ. No. 821 (Rev. 3)

1/ Refers to Taiwan Province of China.

2/ Excludes Macao and Mongolia where fish supplies are very small, although per-caput consumption in Macao in 1993 was c. 38 kg (v. 23 kg in 1970); in Mongolia per-caput supplies are between 0.5 and 1.0 kg.

Table 6. Australia and New Zealand: apparent food fish consumption: 1970 and 1991-93

Country	Production	Non-food uses	Imports	Exports	Total supply	Population (millions)	Per-caput supply (kg)
	(million mt live weight)						
Australia							
1970	102	1	102	36	167	12.5	13.4
1991-93 average	230	25	224	104	325	17.3	18.7
New Zealand							
1970	60	4	7	17	45	2.8	16.1
1991-93 average	463	1	23	45	60	3.4	17.6

Source: FAO Fish. Circ. No. 821 (Rev. 3)

Table 7. Apparent consumption of food fish in Southeast Asian countries

(kg per caput)

Country	1970	1991-93 average
Brunei	26.2	21.9
Cambodia	7.9	12.0
Indonesia	9.9	15.5
Laos	7.6	6.7
Malaysia	22.8	29.4
Myanmar	13.9	15.5
Philippines	30.2	36.0
Singapore	49.5	37.4
Thailand	24.7	25.3
Vietnam	14.5	13.4

Source: FAO FISHDAB

Table 8. South Asia: total and per-caput food fish supplies: 1970 and 1993

Country	Year	Production	Non-food uses	Imports	Exports	Total supply	Population (millions)	Per-caput supply (kg)
		(million mt live weight)						
Bangladesh	1970	690	0	0	2	688	66.67	10.3
	1993	1 047	3	0	36	1 008	115.20	8.8
India	1970	1 759	129	0	72	1 559	554.91	2.8
	1993	4 324	390	0	308	3 626	901.46	4.0
Maldives	1970	33	0	0	24	9	0.12	77.2
	1993	90	4	0	52	34	0.24	144.4
Nepal	1970	2	0	0	0	2	0.01	0.2
	1993	17	0	0	0	17	0.02	0.8
Pakistan	1970	176	55	0	46	75	65.70	1.2
	1993	622	188	0	115	319	132.94	2.4
Sri Lanka	1970	98	0	85	1	182	12.51	14.6
	1993	221	0	60	6	275	17.90	15.4
Total[1/]	1970	2 758	184	85	145	2 514	699.92	3.6
	1993	6 321	585	60	517	5 279	1 167.76	4.5

Source: FAO Fish. Circ. No. 821 (Rev. 3)

[1/] Including Bhutan: total production 1970 c. 200 t; 1993 c. 350 t; per-caput supplies c. 0.2 kilograms p.a.

APPENDIX 3

MAIN SOURCE MATERIALS USED IN THE REPORT

a) Special Case Studies

- The Sustainable Contribution of Fisheries to Food Security in South East Asia by Deb Menasveta
- The Sustainable Contribution of Fisheries to Food Security in the Oceania Sub-region of the Asian Pacific Region by Gillett, Preston and Associates Inc.
- The Sustainable Contribution of Fisheries to Food Security in the South Asian Sub-Region by K. Sivasubramaniam
- The Sustainable Contribution of Fisheries to Food Security in China by Song Zhiwen
- The Sustainable Contribution of Fisheries to Food Security in Japan by M. Hotta
- The Sustainable Contribution of Fisheries to Food Security in the Republic of Korea by Yong-Ja Cho

b) Other Publications

- World Food Summit - Technical background documents (Vol. I). FAO, Rome, 1996.
- "Safeguarding future fish supplies - key policy issues and measures". International Conference on the Sustainable Contribution of Fisheries to Food Security, Kyoto, December 1995 (Doc KC/F1/95/1).
- "The State of World Fisheries and Aquaculture 1996". FAO, Rome, 1997.
- "The State of World Fisheries and Aquaculture 1994". FAO, Rome, 1995.
- FAO Fisheries Circular No. 821 (Rev. 3): Fish and Fishery Products - World apparent consumption statistics based on food balance sheets (1961-1993). FAO, Rome, November 1996.

THE SUSTAINABLE CONTRIBUTION OF FISHERIES TO FOOD SECURITY IN JAPAN

by

M. Hotta

1. Introduction

Fisheries play an important role in Japan to ensure a stable supply of fish, provide income and employment opportunities, earn foreign exchange, preserve marine environments and traditional marine culture and offer recreational opportunities. Among these, the constant stable supply of fish is by far the most important element directly linked to food security issues. The government considers production prospects to be a key factor in the food security problem, and the issue of sustainability assumes particular importance.

The role of fish in food security can be defined as a situation in which all households have both physical and economic access to adequate amounts of fish for all members and where households are not at risk of losing such access. There are three dimensions implicit in this definition: availability, stability and access. However, the expansion and intensification of Japanese fisheries has threatened access to fish during the last three decades. This is because Japanese fishery development has often been associated with the buildup of pressures that have led to resource degradation and adverse impact on the wider environment. Such pressures may continue in the future, and a major issue will be how to minimize negative effects on the resources, the environment and the sustainability of fisheries.

Sustainable capture fisheries and aquaculture development policies are also needed to make fish production possible at affordable prices on the basis of environmentally sound management of fishery resources. The Japanese government has been implementing support policies to increase fish production and self-sufficiency by balancing the priorities for environmentally sustainable and economically viable advances in fish production.

2. The Role of Fisheries in Food Security

Fish is one of the most widely distributed food commodities in Japan. It currently makes up 40 percent of the total animal protein consumption, or about 20 percent of protein from both animal and plant origin (Table 1). The role of fish in animal protein consumption has declined during the last two decades partly because of the shift in consumers' dietary habits from fish to meat and partly because of increased competitiveness of meat as a result of import liberalization (e.g. beef). Nevertheless, at the global level the highest level, of fish consumption is still found in Japan.

The self-sufficiency rate in food fish has declined sharply during the last decade from 86 percent in 1985 to 61 percent in 1994 (Table 2). Per-caput food consumption measured by the dietary energy supply in calories has remained unchanged at the level of around 2,600 calories per day during the last decade, which compares with Denmark (3,675 cal), Germany (3,537 cal), USA (3,495 cal), France (3,491 cal), Sweden (3,443 cal), Switzerland (3,435 cal). The daily calorie intake of Japanese appears to have reached a saturation point corresponding to their average body size. The self-sufficiency rate in calories was only 37 percent in 1993 as compared with France (143 percent), USA (113 percent), Germany (94 percent) and UK (73 percent).

Fish protein is generally recognized as a valuable ingredient in a balanced diet. It is believed that the Japanese dietary pattern with a high percentage of fish protein intake contributes to long life expectancy as fish are low in cholesterol and saturated fats.

The sector contributes directly and indirectly to food security through income generation. Directly, it provides income to about 313,000 fishermen in production and indirectly to about 1.34 million people in related industries (e.g. processing, marketing, transportation, boat building, manufacturing of equipment/material). Fisheries also provide an inducement for promoting other industries and can be a generator of economic development. In small coastal fishing communities where few alternative employment opportunities exist, fisheries play a vital role in employment, income generation and access to fish food and thus contribute significantly to economic and social well-being.

Fish has played a minor role as a source of foreign exchange earnings. Fish exports represented only 0.3 percent of the national exports in 1994, amounting to US$ 1,200 million. However, fish exports are of high economic value, having a comparative advantage in terms of production.

3. Production

3.1 Capture Fisheries

The past three decades have seen a profound change in the Japanese fishery situation. For more than two decades national fish production continued to increase from 6.9 million mt in 1965 to reach 12.8 million mt in 1988 (Table 3). But subsequently, production began to decrease and in 1995 it amounted to about 7.5 million mt. A number of reasons may be responsible for this drastic decline. Chief among these is the gradual and continuing exclusion of Japanese vessels from grounds within 200-mile Exclusive Economic Zones (EEZs) now within the jurisdiction of coastal states. This was due to the change in the pattern of production and processing implemented by coastal states as a result of the creation of EEZs. This course of action has particularly been the case with the USA, Canada and Russia, where the governments have been arranging for their own vessels to catch and process fish for export as well as for domestic markets.

The growth and stagnation of the Japanese fish catch has been much influenced by the growth and decline of distant water fisheries, the role of which has been to supply a variety of fish which coastal and offshore fisheries could not provide (e.g. tuna, cod, salmon, atka mackerel, octopus, crab). During the peak of distant water fisheries, in 1973 for example, these fisheries accounted for 41 percent of the marine fisheries production with a total output of 4 million mt, whereas their yields dropped to around 1 million mt in recent years. In 1989 coastal fish production exceeded distant water production for the first time, and since then the discrepancies between them have widened.

Japan's dependence on the EEZs of other countries as well as high seas is reviewed in Table 4. The Table indicates that the yield from other countries' EEZs totaled 3.4 million mt in 1976, while it drastically declined to 1.7 million mt in 1985 and further to one million mt in 1994. Such a drastic change can be attributable to exclusion from the USA waters which had offered main fishing grounds to Japanese distant water-going vessels in the past. Whilst the USA's allocation to Japan amounted to 1.178 million mt in 1978 and 837,000 mt in 1985, it dropped to zero in 1988.

The Japanese quotas in the Russian EEZ have also declined sharply over the years, from 465,000 mt in 1978, to 317,000 mt in 1985 and to 100,000 mt in 1995. In contrast to the declining trends in the allocations to Japan, quotas provided by New Zealand have continued to increase from 91,000 mt in 1978, to 144,000 mt in 1985 and to 278,000 mt in 1995.

As regards Japanese fishing on high seas, the yields have continued to rise from 450,000 mt in 1976 to 834,000 mt in 1985 - a peak year. But since then production has begun to decline, and in 1994 it amounted to only 44,000 mt. This is because high sea fisheries have been seriously affected by a number of international regulations in recent years. These include Japanese Pacific salmon fishery under the North Pacific Anadromous Fish Convention (NPAFC); driftnet squid fisheries under the Agreement on Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas (Compliance Agreement); migratory species such as tuna and the like under the UN Agreement on the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (adopted in 1995). In the foreseeable future Japanese fisheries may suffer from stricter controls on high sea waters. A case in point is Alaska pollack fishing in the Bering Sea, the so-called "donut hole", where the USA and Russia insist that trawl fishing in this area will have negative effects on the stocks of this species in the EEZs of their respective countries.

Additionally, Japanese distant water fisheries have been confronted with unprecedented difficulties caused by increased imports, dwindling fish prices, increased wages and ageing of crews, shortage of young manpower and, as a consequence, a decrease in Japan's competitiveness against the Republic of Korea and Taiwan Province of China.

Offshore fisheries have also suffered from a serious setback after a peak production of about 7 million mt in 1985, due mainly to the sharp drop in sardine stocks (including Japanese pilchard) which might have been caused by prevailing high water temperatures. Likewise, the yields from coastal waters have also continued to decline to 1.8 million mt in 1994 - 20 percent less than in the peak year of 1990. The sharp decline in coastal fisheries is also linked to decreasing sardine stocks. Other causes of the dwindling catch include overfishing on the one hand and industrial pollution on the other.

3.2 Aquaculture

With the drop in total Japanese fish landings, especially in distant water fisheries, the importance of farmed fish consumption has grown. For the last three decades aquaculture has been a remarkable economic growth sector for the production of food in Japan. From 1975 to 1994 marine aquaculture output grew by 1.7 times from 773,000 mt to 1.3 million mt, whereas in value terms it rose by 2.5 times from 254 billion yen to 627 billion yen. Much of this has been due to the increase of cage culture production of yellow tail (almost 2.8 times) and other high-valued species (e.g. salmon, horse mackerel, sea bream, puffer fish) and, to a lesser extent, of shellfish (i.e. scallop, oyster) and aquatic plants (i.e. kelp, undaria, nori laver). Production of farmed prawn has been insignificant because of the availability of imported shrimps.

In 1994 farmed fish as a percentage of total landings was 17.5 percent (16.6 percent sea farming and 0.9 percent freshwater). Expensive species that consumers often could not in the past afford to buy have become popular as a result of increased quantities and lower prices made possible through aquaculture development.

The reason for the significant contribution (almost 30 percent in value terms) of aquaculture commodities to the national value of fisheries is the high value of many farmed products (particularly fish and molluscs), which are marketed fresh. Rapid acceleration in production of certain commodities (e.g. yellow tail, scallop) contributed to lower prices of these products. Many farms, both large and small, had financial difficulties during the last half of the eighties.

Since farmed commodities are hardly exported, increased aquaculture production has significantly contributed to meeting domestic demand for fish. Around 705,000 mt of fish were provided by the aquaculture sector in 1994, which accounted for some 9 percent of the total consumption of fish. Aquaculture has played an important role to fill gaps in the production decrease largely caused by distant water fisheries.

Whilst the yield of freshwater aquaculture is insignificant, accounting for around one percent, the freshwater species (e.g. eel, carp, trout, sweet fish) kept their traditionally high value, as they offer seasonal flavour and tastes.

3.3 Stock Enhancement

Salmon is by far the most important species in terms of the scale of stocking operations. In 1994 some 2,000 million fingerlings were released and 68,470,000 salmons were captured in the same year, an increase of 13.4 percent over the previous year. Sea bream, flounder, prawn, crab, abalone, scallop, top shell, sea urchin and red shellfish have gained popularity in stocking programmes during the last two decades and in 1996 a total of 3,854 million fry/fingerlings of these species were set free into the sea. Mass production of seed is undertaken by prefectural fish farming centres; there are at present 49 such centres throughout the country. Seed produced by the centres are sold at subsidized prices to fisheries cooperatives which undertake the responsibility of release and management of the seed. At the central level the Japan Fish Farming Fisheries Association is responsible for coordination and monitoring of stock enhancement programmes.

4. Consumption and Trade

Table 5 gives details of the demand and supply situation in respect of fresh and frozen fish during the last three decades. Domestic consumption of fish steadily increased from 2.0 million mt to 3.4 million mt from 1965 to 1994. Once domestic production declined, the gaps between demand and supply had to be filled by imports. In fact, Japanese imports increased by 25 times from 103,000 mt to 2.5 million mt during the above period. Imports of fresh and frozen fish were nearly 2.4 times greater than the domestic production of the same commodities. The major frozen items included prawn, tuna, salmon, cephalopods, cod, Alaska pollack and crab.

The Table also illustrates that the imports of fresh and frozen fish represented some 75 percent of the total domestic consumption in 1994, showing a heavy reliance of Japanese consumers on imported fish. From the food security point of view, the self-sufficiency rate in fresh and frozen fish was 96.5 percent in 1965, whereas it dropped to 10.8 percent in 1994.

Farmed fish imports, as a percentage of total fish imports, have also been increasing in the Japanese market. While imported farmed fish species are limited (major species being warm-water shrimp, Atlantic coho and spring salmon, trout, and eel), their market share has developed rapidly. For example, in 1995, total imports of farmed salmon amounted to 90,000 mt (an increase of 16 percent from 1994) while imports of wild salmon decreased by 32 percent from 167,000 mt in 1994 to 113,000 mt in 1995. Increased availability, consistently high quality, and a higher fat content than wild salmon have contributed to the increasing popularity of farmed salmon among Japanese consumers.

The Japanese fish market has recently been on the road to recovery after a long-lasting slowdown. However, while the depreciated yen has not been a great factor in impeding the recovery of the fish market, a massive outbreak of food poisoning by *E.coli* bacteria exerted negative effects on certain items of fish that are consumed in raw form (sashimi or sushi). Since the outbreak of the massive infection in Okayama prefecture in May 1996 and in Sakai city, Osaka, the Japanese government has been trying without success to identify the actual route of infection, the source of which appears not to be from fish or seafood products.

In order to satisfy domestic demand for seafood, which is still rising despite increasing competition from red meat, Japan is turning more and more to imported fish. Seafood imports are now equivalent to a third of the total Japanese catch in terms of volume but, because of the species involved, are equivalent to 60 percent in terms of value. The country now buys a wide range of species from an ever-increasing number of countries. Most of these are items with high unit value such as shrimp, and lobster species, which together formed the most important product category in 1995, comprising 22 percent of the total value of imports. This category was followed by tunas and marlin at 11 percent, then salmon and trout at 8 percent and crab at 7.2 percent.

The list of countries exporting to Japan in 1995 is dominated by the USA at 15 percent. Next comes China at 10.3 percent, Thailand at 8 percent, the Republic of Korea at 7.5 percent, followed by Taiwan Province of China at 7 percent.

Although fish imports have continued to increase during the last three decades, each period saw different underlying characteristics in the import trends.

1965-1973: Reflecting high economic growth, consumer demand became oriented towards high-value commodities, and import items diversified. Imports began to increase rapidly and in 1971 total imports exceeded total exports in value terms. Aquaculture development was facilitated to meet rising demand in terms of both volume and variety. Capture fisheries production grew steadily, with an increase of 230,000 mt between 1965 and

1973. During this period, fish imports increased in parallel to the expansion of capture fisheries and the volume of imports was not more than 10 percent of domestic production. Clearly, there was no competition between domestic yields and imports.

1974-1981: This period was characterized by rising prices of fuel as a result of "oil shock", dwindling fish prices, and the gradual exclusion of Japanese vessels from the EEZs of other coastal states. A 200-mile EEZ was universally established in 1977 and this began to influence national landings. Fresh and frozen fish imports increased considerably from 526,000 mt in 1974 to 998,000 mt in 1981 to help to fill shortfalls caused by reduced domestic landings.

1981-1989: As a result of large reductions in quotas to Japan by other coastal states, there was a spectacular increase in imports as compared with the previous periods. This phenomenon culminated in 1988 when the USA's allocations to Japan became nil, followed by the USSR's extensive restrictions to Japan. As a consequence, capture fisheries experienced a decline of some 500,000 mt and, in substitution, imports increased tremendously. Other important factors affecting the import trends included increased demand for raw materials from the processing industry, increased demand for fish commodities from supermarkets and changes in trade terms due to the rising yen. These problems contributed to the near doubling of the amount of imports compared with the previous period.

1989-1994: Trends in fish trade were influenced by changes in production, currency rates and demand of individual consumers as well as the food industry sector (e.g. supermarkets). The appreciation of the yen contributed to a sharp increase in Japan's imports. One striking phenomenon was that imports of expensive species were either at their peak or close to it, whereas imports of cheaper items such as mackerel (e.g. from Norway) showed a remarkable growth. Some of these cheaper imported species are subject to quota restrictions, the quotas being ostensibly to protect Japanese fishermen and accordingly fixed in time for the June-November and December-May seasons. However, it is considered by Japanese importers that the quota system is not yet a bar to increased imports of those species governed by it.

The Japan Marine Products Importers Association has recently predicted that imports would start to level off in the near future and annual totals are unlikely to rise above 3.5 million mt, and would certainly not exceed 4 million mt, at least in the foreseeable future.

Rapid economic growth in Japan from 1970 to 1990 also led to significant changes in traditional eating habits. These developments have been accelerated by additional changes in economic growth and socio-cultural perceptions: (e.g. the increase in the number of women in the workforce who now comprise more than 41 percent of the total). The overall trend to eat out continues to grow because of changing work habits and the breakdown of the traditional Japanese family, also called the emergence of the "nucleus family". Single-person households and the aging of the society have also accelerated the change of eating habits, leading to the growth of a food industry which has helped housewives to reduce the time spent in cooking.

The Annual Report on the Household Income and Expenditure Survey (1994) revealed that the expenditure of a Japanese household for dining out accounted for 10 percent of the total expenditure for food in 1974, while it increased to 14 percent in 1984 and 17 percent in 1994. Per capita, the Japanese spend approximately 13,000 yen a year in restaurants. They eat a wider variety of foods and more ready-to-serve prepared items. Japanese continue to demonstrate concern for the safety of food products and are showing a growing preference for healthy foods (lower fat and salt content).

5. Future Demand and Supply Possibilities

The demand for fish has two distinct components, that for direct human consumption and the derived demand which operates through the demand for fish-meal. Possible future levels of demand for food fish and feed at 2010 projected by the Ministry of Agriculture, Forestry and Fisheries are set out in Table 6.

The demand for food fish is affected by the forces influencing demand, particularly income and price. Assuming a continuance of past trends and no change in relative prices, by 2010 total demand for food fish will have increased to about 8.95 million mt live weight, i.e. some 615,000 mt more than the amount consumed during the 1993/95 base period. Per-caput consumption is also expected to increase from 36.7 kg to 38 kg.

The potential demand for fish for feeding purposes, whether of aquaculture or livestock, can be expected to fall. Average consumption in the period 1993/95 was of the order of 3.67 million mt and it is estimated that in 2010 the demand will be around 3.2 million mt. With increasing demand for fish for direct human consumption and the declining trends of the sardine stocks, the long-run trend in the relative prices of fish-meal is likely to be upwards; fish-meal will play a diminishing role in the preparation of compound feeds and is likely to be replaced by low-cost plant protein.

It is thus estimated that total requirements for fish and shellfish in 2010 will reach 12.130 million mt from the 1993/95 consumption of 12.030 million mt, an increase of 127,000 mt.

Table 6 also shows that total demand for seaweeds is expected to increase by 30,000 mt wet weight over the period from 1992/94 to 2010, reflecting consumers' preference to eat healthy food containing minerals and cellulose. Per-caput consumption of seaweeds is likely to increase to 1.5 kg from the present level of 1.3 kg during the above period.

Marine fisheries production has been on a downward trend since the peak year of 1988 due to the deterioration of the sardine stocks, which might have been caused by prevailing high water temperatures in the fishing areas. Distant water fisheries will face even severer situations as a result of restrictions which may tighten high sea fisheries. Exploitation of under-exploited species on high seas is unlikely to influence national landings significantly.

It has been projected that total marine landings will be about 6.72 million mt in 2010 over the 1992/94 production of 7.67 million mt and there will be an overall reduction of some 950,000 mt (Table 7). The largest setback will be seen in offshore fisheries with a decrease of more than one million mt, and distant water fisheries will also decline by some 146,000 mt from 1.196 million mt in 1992/94 to 1.05 million mt in 2010. On the other hand, it is expected that coastal fisheries will demonstrate an increase of some 240,000 mt during the period under review due to the effects of stock enhancement programmes. There will also be a significant increase of 223,000 mt in the marine aquaculture sector.

It is estimated that the output of seaweeds will increase from the present level of 140,000 mt to around 160,000 mt wet weight in 2010 because of increasing demand for seaweeds and positive effects of coastal fishing grounds rehabilitation and enhancement programmes.

In summary, the domestic production of fish and shellfish in 2010 will approximate 7.87 million mt as against the projected demand for fish for direct human consumption of 8.95 million mt, a shortfall of over 1 million mt. A number of consequences will result from an insufficient supply in relation to demand, including the prices of fish and its consumption. The shortfall between supply and demand will continue to be translated into increased fish imports and fish prices. It may be expected that increasing real fish prices will result in a decline in average per-caput consumption, but the extent to which this occurs is likely to vary according to the availability of substitutes such as meat. Increasing real prices may stimulate an increase in aquaculture production.

6. Policy Framework and Action Required to Enhance Food Security Fisheries

The preceding paragraphs have indicated in broad outline the most likely trends in Japanese fisheries to 2010. It is clear that the main issues of concern to Japanese policy makers arise from the growing shortage of fish. Fisheries policy therefore should be directed to increasing production and reducing waste, including the waste of over-exploitation. The issues and policy directions presented below are comprehensive and predominantly important from the standpoint of ensuring a stable supply of fish for food security purposes. Detailed elements to address policy directions are presented in Appendix 1.

Appropriate actions to meet this challenge, many of which have already been taken, can be broadly classified as (a) efforts to increase and sustain production through fisheries management, stock enhancement, and aquaculture development; and (b) protection of the marine environment through enhancement of coastal fishing grounds.

6.1 Efforts to Increase and Sustain Production

Fisheries management

According to the Fisheries Agency (1993), many fishery resources in the waters around Japan are subject to exploitation close to or beyond the level of the maximum sustainable yield. The greater part of these threatened stocks includes small pelagics, demersal species and cephalopods. Catch per unit effort of major offshore fisheries (e.g. bottom trawling, squid jigging, gill-netting) have in most cases declined both in total catches and per-unit catch. Even when total catches rose (e.g. gill-netting), the catch per boat has declined as a result of increased fishing effort.

As part of structural adjustment programmes, the government tightened management measures in 1995 through a reduction of fishing effort as well as area and seasonal control to ensure the conservation and rational utilization of fisheries resources. The adjustment measures are intended to reduce the number of vessels to appropriate levels commensurate with the state of the fish resources and improving fishermen's economic returns. In some cases financial incentives were extended to vessels owners for scrapping their vessels. Vessel reduction programmes have been implemented for large and medium scale purse seining as well as offshore trawling which suffered from unfavourable results in catches and economic returns. The structural adjustment policy aims at introducing energy saving vessels and equipment to optimize the cost for production.

The government has also taken steps to introduce a Total Allowable Catch (TAC) system and a quota system in compliance with the UNCLOS which was ratified by Japan in 1996. A Law concerning Conservation and Management of Marine Aquatic Resources, commonly known as the Law of the TAC, came into force on 1 January 1997. Sardine, jack mackerel, mackerel, saury, Alaska pollack and crab are the fishes to which TAC is applied. The criteria of the selection of these species were (a) both production and economic value are high; (b) the state of stocks is critical and there is an urgent need for the conservation and management of the stocks; (c) they are fish which are also taken by foreign vessels in the waters around Japan. It is likely that the coverage of fish species which come under TAC will be expanded as experience is accumulated. The TAC for 1997 was determined only for Alaska pollack and crab by fishing areas.

Efforts will be continued to integrate TAC systems into the existing fisheries legislation and management mechanisms. The government allocated 1.2 billion yen in 1995 for the assessment of fishery resources. One important action to be taken is to establish a system to collect catch data, say 2 to 3 days after landing, at the central level by making full use of a computer network. To this end, in 1995 the government provided 500 million yen to install communication equipment at major fishing ports. The law of the TAC obliges fishermen to report their catches immediately. Future issues include (a) application of TAC to Chinese and Korean vessels which operate in the waters around Japan; (b) establishment of a single management authority (amalgamation of national and prefectural management bodies); (c) building early catch reporting systems; and (d) withdrawal of vessels and compensation.

Recreational fishing has gained popularity over the years (37 million sport fishermen at sea and 11 million persons on freshwaters, 1993) and it is estimated that the total amount of fish taken by sport fishermen amounted to about 35,000 mt in 1994. However, there have been serious conflicts between sport and professional fishermen over fishing grounds, navigation routes, environment degradation, mooring and the use of landing facilities. Open access enjoyed by sport fishermen is now restricted by the relevant laws enacted in 1993.

Community-based fisheries management (CFM) has achieved significant success in respect of a fair and equitable allocation of resources, improving compliance and reducing management costs. CFM has been implemented by fisheries cooperatives for many years and the government has played a catalytic role to promote research and extension.

Stock enhancement

Fish farming, "sea ranching" or aquaculture-based fisheries, which increase the harvest of existing species and new species, continue to offer significant prospects for higher catches, increased income and enhanced food security in Japan. Seed for reproduction is determined on the basis of local demand, the state of resources and its suitability to local natural conditions. Released seed is placed under stringent management controls such as banning of small-sized fish harvest, rearing of fry to a marketable size and conducting market studies.

In Japan modern fish farming was first implemented by the National Fish Farming Fisheries Centre established in Yashima, Kagawa Prefecture, in 1963 and the Seto Inland Sea was designated as a model area to develop fish farming technology. With the advent of the EEZ regime, the importance of fish farming was further recognized and prefectural fish farming centres have been deployed throughout the country to undertake applied research activities on fish farming. There are now 49 prefectural fish farming centres. In addition, there are 16 national fish farming fisheries centres which are engaged in basic research on the technological development of fish farming.

In order to facilitate fish farming the relevant legislation has been revised several times to cope with emerging problems and issues. The most recent revision (1994) focused on the following: (a) to increase the survival rate of seed released to the sea and the prevention of mass losses during hatching; (b) prudent care to be taken in the selection of sites where seeds are released, taking full account of natural conditions, ecological systems, etc. to minimize the death and loss of seed; (c) to establish plans to oblige beneficiaries (i.e. fish farmers or fisheries cooperatives) to bear part of the costs incurred for fish farming projects; (d) to establish management measures for stocks of migratory species reared by fish farming which cross over the boundaries of the prefectures; (e) research on fish disease; and (f) effective integration of the relevant regulations and ordinances (e.g. use of fishing grounds regulations, nursery grounds preservation regulations) into the law concerning fish farming.

Table 8 shows the projected supply of seed in 1998 as compared with the actual supply in 1993. The government foresees that seed production of major species will substantially increase over the next few years; the rate of increase would range from 30 to over 100 percent (except for scallop). In order to facilitate mass production of seed, the government will implement the above-mentioned activities at central, prefectural and community level. In this context, in 1995 a national fish farming fisheries centre was established in Amami Oshima to develop fish farming technology for bluefin tuna.

Aquaculture

Demand for aquaculture products has been somewhat sluggish in recent years as a result of increased supplies and stagnation of prices. Future advances will depend on establishing a production system to combine activities relating to demand analysis, market trends and joint shipment through cooperatives. There is also a need to introduce better management measures to maximize the use of aquaculture grounds in inshore waters and develop offshore aquaculture development.

In this connection, efforts are being made to develop a model project for an overall farming system embracing the entire process from production to marketing to strengthen competitiveness. Such a model will be replicated in other areas, where appropriate. Particular attention will be paid to increasing the productivity of farm management through the improvement of ingredients of feeds and feeding methods, the use of labour-saving equipment, rational use of farm grounds and under-utilized areas for aquaculture.

Investments in research and development must be continued at a high level to cope with the outbreaks of pathogenic diseases. Although many feeds are adequate, they remain costly. The changing environment due to pollution requires continuous monitoring and research to avoid incidents such as algal blooms, red tides, etc.

Improved facilities for detecting environmental degradation of farm grounds will help to ensure stable supply and the safety of farm products. Indicators required for environment management and simple methods of measuring environmental conditions need to be developed. Research on the appropriate treatment of residual waste products in culture farms, as well as non-feeding culturing systems, should be facilitated. Contamination of fish caused by preservative materials or paints coated on fishing nets will continue to be studied. Possibilities will be explored to produce new fish species which will be resistant to disease and have a high feeding efficiency and better taste. In this respect, application of bio-technology to aquaculture is being experimented with.

Appropriate use of aquaculture grounds in coastal waters needs to be promoted through establishment of common management systems by fisheries cooperatives. Such systems can be strengthened through better coordination between research institutes and extension agents. Field surveys carried out by the National Federation of Fisheries Cooperatives (1994) revealed that there was a need to assist fish farmers by providing advice on stocking rates of fish farm/cage net, carrying capacity of unit area of culture grounds, methods to count the number of fish bred, inspection of culture farms, disposal of residual waste products, disposal of perished fish, removal of aquatic organisms adhering to culture installations, appropriate distances between culture installations, feed quantities, feeding methods and frequency, treatment of polluted water, etc. to increase competitiveness and permit its expansion.

Legislative and regulatory processes to control farming activities will be required to meet water quality standards for all discharges concerning nutrient loading and residual levels of chemicals and thus maintain environmental compatibility. These include treatment of pathogenic organisms and parasites with fishery medicines and pesticides, site treatment of algicides and herbicides, and banning certain construction materials and paints which contain toxic chemical components. These stringent standards for the environment have also been carried over into the safety of aquaculture products for human consumption. The Japanese authorities impose severe restrictions on manufacturing, marketing and use of fishery medicines in respect of the methods, quantity, banning period, etc.

6.2 Protection of the Marine Environment

Protection and enhancement of the coastal fishing grounds

The loss of valuable coastal fishing grounds as a result of large-scale industrial development in coastal areas, land reclamation schemes and ensuing pollution and environmental degradation led in the 1970s to recognition of the need to protect and enhance the coastal fishing grounds. A special programme to this end was enacted in 1974 with three main approaches - the placement of artificial reefs, the enhancement of fish habitats and breeding grounds and the restoration through sediment removal and dredging of degraded grounds. The programme has had positive effects upon the fisheries; production has risen, CPUE's increased, new commercially valuable species marketed; operating costs have been reduced and quality improved. The programme was implemented as part of public investment from 1976 to 1993.

As a continuation of the above programme, a new Five-Year "Coastal Fisheries Structural Improvement Programme" (CFSIP) (1994-99) has been under implementation with total costs of 251 billion yen (including institutional loans of 136 billion yen). The purpose of CFSIP is to rehabilitate fishing communities, increase self-sufficiency in food fish and enhance the linkages between regional fisheries and regional economic and industrial development activities.

The CFSIP consists of (a) rehabilitation of regional fisheries in 85 regions by improving production facilities, infrastructure and the environments of fishing communities and enhancing linkages with urban areas to make better use of regional resources; (b) strengthening of regional coordination between neighbouring prefectures and coastal villages in respect of seed production, marketing, treatment of fisheries refuse and establishing fisheries training facilities; (c) development of islands and isolated fishing villages by reinforcing fisheries production and marketing facilities, social infrastructure and seed production facilities; (d) building a model fishing village by improving landing and market facilities, beach preservation, exhibition halls, recreational facilities; and (e) accelerating community-based fisheries management by improving infrastructure facilities for seed production, fish handling, processing and storage, social infrastructure and habitat construction for resource enhancement.

The Central Bank for Agriculture, Forestry and Fisheries will provide individual fishermen, fisheries cooperatives, private firms and public entities with loans for vessel construction and acquisition, gear purchase, habitat construction, aquaculture equipment and fish production facilities.

Experience has shown the importance of encouraging fishermen's participation in the planning, siting and execution of fisheries management and development projects and in this respect fisheries cooperatives are an important vehicle for planning and implementation of CFSIP.

7. Conclusions

The projected increase in demand for direct human consumption of an additional 585,000 mt by the year 2010 might be satisfied by better fisheries management, possible increase from aquaculture (223,000 mt) and stock enhancement programmes. Delays in improving management and introducing TACs and therefore alleviating supply constraints can be expected to increase fish imports further. The role of fish imports in fostering food security will further increase in the light of reduction of fishing areas within the EEZs of other countries as well as on the high seas.

Japanese fisheries growth is likely to be slower in the future compared with that of earlier decades. This slow-down may be partly attributable to a slower demand growth, and per-caput fish consumption may remain almost unchanged from the present level or become even lower, reflecting increasing consumption of substitutes such as meat.

The prospects for an improved role of fisheries in food security could be affected by limitations on the side of production. Many of the problems associated with production are likely to be solved only in the medium and long term since it would take some time before positive effects of policy measures are observed. More immediate are the problems of ensuring the maintenance of high and sustained yields from conventional stocks. Management issues are urgent because of the increasing number of stocks requiring management action to restore yields and reduce excessive costs, and because of increasing pressures on Japanese distant water fisheries.

The aquaculture sector has made a significant contribution to the increase in national fishery production and offers considerable potential for future expansion and for food security. Higher demand for fish as compared with supply may improve the viability of aquaculture production. Fish farming offers effective means of rehabilitating deteriorated fish stocks. Stronger and refocused research on aquaculture and fish farming is identified as a key priority for fish production and improved food security.

Financial assistance for fisheries investment has an indispensable role to play in respect of strengthening basic facilities and infrastructures including artificial reefs which are essential to protect marine environment, enhance fish habitats, and ensure an improved contribution of fisheries to food security.

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APPENDIX 1

MAJOR POLICY MEASURES AND ACTION NEEDED FOR SUSTAINABLE CONTRIBUTION OF FISHERIES FOR FOOD SECURITY

1. Strengthening fishery resources survey around Japan

- Studies on the present state of major fishery resources and future forecast of resource trends;
- Collection of catch statistics by fishing grounds and surveys of the distribution density of fishes in major fishing grounds by research vessels;
- Survey to determine the ages of fish at fish markets;
- Survey of eggs and fry in fishing grounds; and
- Modeling on the productivity of fishing grounds and their mechanisms.

2. Fisheries management

- Introduction of Total Allowable Catch (TAC) systems to selected fisheries (i.e offshore bottom trawling for crab and Alaska pollack, purse seining, stick-held dipnet for saury);
- Monitoring of catches under TAC systems and educational activities for fishermen to ensure their prompt reporting on their catches to fish markets; and
- Establishing a computer network for collection and analysis of data.

3. Community-based fisheries management

- Promotion of community-based fisheries management on a nationwide scale under close coordination between fisheries cooperatives, prefectural government and central government;
- Establishing a comprehensive management plan by expanding the kind of species and types of fishing; improving extension, resource surveys, infrastructure facilities related to resource conservation;
- Development of quantitative forecast methods for migration of pelagic species;
- Implementation of fish propagation projects for community-based fisheries management; reduction of the number and size of vessels commensurate to the state of resources; and
- Financial assistance to cover the reduction of income as a result of implementation of management measures with the allocation of 4,000 million yen.

4. Restructuring of fishery production systems

- Provision of subsidies in conjunction with reduction of fishing effort and changes to fishing operations which require high efficiencies - such subsidies will be used for disposal or scrapping of vessels and reducing financial burdens likely caused by such operations;
- Provision of subsidy for withdrawal of vessels and reduction in the size of vessels for coastal fisheries;
- Provision of subsidies for the withdrawal of vessels caused by difficulties in

competing with foreign vessels; and

- Creation of working funds (100 billion yen) to be used for restructuring of medium and small-scale fisheries and provision of investment funds (16.2 billion yen).

5. Expansion of culture-based fisheries

(i) Stock enhancement

- Rehabilitation and establishment of national fish farming centres for technological development in fish farming which will include research programmes relating to fish disease, application of bio-technology to fisheries, etc.;
- Provision of subsidies for building facilities at prefectural fish farming centres to introduce new technologies;
- Provision of subsidies for establishing pilot projects to enhance stocks of highly migratory species; for further deployment of fish farming projects in specified waters; and
- Implementation of pilot projects on fishery management for the resources of released fry/fingerlings/fish.

(ii) Aquaculture

- Formulate a development plan covering management from production to marketing and suited to specific local conditions to strengthen the competitiveness of aquaculture operations. The main purpose of the plan is to reduce costs, increase feeding efficiency, install labour-saving equipment under common use to increase the productivity of aquaculture operations;
- Appropriate deployment of aquaculture installations for rational use of farm grounds and effective utilization of underdeveloped waters; pilot test operations for culturing fish species suitable for that area;
- Inspection and monitoring methods and systems will be developed for protection of aquaculture grounds by establishing environment indicators. Likewise, pilot tests will be carried out to develop techniques for appropriate treatment of residual waste products in aquaculture farms and produce new species which will require feeding;
- Development of cheap and effective composite food to replace sardines, stocks of which have drastically declined in recent years;
- Application of bio-technology to produce new species which are resistant against disease, have high feeding efficiency and improved taste; and
- Conducting studies on contamination of fish by preventive material of fish nets.

(iii) Stocking programmes of salmon fry

- Pilot projects will be operated to develop methods to increase the return rates of fish with a smaller number of released fry;
- Comprehensive countermeasures to reduce threats of fish disease will be established, which will include (i) information collection and dissemination regarding the breakout of disease and preventive methods, (ii) technological improvements in examination, treatment and prevention of disease, and (iii)

inspection of imported fish seed and fry and preservation and storage of vaccine, etc.; and

- Increase the safety level of farmed fish by decreasing the outbreak of fish disease and providing adequate guidance on the use of pathological medicines.

6. Rational use of marine waters

- Establish balanced utilization of marine waters for fishing and recreational fishing through adjustments in marine water use between them; conduct surveys on catches taken by sport fishermen, impact of feeding on environment in fishing grounds;
- Education for guides for sport fishermen with regard to "regulations on sport fishing";
- Establish discipline and order in the use of fishing ports.

7. Enforcement

(i) Within EEZ of Japan

- Inspection will be strengthened for fishing by foreign vessels within the EEZ of Japan by deploying patrol boats, aircraft, inspection boat; and
- The government launched 20 patrol boats and 6 airplanes in 1996.

(ii) Coastal and offshore waters

- The central government will give guidance and provide subsidies to the Prefectural Sea Area Fisheries Coordination Commission and Inland Water Fisheries Management Commission; and
- Inspection and surveillance will be intensified to detect poaching in coastal water.

(iii) Monitoring, control and surveillance for foreign vessels

- Tighten surveillance on foreign vessels to control illegal fishing through fishermen's participation in MCS; and
- Reinforce the deployment of patrol boats and air craft.

Table 1. Role of fish in Japanese protein intake

(Unit: gram per person per day)

	1980	1985	1987	1988	1989	1990	1991	1992	1993
Protein intake (A) g	83.0	84.6	86.7	88.1	87.9	87.7	88.0	88.6	88.5
Animal protein intake (B) g	39.1	41.5	43.8	45.2	45.0	45.4	45.6	46.0	46.7
Animal protein as a percentage of total protein (B)/(A)	47.1	49.5	50.5	51.3	51.2	51.8	51.9	51.9	52.8
Fish protein intake (C) g	17.8	18.3	18.6	18.9	18.8	18.8	18.4	18.5	18.9
Fish protein as a percent of total protein (C)/(B)	45.5	44.1	42.5	41.8	41.8	41.4	40.4	40.2	40.5

Source: Food balance sheet, Ministry of Agriculture, Forestry and Fisheries, 1966.

Table 2. Changes of self-sufficiency rate of fish and shell fish

(Unit: rate: %, Quantity: 1 000 mt)

	1985	1990	1991	1992	1993	1994	Changes (%)	
							1993/92	1994/93
Self-sufficiency rate excluding feed	86	72	71	70	64	61	-6.0	-3.0
Self-sufficiency rate including feed	96	86	86	83	76	73	-7.0	-3.0
Domestic production	7 268	6 311	5 857	5 779	5 417	5 142	-6.3	-5.1
Imports	1 880	2 714	2 938	3 098	3 309	3 390	6.8	2.4
Exports	601	453	480	441	425	342	-3.6	-19.5
Holdings	131	-226	38	171	163	173		
Domestic consumption	8 416	8 798	8 277	8 265	8 464	8 363	2.4	-1.2

Source: Prepared based on Food Balance Sheet, Ministry of Agriculture, Forestry and Fisheries, 1996.

Note: Self-sufficiency rate = domestic production/domestic consumption x 100.
Quantities are shown in live weight terms.
Domestic production, imports, exports, holdings and domestic consumption exclude feed.

Table 3. Fisheries and aquaculture production

(Unit: 1 000 mt)

	1965	1970	1975	1980	1985	1990	1991	1992	1993	1994
Total	6 908	9 315	10 545	11 122	12 816	11 052	9 978	9 266	8 707	8 103
Marine fisheries	6 382	8 598	9 573	9 909	11 501	9 570	8 511	7 772	7 256	6 590
Distant waters	1 733	3 429	3 168	2 167	2 280	1 496	1 179	1 270	1 139	1 063
Offshore waters	2 787	3 279	4 469	5 705	6 956	6 081	5 438	4 534	4 263	3 720
Coastal waters	1 861	1 889	1 935	2 037	2 266	1 992	1 894	1 968	1 861	1 807
Marine aquaculture	380	549	773	992	1 111	1 273	1 262	1 306	1 274	1 344
Inland capture	113	119	127	128	107	112	107	97	91	93
Inland aquaculture	33	48	72	94	97	97	97	91	86	77

Source: Annual fisheries and aquaculture statistics, Ministry of Agriculture, Forestry and Fisheries, 1996.

Table 4. Japanese production by areas

(Unit: 1 000 mt)

	1976	1985	1994
Japan's EEZ	4 887	4 816	5 527
EEZs of other countries	3 386	1 742	1 019
USA	1 481	837	0
Russian Federation	1 090	316	100
China	116	82	80
Rep. of Korea	129		111
New Zealand	91	144	278
Others	359	256	450
High seas	450	834	44
Total domestic production	8 728	7 392	6 590

Source: Fisheries Agency and National Federation of Fisheries Cooperative Association, 1997.

Table 5. Changes in demand and supply of fresh and frozen fish

(Unit: 1 000 mt live weight)

Year	Demand		Supply				Ratio to domestic consumption		
	Domestic consumption	Exports	Domestic production	Capture	Culture	Imports	Capture %	Culture %	Imports %
1965	1 973	260	2 130	1 904	226	103	96.5	11.5	5.2
1969	2 114	162	2 082	1 803	279	85.3	85.3	13.2	9.2
1973	2 661	341	2 476	2 117	359	526	79.6	13.5	19.8
1977	2 931	196	2 608	2 179	429	818	74.3	14.6	27.9
1981	2 928	158	2 094	1 616	478	998	55.2	16.3	34.1
1985	3 329	151	2 113	1 547	566	1 356	46.5	17.0	40.7
1989	3 352	345	1 813	1 127	686	1 870	33.6	20.5	55.8
1990	3 315	280	1 510	803	707	2 034	24.2	13.7	61.0
1991	3 098	340	1 182	476	706	2 285	15.4	22.8	73.8
1992	3 154	331	1 159	431	728	2 335	13.7	23.1	74.0
1993	3 320	322	1 106	358	748	2 519	10.8	22.5	75.9
1994	3 398	256	1 070	366	704	2 545	10.8	20.7	74.9
Increase between									
1965-73	688	81	346	231	133	423			
1973-81	267	-183	-382	-501	119	472			
1981-89	424	187	-281	-489	208	872			
1989-94	46	-43	-743	-761	18	675			

Source: Prepared on the basis of Food Balance Sheet, Ministry of Agriculture, Forestry and Fisheries, 1996.

Note: Demand and supply do not tally because of inventories.

Table 6. Estimated demand for fish, shellfish and seaweeds in 2010

(Unit: 1 000 mt live weight)

	Total		
	Consumption (1992/94)	Projected demand (2010)	2010-1992/94
Fish and shellfish			
- Domestic demand	11 870	12 130	127
- Food	8 365	8 950	585
- Feed	3 505	3 180	(325)
- Per-caput consumption	37	38	1
Seaweeds			
- Domestic demand	211	230	30
- Food	179	215	18
- Non-food	32	15	-17
- Per-caput consumption	1.3	1.5	0.2

Source: Food Balance Sheet, Ministry of Agriculture, Forestry and Fisheries, 1996.

Table 7. Projected production of fish and fishery products in 2010

(Unit: 1 000 mt live weight)

	1992/94	2010	2010-1992/94
Domestic fish and shellfish production	8 586	7 870	-716
Distant waters	1 196	1 050	-146
Offshore waters	4 743	3 700	-1 043
Coastal waters	1 731	1 970	239
Marine aquaculture	727	950	223
Inland capture	98	100	2
Inland aquaculture	91	90	-1
Domestic seaweeds production	140	160	20
Marine fisheries	38	40	2
Marine aquaculture	102	110	8

Source: Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries, 1996.

Table 8. Estimated amounts of seed supplies in 1999

(Unit: million)

		1993 Actual output	1999 Estimated amount	Size of seed (million)
Fish	Sea bream	35	45	20
	Flounder	29	42	30
Crustacean	Prawn	499	666	15
	Blue crab	54	99	5
	Yoshiebi	37	77	15
Shellfish	Scallop	3 232	3 417	30
	Abalone	39	78	10
	Redshell	12	12	2
	Top shell	3	6	5
Others	Sea urchin	78	100	5

Source: Ministry of Agriculture, Forestry and Fisheries, 1996.

The Sustainable Contribution of Fisheries to Food Security in the Republic of Korea

by

Yong-Ja Cho

1. Introduction

This report was prepared as part of the study on the fisheries contribution to food security in Asia. The report provides a brief review of the status of the fisheries of the Republic of Korea, fish food consumption, issues affecting demand and supply of fishery products, and implications for future fishery policies. The terms of reference for the study is attached as Annex 1.

2. Fisheries in the Republic of Korea

The Republic of Korea, with a population of 44.5 million in 1994, occupies the southern 45 percent of the Korean peninsula that is surrounded by the East Sea (western part of the Sea of Japan) in the east, the Yellow Sea in the west and the South Sea in the south (extension of the Yellow Sea and a northern part of the East China Sea). Located between the longitudes 122° 5’ and 133° 5’ and latitudes 31° and 38°, the Republic of Korea has a coast-line of 11,540 km and about 3,200 islands. The marine area falling under the national jurisdiction of the Republic of Korea on the basis of delimitation by the median-line-equidistance formula is about 317,000 km^2 which is about 3.2 times the land area (99,262 km^2) and about fourteen times the arable land area (about 23 percent of the land area).

The East Sea is a semi-enclosed basin reaching more than 3,000 m in depth. The warm and saline water from the Kuroshio enters through its southern inlet and forms the Tushsima current in the upper 300 m. The East Sea deepens abruptly, forming a number of deep basins between ridges and surrounding margins. The 1,700 km of the east coast is characterized by a narrow shelf with a straight coastal line.

The Yellow Sea is a shallow, post-glacially-submerged epicontinental sea bounded on the east by a long stretch of ria-type coast. The Yellow Sea floor is rather flat and progressively deepens toward the southeast to form the Okina Trough in the northern East China Sea.

Table 1. Characteristics of the seas surrounding the Korean peninsula

	East Sea	Yellow Sea	East China Sea
Area (km^2)	1 013 000	417 000	752 000
Mean depth (m)	1 667	44	272
Volume (km^3)	1 690 000	18 000	209 000
Continental shelf area (1-200 m)	23.5%	100%	81.3%
Continental slope area (200-1,000 m)	15.2%	0	11.4%
Deep basin area	61.3%	0	7.3%

Source: MOMAF. Correspondence.

The East China Sea is a broad continental shelf with depths less than 200 m. Its hydrography is strongly influenced by the vast amount of freshwater discharge from the Chanchian (Yangtze) and Huang Ho (Yellow) Rivers. The sediment transported from the two large rivers is estimated to be 1,500 million mt/year which is equivalent to the world's largest, the Ganges-Bramaputra river input. The circulation of this sea seems to be influenced by the prevailing northwestly wind in colder seasons, by river discharge and by intrusion of the Kuroshio. The Yellow and South Seas are stratified in summer and well mixed in winter. The South Sea is also shallow and flat, similar to the Yellow Sea, but characterized mostly by rugged embayments.

The seas are in the temperate zone, and their temperatures vary according to weather and ocean current. Annual fluctuation has been approximately 1-5° C.

Table 2. Average sea temperatures

(Unit in ° C)

	Winter		Spring		Summer		Autumn	
	surface	at 50 m	surface	at 50 m	surface	at 50 m	surface	at 50 m
East Sea	7-15	6-15	2-20	5-17	18-26	6-21	16-24	7-24
South Sea	9-16	10-16	11-20	11-19	23-27	11-22	20-25	12-25
West Sea	4-10	4-11	6-18	6-15	19-25	9-20	17-21	10-20

Sources: MOMAF and NFA. Annual Report of Korean Fisheries 1996, 1994, 1993.

With many islands and diverse characteristics, the seas surrounding the Republic of Korea provide good habitats for the 100 aquatic species found in the coastal waters. According to 1994 FAO fishery statistics, the Republic of Korea is the tenth largest fisheries producer in the world. Major species of fish produced are anchovy, mackerel, hairtail, squid, Alaskan pollock, tuna, croakers, Pacific saury, crab, shellfish such as oysters, abalone, cockles and top shells, and seaweeds such as laver, seamustard and fusiforme.

Whilst the fisheries sector has contributed less than 1 percent of GNP (about 0.75 percent) in the 1990s, it has made an important contribution to the diet and livelihood of the people and to the nation's export earnings. In 1994, about 45.5 percent of animal protein was supplied by fishery products, with average consumption of 44.8 kg of fishery products per caput per year, which is 3.4 times larger than the world average of 13.0 kg and 1.9 times the average fish consumption of Southeast Asia (23.8 kg).

The fisheries sector also provides employment opportunities to nearly 200,000 people engaged in fishing or fishfarming activities. On the basis of the assumption that each employment in primary economic activities generates four or more employment opportunities in secondary and related economic activities, it can be said that the fisheries sector supports the livelihood of more than one million people. The average income of fishing households has increased significantly, from 4,869,000 Korean Wons (krw) in 1985 to 18,790,000 krw in 1995. However, it remains at about 86 percent of the average income of agricultural households and 82 percent of city households.

Until the early 1960s, the fisheries sector consisted mainly of coastal fishing. However, since the development of aquaculture and the deep-sea fishing industry in the

1970s and 1980s, the fisheries industry has diversified. Total domestic fisheries production has remained at about 3.2 to 3.4 million mt per year for the last ten years. While fisheries contributes about 52 percent (valued at approximately US$ 1.7 billion in 1995) of total exports of agricultural products, imports of fishery products have accelerated since the early 1980s. Total fishery imports in 1995 reached 416,149 mt, which was about 9 times higher than in 1980 (46,818 mt).

In common with other industries, the fisheries sector has made impressive progress over the years, but is going through a major transition, from a centralized system to a decentralized one. Additionally, the fisheries sector encounters a variety of difficulties. They include the impact of the introduction of 200-mile Exclusive Economic Zones (EEZs) by many coastal nations that significantly reduce fishing areas, intensified fishing regulations for resource management, increased financial burden from high fishing permit fees, the decline in abundance of fisheries resources, and escalating labor costs. Other difficulties are the impact of trade liberalization and increasing incidents of marine pollution from all sources, including industrialization and reclamation of coastal areas that negatively affect fish habitats and reduce fishing grounds.

The judicious use of the inland, coastal and marine resources is an important challenge as the country is poorly endowed with land resources. The critical task facing the sector is effective and efficient implementation of policies and management interventions that are environmentally sound, socially equitable and consistent with new global trade and ocean management policies.

3. Fisheries and Food Security

Food is one of the basic needs of human beings. Food security at the individual level means the continued accessibility and availability of food at affordable prices. Thus, one of the essential roles of the government is to ensure that adequate amounts and variety of foods are available and that individuals have the means to purchase them.

Fish, a source of high-quality animal protein, is also rich in micro-nutrients such as vitamins A and D, calcium, iodine, and is rich in fatty acids essential for the proper development of the brain and body and the prevention of cardiovascular diseases. These micro-nutrients are not commonly found in staple foods. Supplementing staple foods with fish food is known to be important to the well-being of human beings, particularly children and the elderly.

The Republic of Korea is a coastal country and the people have always depended on the sea as one of their main sources of food. Fish, rice and vegetables have been the staple diet of Koreans. Although the percentage of fish as a source of animal protein in the diet decreased to 45.4 percent in 1994 from 64 percent in 1970 and 70 percent in 1962, the quantity of fish food consumed had increased to 44.8 kg/caput/yr in 1994 from 17.3 kg/caput/yr in 1970 (see Table 15).

In addition to providing food, fisheries also contributes to the employment and income opportunities of many people engaged in fishing or fishfarming activities, and contributes to the national economy. Nearly 200,000 people are directly involved in fisheries, on either a full-time or a part-time basis, mostly in small-scale coastal fishing or aquaculture (see Table 4 and Table 19). The economic contributions of fisheries are much larger if secondary and supporting industries are included.

Although the absolute value has increased, the percentage contribution of the fisheries sector to the gross national product (GNP) has declined over the years as the growth rates of other sectors, such as construction, manufacturing, mining, and services, have been much faster than that of fisheries.

Table 3. Percentage contribution to GNP by sector

	Total GNP (US$ 10^9)	Agriculture	Forestry	Fisheries	Manufacturing & mining	Construction & energy	Service
1970	n/a	23.3	1.7	1.6	22.5	6.5	44.3
1975	209	22.0	1.3	1.6	27.5	5.9	41.7
1980	606	12.7	1.0	1.2	29.7	10.1	45.5
1985	911	10.6	0.7	1.2	30.5	10.6	46.5
1990	2 518	7.4	0.4	0.9	29.7	13.7	47.9
1991	2 920	6.5	0.3	0.9	29.0	16.0	47.3
1992	3 057	6.3	0.3	0.8	28.1	15.9	48.6
1993	3 308	6.0	0.3	0.8	27.3	16.2	49.4
1994	3 780	5.9	0.3	0.8	27.2	15.8	49.9
% change btwn '75-'94	+1 809	-73	-77	-50	-1	+268	+20

Sources: MOMAF and NFA. Annual Report of Korean Fisheries 1996, 1994, 1993.

4. Fisheries Sector

4.1 Status of the Fisheries Industry

The establishment of the fisheries law in 1953 laid the foundation for the fisheries sector. In order to meet domestic and export needs, fisheries policies stressed increased production. The fisheries strategies in the first (1962-66) and second (1967-71) national economic development plans aimed to protect coastal fisheries resources; develop aquaculture and deep sea fishing; develop infrastructure such as cold storage and fishing ports; strengthen fishing efforts; improve fishing gear; and develop quick processing capacities in fishing villages.

In the third (1972-76) and fourth (1977-81) national economic development plans, fisheries policies were targeted to expand aquaculture, particularly culture of shellfish; update port facilities; modernize fishing vessels; develop facilities for distribution and marketing; strengthen processing industries; develop and transfer fisheries technologies; manage deep sea fishing; develop inland fisheries; develop fishing communities; and manage fisheries resources.

The strategies of the fifth (1982-86) national economic development plan were oriented to intensification of management of coastal fisheries resources, including promotion of the concept "from fishing to ranching" in the coastal waters; intensification of fisheries technology development and transfer; development of skilled and experienced human resources; improvement of distribution and marketing channels; decommissioning old and inefficient fishing vessels; and strengthening port capacities. In the sixth national development plan (1987-91), priority was given to management of fisheries resources, including rehabilitation of fish habitats and removal of wastes and pollutants from fishing and fishfarming areas; holistic development of fishing and fishfarming communities; and development and transfer of technologies for both production and post-harvest handling and processing.

Fisheries was considered a strategic industry supplying food and contributing to the national economy, and fisheries policies encouraged intensified investment efforts. However, the sector has been affected by changes in national and international economic and trade policies of recent years and inadequate attention given to the impact of the policies of the fisheries and other sectors on aquatic resources and environment. Current policies are directed toward management and rehabilitation of aquatic environments and resources; skilled and specialized human resource development; holistic development of fishing and fishfarming communities; and comprehensive, integrated coastal areas.

4.2 Trends in Fish Production

Although fisheries production levels have not changed significantly, the number of persons directly employed in the fisheries sector has declined by 23 percent over the past ten years. However, the number of women and persons over the age of fifty who work in the fisheries sector has increased, showing a trend of fewer young men entering this sector. Possible reasons for this are: the availability of alternative employment opportunities, limited opportunities for maintaining a satisfactory livelihood within the fisheries sector, difficulties in obtaining fishing permits, difficulties in accessing fishing grounds, the high cost of fishing and fishfarming, declining fisheries resources, and use of labour-saving devices and measures.

Table 4. Number of persons employed in the fisheries sector (1 000s)

		1985	1990	1991	1992	1993	1994
Total		260.3	211.8	204.6	206.6	206.6	197.8
Distribution by gender	Men	156.9	118.7	113.0	108.7	106.9	101.3
	Women	103.4 (39.7%)	93.1 (44%)	91.6 (44.8%)	97.9 (47.4%)	99.7 (48.3%)	96.5 (48.8%)
Distribution by age	15-19 yrs.	4.6	1.5	1.4	0.9	0.7	0.4
	20-49 yrs.	175.5	126.0	115.8	109.1	105.8	97.0
	Over 50 yrs.	80.2 (30.8%)	84.3 (39.8%)	87.4 (42.7%)	96.6 (46.8%)	100.1 (48.5%)	100.4 (50.8%)

Sources: MOMAF and NFA. Annual Report of Korean Fisheries 1996, 1994, 1993.

Table 5. Number of fishing vessels by tonnage

	1990	1991	1992	1993	1994	1995
< 1 mt	34 428	38 135	36 675	32 234	24 592	27 522 (35.3%)
1-5 mt	52 797	52 877	44 515	42 186	39 753	36 743 (47.2%)

5-50 mt	9 082	9 457	9 595	9 800	9 711	10 297	(13.2%)
50-100 mt	1 937	1 941	1 910	1 945	1 938	1 906	(2.5%)
100-200 mt	630	665	685	670	698	684	(0.9%)
>200 mt	784	773	755	638	699	716	(0.9%)
Total	99 658	103 848	94 135	87 473	77 391	77 868	(100%)

Sources: MOMAF and NFA. Annual Report of Korean Fisheries 1996, 1994, 1993.

The number of fishing vessels/boats increased considerably until 1991, reaching 103,848. But since then, the fishing capacity has been reduced. The number of vessels in 1995 was about 86 percent of the 1985 total, but total tonnage in 1995 was 118 percent of the 1985 total. Over 64 percent of the 77,868 vessels in 1995 were very small, i.e., less than 5 mt, and 13 percent were between 5 and 50 mt. Fewer than 2 percent of fishing vessels are over 50 mt. This may be explained by the fact that over 90 percent of the vessels are used for coastal fishing, aquaculture or inland fisheries. Fewer than 1 percent of fishing vessels are used for deep sea fishing.

The number of fishing households with powered vessels doubled in the 1980s, while the number of fishing households without powered vessels decreased drastically. Of the 104,000 families working in the fishery sector, about 34 percent fish with powered vessels; 33 percent are in aquaculture and 32 percent fish without fishing vessels.

Table 6. Number of fishing vessels by fishing activities

	Coastal fishing	Aquaculture	Inland fishing	Deep Sea fishing	Other	Total	Total powered	Total non-powered
1970							(20.6%)	(79.4%)
1980						77 574	51 113	26 461
1985	50 457	36 388	3 089	651	385	90 970	71 836	19 134
1990	57 648	37 831	3 057	783	339	99 658	79 365	20 293
1991	56 911	40 928	3 181	771	2 057	103 848	84 024	19 824
1992	55 795	31 734	2 967	734	2 905	94 135	76 825	17 310
1993	53 163	26 857	3 044	734	3 863	87 661	73 026	14 635
1994	50 061	21 483	2 501	616	2 730	77 391	70 082	7 309
1995	51 664 (66.4%)	20 408 (26.2%)	2 493 (3.2%)	637 (0.8%)	2 656 (3.4%)	77 858 (100%)	71 077 (91.3%)	6 781 (8.7%)

Sources: MOMAF and NFA. Annual Report of Korean Fisheries 1996, 1994, 1993.

Table 7. Use of fishing vessels by fishing households (1 000 households)

	Total	Households without vessel	Households with non-powered vessel	Households with powered vessel	Households in aquaculture

1980	134.1	46.4 (34.6)	14.3 (10.7)	17.5 (13.0)	55.6 (41.7)
1990	121.5	32.7 (26.9)	2.9 (2.4)	36.2 (29.8)	49.7 (40.9)
1991	119.7	31.4 (26.2)	2.8 (2.3)	36.6 (30.6)	48.9 (40.9)
1992	116.2	33.9 (29.2)	2.0 (1.7)	35.4 (30.5)	44.9 (38.6)
1993	113.6	33.8 (29.2)	1.8 (1.6)	35.2 (31.0)	42.8 (37.7)
1994	110.4	33.8 (29.7)	1.7 (1.5)	35.5 (32.2)	39.5 (35.8)
1995	104.4	33.4 (32.0)	2.0 (1.9)	35.1 (33.6)	33.9 (32.5)

Sources: MOMAF and NFA. Annual Report of Korean Fisheries 1996, 1994, 1993.

Fishery production increased impressively until the mid 1980s, peaking early in the 1990s. Since then, production has leveled off. Important species of fish produced are anchovy, mackerel, hairtail, yellow corvenia, squid, Alaska pollock, tuna, croakers, Pacific saury, crab, akiami paste shrimp, shellfish such as oysters, abalone, cockles and top shells, and seaweeds such as laver, seamustard and fusiforme.

Table 8. Fisheries production (1 000 mt)

	Total production	Coastal fisheries	Inshore fisheries	Deep-sea fisheries	Aquaculture	Inland fisheries
1970	935	455 (48.7%)	271 (30%)	90 (9.6%)	119 (12.7%)	-
1975	2 135	819	390	566	351	9
1980	2 410	803 (33.3%)	569 (23.6%)	458 (19%)	541 (22.5%)	39 (1.6%)
1985	3 103	838	657	767	788	53
1990	3 275	798	744	925	773	35
1991	2 983	801	503	874	775	30
1992	3 289	759	536	1 024	936	34
1993	3 336	899	627	741	1 038	31
1994	3 477	921	566	887	1 072	31
1995	3 347	814	611	897	997	29
Value (in 10^9 Krw)	41 224	24 794		8 860	6 480	1 090
% increase between 1985-95	7.9	-3.0	-7.0	16.7	26.5	-45.0
Average during 1991-95	3 286 (99.9%)	837 (25.5%)	569 (17.3%)	885 (26.9%)	963 (29.3%)	31 (0.9%)

Sources: MOMAF and NFA. Annual Report of Korean Fisheries 1996, 1994, 1993.

Table 9. Production by key species

(Unit in mt)

	1989	1990	1991	1992	1993	1994
Common carp	7 299	10 778	8 416	13 213	11 529	14 137
Yellow striped flounder	15 856	13 204	13 143	14 631	13 505	13 343
Alaska pollock	385 394	321 496	197 788	335 422	226 098	31 1574
Whitespotted conger	23 368	22 053	22 337	24 163	29 882	2 1703
Large yellow croaker	12 698	15 091	20 199	24 122	20 680	2 6613
Yellow croaker	18 575	27 890	37 422	39 672	31 119	3 7488
Croakers, drums nei	53 291	65 287	80 859	69 502	88 381	9 2625
Porgies, seabreams, nei	12 424	19 028	19 406	17 801	14 772	1 6879
Atlantic redfishes	29 678	14 866	5 761	15 215	3 687	-
Threadsail filefish	159 104	230 252	70 454	34 872	11 365	4 382
Pacific saury	3 367	23 103	29 034	34 153	40 889	35 082
Japanese jack mackerel	22 969	17 376	16 259	27 715	38 095	38 433
Japanese sardinella	7 280	4 205	4 463	3 597	24 383	23 974
Japanese anchovy	131 855	168 101	170 293	168 235	249 209	193 398
Skijack tuna	80 958	138 491	171 975	115 295	73 993	145 541
Yellowfin tuna	53 454	56 473	69 344	83 816	67 520	64 825
Bigeye tuna	30 936	33 940	23 301	25 202	24 840	30 604
Largehead hairtail	102 399	103 970	95 662	87 325	58 035	101 052
Chub mackerel	163 667	97 232	91 557	116 425	174 798	211 233
Gazami crab	28 753	23 415	18 729	17 317	10 419	21 483
Marine crab	21 539	30 316	34 767	30 000	40 620	56 552
Akiami paste shrimp	21 493	24 568	18 138	29 348	24 324	18 510
Natantiam decapods nei	24 215	26 964	24 042	25 305	35 180	29 614
Pacific cupped oyster	256 262	235 276	231 936	252 852	286 427	193 023
Korean mussel	14 181	15 506	15 993	15 992	57 454	42 495
Ark clams	23 572	18 773	17 512	21 461	12 166	14 247
Cattlefishes	19 796	17 623	11 253	7 471	7 150	4 469
Japanese carpet shell	83 843	74 608	58 133	67 418	41 248	33 630
Japanese flying squid	65 885	75 293	109 902	139 792	222 009	191 857
Marine molluscs nei	15 945	15 288	17 544	18 198	23 769	20 303
Sea squirts nei	2 4643	20 990	7 216	5 099	14 325	45 000

Source: FAO. Fishery Statistics Yearbook 1994, Catch and Landing. Vol. 78.

The Republic of Korea’s fishery supply and demand amounted to about 4.6 million mt in 1995. Demand can be divided into 3.5 million mt for domestic consumption and 1.1 million mt for export. Approximately 78 percent of the supply (i.e., 3.6 million mt, including about 0.4 mt of carry-over from the previous year) was produced domestically, and approximately 1 million mt were imported in 1995.

Marine capture fisheries

Coastal Fisheries – The Republic of Korea's long coast lines and peripheral waters that contain a mixture of warm and cold waters, provide favorable living conditions for a variety of aquatic species. Coastal fishing expanded into the South Sea in the 1960s and to the Yellow Sea, East China Sea and East Sea in the 1970s. Key species caught from the coastal waters included anchovy, squid and mackerel.

Coastal fisheries play two important roles: they serve as a major income source for small-scale and subsistence-level fishing households, and supply high-quality fishes for domestic consumption. Fishing activities have been a way of life for many coastal communities, but commercial fisheries have been developing since the 1960s. With the modernization of fishing vessels in the 1970s and 1980s, the fishing efforts in the coastal waters increased drastically. However, production from coastal fishing has leveled off since the mid 1980s. Coastal fisheries provided 79 percent of total fishery production in 1970, 56 percent in 1980 and 43 percent in the 1990s.

It is generally recognized that the coastal fisheries resources have been utilized to full capacity, so that fishing effort now is not commensurate with the regenerative capacities of the resources. Additionally, the coastal fisheries resources are adversely affected by the loss of habitats and environmental degradation and contamination caused by various human activities both on land and in the seas. One indication of environmental damage is the incidence of harmful algal blooms. The cost of rehabilitation of damage by algal blooms in 1995 was estimated at approximately US$ 100 million.

Table 10. Number of reported harmful algal blooms

	1980	1985	1990	1991	1992	1993	1994	1995
No. of incidents	5	7	41	40	25	38	29	65

Sources: MOMAF and NFA. Annual Report of Korean Fisheries 1996, 1994, 1993.

Deep Sea Fishing - Deep sea fishing by the Republic of Korea began with tuna fishing in the Indian Ocean in 1957. Until the late 1970s, the output of tuna fishing and squid fishing steadily increased.

The enforcement of international maritime laws (UNCLOS) affected deep sea fishing. In particular, in 1977, the USA and the Russian Federation proclaimed 200-mile Exclusive Economic Zones, prompting many other nations to enact similar declarations to ensure full benefits from the marine resources in their EEZs. This inevitably led to reduction of fishing areas. Nations also began demanding expensive fishing permit fees, the landing of catches at their national ports for processing or export, and other controlling measures. Deep sea fishing fleets of the Republic of Korea thus found themselves in a rather unfavorable position. To deal with it, the Government intensified its efforts in international fisheries cooperation with a number of coastal states, including negotiations for potential fishing areas and joint fisheries development and management. It also encouraged rationalization of the deep sea fishing industry.

At the end of 1995, a total of 637 vessels operated in five oceans, catching mainly tuna, squid, anchovy and shrimp for domestic consumption and export. Deep sea fishing accounted for about 26.8 percent of the total catch in 1995.

Inland capture fisheries

Inland water makes up about 2 percent of the total area of the Republic of Korea, and produces about 15 types of fishes, including eel, trout and Israeli carp. Production from inland fisheries in 1995 was about 29,000 mt, less than 1 percent of total fisheries production. However, inland or freshwater aquaculture is becoming more common. Aside from providing places for fisheries production, inland water fisheries also provide recreational opportunities, thus contributing to the local economy.

Aquaculture

Cultivation Fisheries - Cultivation fisheries is an industry in which fish fry are produced and reared in hatcheries, released into a natural environment, and then caught for consumption. Cultivation fisheries has primarily been implemented at the eleven fishery cultivation centers currently in operation. These centers undertake technology research for the production, release and reproduction of fish fry.

Aquaculture - Aquaculture is of great importance, particularly since the introduction of 200-mile EEZs by many coastal nations. In recent years, emphasis in fisheries policy of the Republic of Korea has shifted from capture fisheries to culture fisheries. Through technical innovations, aquaculture has expanded rapidly, and the application of culture techniques has diversified into various species groups, i.e., development and expansion of seaweed culture in the 1960s, shellfish culture in the 1970s and finfish culture in the 1980s. Current strategies for aquaculture development include infrastructure development for mass production of seeds; intensified efforts in stock enhancement and inland aquaculture; promotion of local specialty species; genetic improvement and conservation; culture species diversification; and development of culture technologies and systems, including integrated farming systems.

Table 11. Aquaculture production by major species (mt)

	Fish	Shellfish	Others	Subtotal*	Seaweed
1985	3 745	369 722	19 575	393 042	397 498
1990	17 934	326 447	32 302	376 683	411 882
1991	16 939	308 322	16 968	342 229	445 538
1992	24 343	339 438	11 726	375 507	579 970
1993	23 760	346 072	22 343	392 175	664 328
1994	27 445	264 753	50 587	342 785	750 206
1995**	28 725	312 250	26 740	367 715	649 100

Source - FAO. Aquaculture statistics 1985-94.

* Total of fish, shellfish and other aquatic animals.
** Source. MOMAF. Annual Report of Korean Fisheries 1996.

At the end of 1995, some 40 fish species were being cultured in a total of 1,067 ha of inland waters and 109,000 ha of coastal waters and contributing about 30 percent of total fisheries production. It is interesting to note that nearly 60 percent of coastal culture areas are used for seaweeds, followed by 37 percent for shellfish; the area used for culture of fish is only about 2 percent. In terms of ownership, 49 percent (4,294 business units) were operated by communities or fisheries cooperatives; 26 percent (2,307 units) by corporations and 25 percent (2,169 units) by individuals.

Table 12. Coastal areas used for aquaculture (in ha)

	1985	1990	1991	1992	1993	1994	1995
Fish	216 (0.2 %)	1 260 (1.1%)	1 196 (1.1%)	1 281 (1.2%)	1 348 (1.2%)	1 512 (1.4%)	2 234 (2.1%)
Shellfish	43 471 (44.9%)	40 071 (35.5%)	38 981 (35.6%)	38 520 (35.6%)	38 654 (35.5%)	39 390 (36.3%)	40 365 (37.1%)
Seaweed	51 547 (53.2%)	68 428 (60.5%)	66 109 (60.5%)	65 503 (60.5%)	66 091 (60.6%)	64 856 (59.7%)	62 807 (57.7%)
Other	1 651 (1.7%)	3 267 (2.9%)	3 096 (2.8%)	2 937 (2.7%)	2 942 (2.7%)	2 879 (2.6%)	3 356 (3.1%)
Total	96 885	113 026	109 382	108,241	109 035	108 637	108 762
Owned by communities or fisheries cooperatives	58 350 (60%)	78 698 (70%)	74 114 (68%)	74 249 (69%)	76 481 (70%)	76 772 (71%)	77 885 (71%)
Owned by individuals or corporations	38 535 (40%)	34 328 (30%)	35 268 (32%)	33 992 (31%)	32 554 (30%)	31 865 (29%)	30 877 (29%)

Sources: MOMAF and NFA. Annual Report of Korean Fisheries 1996, 1994, 1993.

To further develop this sector and efficiently implement the coastal development plan, the Fishery Act was revised in 1991. However, aquaculture is severely affected by environmental degradation and pollution caused by both land and marine sources, tideland reclamation, intensified culture, the high density of fishfarms, and inadequate management of the aquaculture environment. At the same time, concerns were raised about the impact of coastal aquaculture on fish habitats, particularly spawning and nursery grounds.

Fishing ports and markets

Fisheries is different from other sectors in that it depends on nature for much of its production. It is difficult to schedule and/or plan its production as is normally done in manufacturing industries. This requires careful monitoring of pricing policy, supply and demand, and well-coordinated distribution systems, including processing and storage facilities. An added dimension is that with increasing production of fish food and growing demand for variety in processed fishery products, it is expected that the quantity and variety of processed fishery products will continue to grow. To ensure the quality of fishery products, standardized packaging and a product quality certification system have been implemented, laying the basis for the Hazard Analysis Critical Control Points (HACCP) system.

To facilitate efficient distribution and hygienic handling and processing, fisheries cooperatives, in collaboration with the government, have upgraded and improved facilities of fish markets at the production/landing sites and transportation facilities, including waste water treatment facilities. At the same time, direct marketing is promoted in order to reduce delay in delivery and involvement of middlemen, thus increasing the income of the producers. Wholesale markets for direct marketing are being developed in several locations around the country.

Table 13. Number of fishing ports

	Total	Completed by 1994	To be completed in 1995
Total	415	86	10
Type 1 & 3 (managed by the MOMAF)	89	48	(4)
Type 2 (managed by local government)	326	38	6

Sources: MOMAF. Annual Report of Korean Fisheries 1996.

Fishing ports serve as the first connecting point in the fish food delivery and distribution channel, and are the points around which the life of fishing communities centres. Therefore, well-functioning fishing ports are considered essential not only for fisheries, but also for the well-being of fishing and fishfarming communities. Efforts have been directed to the development of comprehensive fishing ports that encompass all basic facilities and functions, from maintenance of fishing vessels and gear, landing of catches, and quick processing, to transportation, distribution, information dissemination, and communication. There are 415 designated fishing ports being developed and improved.

Approximately 75 percent of the production from coastal waters has been processed, yielding mainly frozen, dried, canned and other such products.

Since 1962, the export of fisheries products has increased, but the relative proportion of fisheries exports to total national exports has been decreasing. In the 1960s, fisheries exports amounted to 20 percent of total national exports. In 1995, it represented only 1.4 percent of total exports, or about US$ 1.72 billion. On the other hand, with the increase in personal income, there is increasing consumer demand for diversified high-quality fish products that are suitable for the changing life style. As production from national waters stagnates, imports of fishery products have been increasing (more than doubled) during the past five years, and the margin between export earnings and import spending is being narrowed.

Table 14. Export and Import of fishery products

	1980	1985	1990	1991	1992	1993	1994	1995
Export (volume in 10^3 mt)	376	432	455	492	437	371	385	437
(value in US$ 10^6)	871	891	1 513	1 643	1 518	1 497	1 647	1 721
Import (volume in 10^3 mt)	47	91	286	366	328	356	381	416
(value in US$ 10^6)	37	83	368	576	506	542	726	843

Sources: MOMAF. Correspondence.

Presently, the Republic of Korea exports fishery products to over 70 countries, with 90 percent of the products going to Japan, the USA, the People's Republic of China, Spain, Thailand, France, Italy and Taiwan Province of China. At the same time, fishery products are imported from some 60 countries, with over 67 percent coming from the Russian Federation, the USA, the People's Republic of China, Japan, and Argentina.

5. Contribution to Food Security

5.1 As Food

As the Republic of Korea is a coastal nation, fish, along with rice and vegetables, has been one of the main staples of its people. However, there has been a marked shift in the food consumption pattern of the people of the Republic of Korea. Per-caput consumption of rice, the main staple, declined to 114.5 kg in 1992 from 130.4 kg in 1970, a decline of about 6.7 percent. During the same period, consumption of meats increased 3.4 times, dairy products 17 times, fish 2.4 times, fruits and vegetables 2.5 times, and oil and fats 9 times.

Table 15. Annual food consumption (in kg)

	Rice	Fruits & vegetables	Meat	Dairy Products	Fish*	Oils & fats
1970	130.4	69.9	8.3	1.8	17.3	1.5
1975	119.8	76.5	9.3	4.4	29.9	2.7
1980	132.9	136.8	13.9	10.8	27.0	5.0
1985	128.0	125.2	16.5	23.1	37.2	9.2
1990	120.8	161.6	23.6	31.8	36.2	14.3
1992	114.5	173.5	27.5	32.0	40.5	13.9
1993	113.7	188.6	28.6	34.8	43.3	13.3
1994	112.6	175.8	28.8	32.8	44.8	13.9

* All fishery products, including shellfish and molluscs.

Source: Park, S. K. and M. S. Chung. 1994. Consumption Pattern of Fishery Products and Supply Projection. Korean Rural Economic Research Institute. 44 pp. MOMAF. Correspondence.

Table 16. Daily protein consumption (in grams)

		1970	1975	1980	1985	1990	1992	1993	1994
Vegetable protein	Grain	40.19	40.44	36.93	41.41	38.41	38.26	36.99	37.90
	Root crop	8.18	8.87	8.91	10.14	9.49	9.26	8.87	10.13
	Others	6.12	6.61	7.62	6.53	8.22	9.12	10.36	10.13
	Subtotal	54.49	55.92	53.46	58.08	56.12	56.64	56.22	58.16
Animal protein	Meat	4.07	4.90	9.49	12.08	17.25	18.36	19.45	19.79
	Fish*	6.59	10.31	10.66	16.44	15.88	15.19	16.04	16.52
	Others	n/a	n/a	n/a	0.01	0.02	0.02	n/a	n/a
	Subtotal	10.66	15.21	20.15	28.53	33.15	33.57	35.49	36.31
Total		65.15	71.13	73.61	86.61	89.27	90.21	91.71	94.55

Source: MOMAF. Correspondence.

In terms of protein consumption, while consumption of vegetable protein has remained relatively stable at approximately 56 g/day, consumption of animal protein has increased significantly over the past two decades. Fish was the main source of animal protein; in the 1970s fish provided about 2/3 of the animal protein in the diet. With the increase in personal income in the 1980s, protein intake increased significantly and so did the popularity of red meats. Consequently, consumption of meats surpassed that of fish in 1989. However, it should be noted that although the relative contribution of fish to animal protein intake declined to 45 percent in 1995, the quantity of fish food consumed per person was increasing, reaching about 45 kg/person/year in 1995. The per-caput consumption in the Republic of Korea is about 3.5 times the world average of 13 kg and 1.9 times that of Southeast Asia which is known as the major fish-eating region of the world.

Table 17. Annual fish food consumption pattern by type (in kg)

	1970	1975	1980	1985	1990	1991	1992	1993	1994
Total	17.3	29.9	27.0	37.2	36.2	35.9	40.5	43.3	44.8
% increase		72.8	-9.7	37.8	-2.7	-0.8	12.8	6.9	3.5
Fish	14.7	24.6	22.5	30.7	30.5	28.9	29.7	31.6	32.5
Shellfish & seaweed	2.6	5.3	4.5	6.5	5.7	7.0	10.8	11.7	12.3

Source: MOMAF. Correspondence.

In the 1990s, the fish food consumption of the people of the Republic of Korea has increased at an annual rate of about 5.6 percent. However, it is interesting to note that consumption of shellfish and seaweed has increased at a much higher rate (about 22.6 percent annually) than that of fish (about 1.7 percent annually). On the basis of the above statistics, one can project that fish food consumption could reach about 60 kg/caput/yr by 2000.

5.2 As Employment/Income

In addition to providing fish food, fisheries is an important source of income for over 100 thousand fishing and fishfarming households and nearly 200 thousand people working in fishing and fishfarming. It should be noted that the economic activities generated by fisheries would be much higher if secondary industries such as post-harvest processing, marketing, and other supporting industries were included.

In terms of the fisheries contribution to employment, while the total value of fishery production has increased, the number of persons directly engaged in the fisheries sector has decreased. Since 1970, the population has increased by 38 percent, while the number of fishing households has decreased by 47 percent and the number of persons in fishing households has decreased by 70 percent. Similarly, employment in the fisheries sector decreased by 24 percent between 1985 and 1994 (see Table 4). This indicates a significant manpower drain from fisheries to other sectors.

Table 18. Population and number of fishing households (1 000s)

	1970	1980	1985	1990	1991	1992	1993	1994	1995
Total population	32 241	38 124	40 806	42 869	43 268	43 663	44 056	44 453	44 606
Fishing Households	195	157	145	122	120	116	114	110	104
Persons in Fishing Households	1 165	894	844	689	496	425	405	382	347

Source - MOMAF and NFA. Annual Report of Korean Fisheries. 1996; 1994; 1993.

In 1994, fishing was the principal occupation of about 22 percent of the fishing households, and 78 percent of the fishing households combined fishing with other occupations such as agriculture, commerce and office work. In terms of types of fishing activity, 32.5 percent of fishing households were engaged in aquaculture; 35.7 percent in fishing using vessels and 32 percent in fishing without vessels.

A variety of actions has been implemented to improve the socioeconomic conditions of fishing and fishfarming communities, particularly through the Semaul Movement and development of small-scale fisheries in the 1970s. However, national priority was given to the development of high-growth industries and large urban areas where the population density is much higher. The statistics show that while the income of fishing households increased significantly over the years, it still lags behind the incomes of farm and city households. It has also been pointed out that within the fisheries sector, the income levels vary widely, depending upon the location of fishing communities, e.g. remote islands, mainland, close to urban areas.

Table 19. Income of fishing households (1 000 Krw)

	1985	1990	1991	1992	1993	1994	1995
Fishing households	4 869	10 023	11 309	12 371	14 432	17 110	18 780
Increase		(106%)	(12.8%)	(9.4%)	(16.7%)	(18.6%)	(9.8%)
Fisheries	2 815	5 216	5 285	6 036	6 222	8 665	9 437
Other sources	1 553	3 192	3 776	4 217	4 685	5 719	6 075
Transferred income	501	1 615	2 248	2 118	3 525	2 726	3 268
Farm (agriculture) households	5 736	11 026	13 105	14 505	16 928	20 316	21 803
City households	7 172	11 319	13 903	16 273	17 734	20 416	22 933

Source: MOMAF and NFA. Annual Report of Korean Fisheries. 1996; 1994; 1993.

Consequently, a number of social issues have emerged in fishing and fishfarming communities. The key issues include: (i) a decline in the number of persons employed in fisheries; (ii) difficulty in recruiting young male employees; and (iii) difficulty in recruiting or maintaining educated and skilled personnel (see Table 4). These issues will have serious implications for the development of the fisheries of the Republic of Korea so as to meet the growing demands for diversified, quality fish food suitable for the changing life style of the newly industrialized country.

5.3 Supporting Economic Wealth

The main factors affecting food consumption are availability, relative price, income, culture, changes in social conditions, e.g. growth and composition of population, lifestyle and family structure, and general awareness of health issues. Historically, fisheries expansion relied upon a growing population and increased demand for fish food. The population growth of the Republic of Korea has been only about 0.8 percent per year in the 1990s and it is expected that the growth rate will remain low.

The trend is that with increased personal income, there is more health consciousness and demand for high-quality fish food suitable for a busy life style. As fish gains a reputation for being an important health food, the demand for fish is expected to remain high and/or grow.

Table 20 Projection of supply and demand of fishery products

	Population*	Supply			Total	Demand		
		Production	Import	Carry over from		Domestic use	Export	Carry over to
1995**	44 606	3 348	948	395	4 691	3 150	1 170	371
1996**	45 248	3 244	1 205	371	4 820	3 202	1 191	427
1997***	45 642	3 244	1 189	427	4 860	3 187	1 193	480
2001****	46 789	3 420		500	5 000			
2011****	49 683	4 000			6 000			

* Source - National Statistical Office. Social indicators in Korea, 1994.
** Source - Ministry of Maritime Affairs & Fisheries. 1997 Annual Report. P.288.
*** Source - Ministry of Maritime Affairs & Fisheries. Basic Fishery Statistics. 1998. P.93
**** Source - Ministry of Maritime Affairs & Fisheries. Vision for 21 Century: Maritime Affairs & Fisheries Development Strategies. 1997. P.24.

Assuming that fish consumption remains at the current rate of 45 kg/caput/yr, the Republic of Korea will require about 2,500 mt to meet the domestic need in 2010. However, if per-caput fish consumption is increased to 60 kg, the Republic of Korea will need about 3,300 mt in 2010. This means that it needs to maintain fishery production at the current level of about 3,300 mt per year. However, the quantity of imports has to be increased if the level of exports is to be maintained or increased. Any amount that can be produced beyond domestic requirements will contribute to the global availability of fish food.

6. Role of Public and Private Sectors

6.1 Political Commitment and Government Intervention

Fisheries has been an integral part of the economy of the Republic of Korea. Development and management of the fisheries sector require the concerted efforts of both the public and private sector. The government has played and will continue to play an important role in making decisions on what choices are made in managing and utilizing aquatic resources, and ensuring sustainable availability of affordable fish food.

In the past, government policies were directed toward the development of fishing capacities and infrastructure, development and extension of fishery technologies, and development of fishing and fishfarming communities. In general, the past approaches achieved maximum utilization of fisheries resources without due consideration of environmental degradation and uncontrolled utilization of fisheries resources. This policy direction was based on the assumptions that the seas have unlimited capacity to absorb wastes and pollutants, and that fisheries resources have unlimited regenerative or renewable capacities and are unaffected by environmental degradation and pollution. Experience has shown otherwise.

Learning from experience, the Republic of Korea Government has taken a number of management measures that aim to facilitate rational utilization of fisheries resources, conservation of the aquatic environment and improvement of the livelihood of fishing and fishfarming communities, thus ensuring sustainable availability of fish food.

The 1996 fisheries policies of the Republic of Korea were oriented toward:

(a) management of aquatic environment and rehabilitation of fisheries resources;

(b) empowerment of fishermen and fishfarmers as special resource managers; and

(c) development of holistic fishing and fishfarming communities. The basic strategies adopted to achieve the policy objectives included:

- management of fisheries resources;
- conservation and protection of the aquatic environment;
- restructuring the capture fisheries sector and strengthening culture fisheries;
- integrated coastal and infrastructure development, including holistic development of fishing and fishfarming communities;
- improved distribution and marketing channels and strengthening management capacities for import and export;
- strengthening international cooperation and fishery diplomacy;
- development and transfer of practical fishery technologies, including motivating young people in the fishing and fishfarming communities to enter into and become future leaders in fishery industry, and skilled and specialized human resources; and
- review and reform of fishery legislation and regulations.

Specific measures that were introduced in 1996 included:

- management of aquatic environment, including removal of wastes and sources of aquatic pollution;
- promotion of community-based fisheries management, and designation of protected and special areas for management;
- establishment of mechanisms for management of environmental disasters such as harmful algal blooms and oil spills;
- rehabilitation of fishery habitats and enhancement of natural stocks with cultured stocks;
- promotion of aquaculture through ensuring availability of inputs such as seeds and feeds, and use of recommended culture practices;
- development of inland fisheries;
- reduction and maintenance of fishing capacity that is consistent with the abundance of fisheries resources;
- monitoring and prevention of illegal fishing;
- revision of import/export regulations dealing with fishery products;
- improvement and enforcement of safety regulations and working conditions;

- holistic development of fishing and fishfarming communities, particularly development of secondary industries such as processing, manufacturing, recreational facilities and tourism;
- human resource development in such areas as production systems and technologies, business, maintenance of facilities and equipment;
- infrastructure development, e.g., fishing ports, markets and hatcheries;
- revision and updating of fisheries legislation and regulations;
- stabilization of fish price and supply by improved marketing and regulating supply and demand;
- product development and quality control; and
- promotion of international and regional cooperation in resource management and utilization through active participation in the regional and international fisheries bodies, and bilateral cooperation and collaboration.

The most significant recent action was the consolidation of all government agencies concerned with use of aquatic resources under the Ministry of Marine Affairs and Fisheries (MOMAF). By consolidating the related agencies, the newly-established Ministry aims to improve coordination and harmonization of all ocean-related policies and functions, ensuring environmentally sound and socially responsible utilization of living and non-living aquatic resources. The new Ministry is committed to investing its full resources in stabilizing the supply and demand of fishery products, developing economically and socially viable fishing and fishfarming communities, and sustainable management of aquatic resources.

Many of the difficulties in the fisheries sector are closely related to some of its unique characteristics, e.g. open access and common property nature, production and harvest depending on nature and availability of natural stocks, and the resulting uncertainties in quantity and variety of available fishes. To reduce the uncertainties in fishing and to tackle the issue of declining abundance of fisheries resources in the coastal waters, the new fisheries policy has promoted integrated coastal area development and "culture" fisheries rather than "fishing". The inshore and coastal fishing areas are gradually being converted into community-managed coastal ranching areas, where capture fisheries and culture fisheries coexist. Since sustainable fisheries is closely related to the well-being of fishing and fishfarming communities, the government policies also promote comprehensive development of these communities, where the production sector and the post-harvest processing and service sectors coexist.

In order to promote the concepts of "resource users as resource managers" and community-based management of fisheries resources that encourages active participation of fishermen, fishfarmers and local communities, many management and development responsibilities are being transferred to the provincial and local levels. The policy objectives are to promote participatory management; stimulate fisheries development that takes advantage of local characteristics, suitability, capacity and specialty; and improve management effectiveness by being more responsive to local needs.

The related actions are streamlining fisheries regulations and procedures, and delegation of authority and responsibilities to non-governmental organizations to encourage self-governance.

6.2 Role of the Private Sector

The private sector in the fisheries of the Republic of Korea consists of small-scale, family-owned operations mainly involved in fishing and fishfarming. A small number of medium and large-scale industries are involved mainly in deep sea fishing and post-harvest processing. The private sector is represented mainly by three types of cooperatives - local cooperatives of small-scale, family-owned producers; business cooperatives; and manufacturers' cooperatives. These form a central national fisheries cooperative, i.e. the Nation Federation of Fisheries Cooperatives, which works closely with the government to formulate and implement fisheries development and management policies.

Government interventions are mainly concerned with the formulation and implementation of policies relating to management and rational utilization of fisheries resources, including development research, development of infrastructure and human resources, formulation and enforcement of fisheries legislation and regulations, and management and development of the fisheries sector. The policies are often targeted to the private sector, which is frequently the main channel for policy implementation.

6.3 Inter-country Cooperation

To facilitate successful implementation of various international laws and regulations governing utilization and conservation of aquatic resources, and to contribute to global efforts towards sustainable development and environmental management, the Republic of Korea has increased its participation in international fishery organizations and bodies. Presently, it is a member of 11 international fisheries organizations (APFIC, COFI/FAO, IOFC, CECAF, ICCAT, WECAFC, IWC, CCAMLR, NAFO, PICES and IOTC) and has fisheries agreements with 13 countries.

Open access and the common property nature of fisheries require joint and collaborative management efforts among the countries that share the same resources. Efforts are underway to intensify the scientific cooperation with other countries that is essential for development of a common fisheries management framework. Fisheries diplomacy is being intensified to secure access to fishing grounds and for the responsible use of living aquatic resources for food and other essential needs of the society. Consideration is also being given to strengthening international cooperation in training.

6.4 Cooperatives and Fisheries Associations

Although cooperatives play an important role in distribution and marketing, concerns have been expressed about their effectiveness in responding to the needs of their members. Possible causes for this concern include the non-homogeneity in their memberships, the appointment system used to place key administrators, and a centralized management system. It should be noted that the National Federation of Fisheries Cooperatives consists of local and business cooperatives that have diversified needs and interests. Suggestions have been made to improve management effectiveness. They include restructuring or regrouping cooperatives to make them more representative of their members; reduction of top-heaviness in the organizations; and a more responsive and participatory management system. It also has been suggested that the fisheries cooperatives need to strengthen their role and provide leadership in technology transfer and training, management of fishing grounds, including fisheries resources and environmental aspects, and welfare of fishermen and fishfarmers.

Additionally, there are several professional and trade organizations that represent the private sector. Associations such as the Korean Fishing Vessels Association, the Association of Korean Fishing Ports and the Korean Deep Sea Fisheries Association, not only promote the interests of their members, but also facilitate implementation of the policies and regulations governing their industries. To improve efficiency and effectiveness in management of the fisheries sector, the trend in government policy is to reduce government bureaucracy and promote self-governance. The recent reorganization of the fisheries sector included decentralization of the central government functions and delegation of responsibilities and authority to professional and trade organizations. In this context, the role of the government is to facilitate the transfer of functions, including development of the capacities and capabilities of the private sector to respond to needs of their members and contribute to coherent and coordinated development and management of the fisheries sector.

7. Policy Framework for Sustainable Contribution to Food Security

It has been shown that Korea need not have an immediate concern about meeting domestic demand for fish food. Nonetheless, a sustainable supply of fishery production is important to protect income and employment in rural fishing and fishfarming communities and secondary industries, and to contribute to global availability of fish food.

7.1 Policy Issues

The fisheries sector has made significant progress in supplying fish food for domestic consumption and the expanding export market over the past three decades. However, the past strategies based on intensified investment in fishing efforts and lack of attention to management of fisheries resources and their habitats have resulted in a decline in abundance of fish stocks, causing stagnation in production quantity and change in composition of the catch in the 1990s. From the brief review of the fisheries sector presented above, one can observe the following:

- The fisheries sector continues to dominate the national supply of animal protein, although other meat and non-meat products have claimed a larger share of consumer diets. Fish food is considered as health food, and there is a growing demand for high-quality and diversified fish products that are suitable for the changing lifestyle.

- Fisheries resources have been used to near or total capacity in the coastal waters of the Republic of Korea. There has been a decline in overall abundance of fish stocks in the adjacent waters due to a variety of causes: overfishing, habitat loss and deterioration, marine pollution and use conflicts. Rational utilization of fisheries resources, rehabilitation of fish habitats and conservation of the aquatic environment are urgently needed to ensure a sustainable fish supply.

- There has been substantial modernization of small-scale fisheries within the 12 n.m. territorial waters. However, this sector remains at a subsistence level due to the large number of fishing units, the decline in fisheries resources, and increasing cost of labor and equipment. While this sector is expected to supply high-quality fish for local markets, the fishing capacity is largely related to the abundance of the stocks.

- Production from deep sea fisheries has also declined due to overfishing and competition with other neighbouring countries.

- Implementation of EEZs by many coastal nations has significantly reduced access and increased the cost of reaching fishing grounds. This has resulted in substantial shifts in fisheries operations from coastal state EEZs to nearby waters and the high seas. Access arrangements to fishing grounds have been made with several coastal countries that have surplus fish stocks. However, fishing of straddling stocks has met with considerable resistance, and further difficulties are foreseen with the recommendations of the UN Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks.

- Aquaculture has expanded considerably, with the expansion of seaweed culture in the 1960s, shellfish in the 1970s, finfish in the 1980s, and shrimp, prawns and crab in the 1990s. With the decline in abundance of the natural stocks, aquaculture is expected to fill in the gap between supply and demand. However, further increase in aquaculture production is closely related to successful prevention of environmental contamination and pollution, and management of the aquaculture environment.

- The number of persons employed in the fisheries sector has declined, but the ratios of women and persons older than 50 years are increasing, indicating that the fisheries sector is not able to attract young men at the same rate as older ones. Preventing further manpower drain is of strategic importance to sustainable fisheries.

- Income of fishing households remains lower than that of city and farm households. Development of economically and socially viable fishing and fishfarming communities is fundamental to strong and stable fisheries in the Republic of Korea.

- With stagnating fisheries production and increasing demands for high-quality fish products by domestic consumers, the import of fisheries products has increased significantly over the past five years. The demand for imports is expected to grow.

- The Republic of Korea had a comparative advantage in the past with the low labor cost of harvesting and processing. However, labor is becoming increasingly scarce and expensive. The current international trade arrangement under the WTO may have a substantial impact on the Republic of Korea’s fisheries imports and exports.

- There are increasing environmental concerns, such as the impact of pollution from both land and sea sources, tideland reclamation, destruction of coastal fishing waters, and loss of spawning and nursery areas. Intensification of culture systems and high density of fishfarms are added concerns.

- In recent years, fisheries management efforts have stressed greater commitment to managing declining fisheries resources, protection of employment and income of small scale fisheries, and adjusting fishing capacity to availability of fish stocks. However, the results of the management efforts to date have been modest.

7.2 Resolution of the Above Policy Issues

The government must continue to play an important role in making decisions on the management and utilization of aquatic resources, and ensuring sustainable availability of affordable fish food. With full commitment to sustainable fisheries, the Republic of Korea initiated and implemented a variety of policies and management measures, addressing challenges confronting the fisheries sector. However, given the urgency of targeting actions for environmentally sound and socially equitable fisheries, it is necessary to intensify the existing efforts, emphasizing the following aspects:

i) Policies that are oriented to management and protection of fisheries resources. It should be stressed that sustainable development and management of fisheries resources requires three basic actions. They are: (a) regulation of discharge of wastes and pollutants so that discharge does not exceed the capacity of the water body to self clean; (b) prevention and control of activities that are harmful to fish habitats; and (c) use of fishing effort that is consistent with the regenerative capacity of fisheries resources.

ii) Integrated coastal area development must take into account needs of fisheries as well as other industries.

iii) Market policy must take into account changing consumer demands and secure a supply of high-quality and diversified fisheries products to satisfy domestic needs.

iv) Effective mechanisms are needed that ensure a market for locally-produced fisheries products at fair prices, and availability of fish for special groups such as the aged and poor.

v) Strategies are needed for increased import of raw materials and reduction of labor cost.

vi) Strategies are needed to promote commercial/private technology development, i.e. development of technologies for the private sector, and establishing appropriate technology transfer mechanisms.

vii) Policies that facilitate holistic fishing and fishfarming community development are needed.

viii) Measures are required that encourage community-based management of fisheries and transfer of management authorities, budgets and responsibilities to the local governments.

ix) Promote growth of professional, trade and other non-governmental fisheries bodies, and accelerate participation of the private sector in development and management of the fisheries sector.

x) Human resource development and technology transfer, including prevention of manpower drain and development of skilled and specialized manpower, are needed.

xi) Harmonize national legislation and regulations with international regulations and guides.

xii) Set up policies that promote international cooperation and collaboration in management and utilization of fisheries resources, including collaborative research in such areas as population dynamics and stock assessment that can provide a basis for formulating a common management framework.

xiii) Set up policies that facilitate targeted, policy-relevant and problem-solving research, and development of a comprehensive fisheries information programme.

8. Summary and Conclusions

The most important consideration for the fisheries sector of the Republic of Korea is to align and harmonize its policies with: (a) the national economy that is going through a major transition from a centralized, government-directed/driven system to decentralization, privatization and participatory management, and (b) with various international laws, regulations and guidelines aiming to conserve fisheries resources.

It should be stressed that management policies need to be supported by continual analysis of their effectiveness and study of alternatives and opportunities for management interventions. Comparative and systematic analysis of policy alternatives within and among the related sectors and neighbouring countries is necessary. This requires improved information bases and targeted research that aim to support policy and management decisions.

One area of critical importance that has been overlooked is the recognition that effective and efficient utilization of information is a means of achieving the goals of sustainable fisheries and food security. Information is an essential input to decision making; relevant, timely, and usable information must be made available so that appropriate and informed decisions and actions can be taken. Furthermore, efficient flow of information is a prerequisite to integrated, coordinated and holistic planning and management. Cooperation and collaboration among related organizations, sectors and countries can only be facilitated through efficient information sharing and exchange. Self-governance and sustainable resource management require informed decisions and actions at all levels, from individual, institutional, local, and national to international levels. Successful formulation and implementation of appropriate policies and management interventions depend on effective utilization of information. A future fisheries policy framework should give priority to development of a comprehensive fisheries information programme that can support management decisions, including increasing the awareness of the public to the need for environmentally sound and socially responsible fisheries.

In terms of a contribution to regional and global food security, the Republic of Korea can assist by: (a) sharing surplus production and (b) undertaking a more active role in strengthening regional capacity in fisheries management, i.e. providing leadership in the areas of regional human resource development, technology transfer, collaborative research on fisheries and environmental management, and information exchange and sharing. As was seen above, increasing fishery production may not be realized until the environmental and social issues are successfully addressed.

Nevertheless, the Republic of Korea is one of the major fishing nations; it has accumulated considerable experience and expertise, and has developed research and management capacities in fisheries. These capacities and expertise can be shared and used for the benefit of the region. The existing efforts in international cooperation should be intensified, giving special consideration to strengthening regional fisheries management capacities and sharing experience and expertise.

The main objectives of the fisheries sector are to ensure sustainable availability of fish food and to develop socially and economically viable fishing and fishfarming communities. The fisheries sector has no immediate difficulties in producing adequate amounts of fish food for domestic consumption of 45 kg/caput/yr. The current production level is sufficient to meet the domestic demand at the per-caput consumption rate of 60 kg until 2010 when the population will reach about 50 million.

However, the sector has been affected by a variety of national and international economic, industrial and trade actions and policies. Environmental quality of coastal and inland waters has changed significantly due to discharge and dumping of industrial and domestic wastes and other pollution, including accidental spills, and reclamation of tidelands. Fishing areas have been reduced partly by tideland reclamation and partly due to implementation of EEZs by many coastal countries. Access to fishing grounds has become more difficult. The former abundance of fisheries resources has shown signs of decline. Income of fishing households remains at 82 percent of city household income and 86 percent of farm household income. There is a considerable manpower drain from fisheries to other sectors, and from fishing communities to urban areas.

In addressing issues confronting the fisheries sector, government policies are oriented to promote: (i) improvement of the coastal environment and rational management of fisheries resources, (ii) shifting emphasis from capture fisheries to culture fisheries, (iii) integrated development of coastal areas and fishing and fishfarming communities, (iv) continued development of distant water and high sea fishing, (v) decentralization and privatization, and (vi) restructuring the fisheries sector and institutional arrangements. In addition to the national actions toward these commitments, the Republic of Korea supports and observes the international laws and regulations governing fisheries and actively participates in various international fisheries programmes that promote cooperation and collaboration among the countries involved.

Fish has been and will be an important food for Koreans. The Republic of Korea is a peninsular country with high population density and limited arable land, and sustainable fisheries is therefore critical to food security. Given that the private sector is the main target of government policies and channels for the eventual implementation of the policies, concerted action by both the public and private sectors is essential to ensure a continued supply of quality fish food for current and future generations. Additionally, it is critical to make extra efforts to: (i) formulate and implement holistic policies and management measures, covering every aspect from production, processing, distribution, and marketing to consumption, (ii) devise coordinated and coherent strategies among the related organizations and sectors that are concerned with management and utilization of aquatic resources and environment, and (iii) ensure balanced and consistent actions within the fisheries sector. In this context, the need for relevant and usable information and problem-solving research is greater than ever. Priority consideration must be given to: (i) effective and efficient dissemination and utilization of information that facilitates coordinated policy planning and implementation, participatory and community-based management, and informed actions and decisions at all levels, and (ii) targeted, problem-solving and policy-relevant research in support of sustainable availability of affordable fish food.

Fisheries resources in the waters under the jurisdiction of the Republic of Korea have been used to near or total capacity. It may be difficult to increase fisheries production significantly in the near future. Nonetheless, the Republic of Korea, as one of the major fishing nations, can make an important contribution to regional and global food security by sharing its experience and expertise, and by strengthening regional capacity in sustainable fisheries management.

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ANNEX 1

TERMS OF REFERENCE FOR THE CONSULTANT

1. To discuss and analyze the present fish production situation in the Republic of Korea, future opportunities and outlook for fish supplies to 2010 and beyond;

2. To analyze the contribution of the fisheries sector to overall food security with special reference to production of fish for household consumption and generation of income/employment;

3. To analyze the present policy issues/measures for fisheries management and development and identify the constraints to the sustainable development of fisheries in the Republic of Korea;

4. To recommend mechanisms and approaches to be followed by the country for maximizing fisheries contribution to the sub-region food security; and

5. To recommend policy framework (issues/measures) for the sustainable contribution of fisheries to food security in the sub-region.

THE SUSTAINABLE CONTRIBUTION OF FISHERIES TO FOOD SECURITY IN CHINA

by

Song Zhiwen

1. Introduction

1.1 Physical Features

The People's Republic of China (PRC) is located in the eastern part of Asia and borders the western shore of the Pacific Ocean. The total land area of China is 9.6 million square kilometers, ranking third largest in the world. The mainland extends more than 5,000 km from east to west and over 5,500 km from north to south. China is contiguous to the Democratic Peoples' Republic of Korea, the Russian Federation, Mongolia, Kazakhstan, Kirghizstan, Tadjakstan, Afghanistan, Pakistan, India, Nepal, Sikkim, Bhutan, Myanmar, Laos and Vietnam and her mainland boundary line is approximately 20,000 km. A map of China is shown in Figure 1.

China borders the Bohai, Yellow, East China and South China Seas on the east and south. The Bohai is an inner sea. The Huanghai or Yellow, East China and South China Seas are all continental apron seas in the northwest and western Pacific Ocean. The total area of the four seas is about 4.7 million km^2. The continental shelf, within an isobath of 200 m, covers about 1.5 million km^2. The coastline of China is more than 18,000 km, starting from the mouth of the Yalujiang River in the north, and stretching southward to the mouth of the Beilun River. There are over 5,400 islands scattered in the sea area with Taiwan Province of China being the largest one, followed by Hainan, Changming, Zhanshan, Donghai, Haitan, Dongshan, etc. Eighty percent of the islands are scattered over the sea area to the south of the Yangtze River and twenty percent to the north. The coastline of the islands is over 14,000 km. There are numerous rivers along the coast with a total of 1,880 billion m^3 of runoff into the sea every year. This brings a large quantity of organic material which forms a superior habitat for marine animals and plants. Many bays and gulfs are distributed along the coast.

The Chinese land mass is low in the east and high in the west with the highest area being the Qinghai-Xizang plateau which is more than 4,000 m above sea level. Within the boundaries of the plateau, the river system is well developed and the Yangtze, Yellow and the Yarlung Zangbo Rivers originate here. The plateau extends eastward to Mount Da Xinganling, Mount Tai Hang, Wu Mountain, and the Wu Ling Mountain range which form the next area, which is 1,000-2,000 m above sea level. The Helongjiang and Pearl Rivers originate in this area. Further eastward, there are vast plains and low-lying hilly land. The North-East, northern China and the lower Yangtze are major plains which cover about one tenth of China's territory and are the most densely populated areas. China can be roughly divided into five regions: mountainous, 33 percent; plateaus, 26 percent; basins, 19 percent; plains, 12 percent and hilly areas, 10 percent. The plains and basins are densely covered with rivers, small reservoirs and ponds which have become the most important areas for freshwater fisheries.

China has numerous rivers, with over 50,000 of them each having a drainage area of 100 km^2 or more. There are 104 rivers which are 300 km in length and 22 of 1,000 km. The total water area of the rivers is about 12 million ha, making up 45 percent of the total inland water area. The major rivers include the Yangtze (6,300 km), the Yellow or Huanghui (5,464 km), the Helongjiang (3,101 km), the Pearl (2,214 km), and the Huaihe (1,000 km).

China has more than 2,800 lakes with a water surface area of over 1 km^2 each. The total water area is approximately 75,610 km^2, and includes 16 large lakes: Boyang (3,583 km^2), Dongting (2,820 km^2), Taihu (2,425 km^2), Hongze (1,960 km^2), Chaohu (820 km^2), etc. The lakes are mainly scattered over the eastern plains and the Qinghai-Xizang plateau. In the Mengxin region, the Yunnan-Guizhou plateau and the northeastern region, there are also many lakes. Saltwater lakes are mainly found in west China where the weather is dry and cold.

Reservoirs, totalling 84,775, have been built throughout the country with a total water storage capacity of about 479.7 billion m^3. There are 387 large reservoirs, each having a water storage capacity of more than 100 million m^3; 2,593 medium-sized reservoirs, having a water storage capacity of 10-100 million m^3 and 81,795 small reservoirs, having a water storage capacity of 0.1-10 million m^3. Most of the reservoirs were built to regulate runoff or river flow, and to store water for agriculture, industrial and urban use. Now increasing attention is being given to the use of these reservoirs for fish farming.

1.2 Climate

China covers 50 degrees of latitude with tropical, subtropical and temperate zones, and more than 60 degrees of longitude. The country from east to west is divided into humid, subhumid, semiarid and arid climate zones. The monsoons have a strong influence on the climate; from May to September, the south wind blows from the southern Pacific and Indian Oceans bringing plenty of warm, moist air so the yearly rainfall all over the country is mainly concentrated in this period. From September/October till March/April of the following year, the north wind comes from Asian and European inner lands and blows hard, then gradually abates to the south. This results in a cold dry winter and a great temperature difference between north and south. The alternation of warm air in the south and cold, dry air in the north determines the climate in different parts of the country, particularly in the distribution of temperature and rainfall.

Rainfall is concentrated mostly in summer and decreases gradually from the south-east to the north-west. An annual precipitation line of 400 mm slanting from Daxinganling in the North-East through Zhangjiakou and Lanzhou to Lasa in the South-West divides the country into the south-eastern part and the north-western part. The semi-wet and semi-dry regions are also divided by this line. The farther to the east, the more plentiful the rainfall. An 800 isohyle conforms approximately to the line from Qinling to Huaihe and forms the dividing line of the humid and the subhumid regions. The Yangtze Basin has an annual precipitation of 1,000-1,600 mm while some places in Guangdong province and Taiwan Province of China have 2,000 mm or more, but the precipitation in most places in the north-west is below 250 mm. The yearly average rainfall of the country is about 630 mm or 6,000 billion m^3, of which 2,600 billion m^3 form the water resources of the country.

Typhoons occur in China mainly in July, August and September. The area from Liaoning Province in the north to the coastal areas in the south may be hit by typhoons every year thus causing great damage. The strong winter winds following cold waves may cause the temperature to decrease by more than 10 degrees centigrade within 24 hours. And in northern China and the Yangtze basin, a strong wind is usually accompanied by rain, snow and frost; while in south China, it is rainy. The weather can cause damage to agriculture production.

1.3 Socio-economic Conditions

China has 23 provinces, 5 autonomous regions and 3 cities under the direct jurisdiction of the central government (Beijing, Tianjin and Shanghai). Within the provinces, there are 191 cities, 148 prefectures and 2,171 county administrative units including 323 municipalities considered administratively as counties (the cities and municipalities of Taiwan Province of China are not included).

China has 56 ethnic groups, of which the Han account for 94 percent of the total population, followed by the Manchu, Mongolian, Hui, and Zang minority groups. Mandarin is the most commonly used language.

In 1995, China had a total population of 1.21 billion or a density of 123/km^2. This is more than one fifth of mankind. The Chinese Government has paid the greatest attention to controlling population growth and has treated it as a basic state policy in recent years. The population growth rate dropped gradually from 1.44 percent in 1990 to 1.05 percent in 1995.

The first three years after the founding of the People's Republic of China was an economic restoration period (1949-1952). In 1953, the State implemented the First Five-Year Plan (1953-1957) for the national economy and social development, with great success. During the years 1966-1976, the development of the national economy was stagnant. Then it developed once again through reform and opening to the outside world. In 1995, the Chinese GDP reached 5,826.1 billion yuan (RMB), 6.5 times the 775.6 billion yuan in 1978.

Since the implementation of the policies of reform and opening to the outside world, the country's economic system has been largely a market-oriented one. A household production responsibility system has developed from collectivization and communization. In the coastal areas (Shenzhen, Zhuhai, Shantou, Xiamen, Shanghai, Tianjin, Dalian, etc.) economic development zones have been established. These economic development zones and joint ventures have drawn a large input of foreign capital, which has helped to accelerate fisheries production. From 1991 to 1995, the national economy increased at a rate of 12 percent. At the same time, however, economic growth resulted in serious inflation which in 1994 went up to 21.7 percent. In 1995 it came down to 14.8 percent, while the economic growth rate remained at 12 percent. In 1996 the growth rate of the national economy was 9.7 percent, while the inflation rate was down to 6.1 percent. In spite of the fact that the national economy has developed very fast and great changes have taken place, China is still a developing country.

Agriculture is the foundation and most important sector of China's economy. In 1995, there were 0.23 billion agricultural households, and 0.86 billion agricultural workers, making up 70.9

percent of the total population. The agriculture sector includes crops, livestock, forestry and fisheries, all of which contribute 34.9 percent of the country's GDP. In 1978, the agricultural GDP was only 139.7 billion yuan; by the end of 1995, it had reached 2,034.08 billion yuan of which food grains and crops accounted for 1,188.46 billion yuan or 63.7 percent; forestry, 70.99 billion yuan or 4.3 percent; livestock, 604.49 billion yuan or 23.5 percent; and fisheries, 170.13 billion yuan or 8.5 percent.

2. Fisheries Sector

2.1 Present Situation in Relation to Other Sectors

During the period from 1949 to 1957, Chinese fisheries was restored and began to develop. In 1949, the total fisheries production was 447,927 mt. After three years of hard work, at the end of 1952, the total output was 1.66 million mt, which exceeded the highest output of the past. In the course of the first Five-Year Plan (1953-1957), fisheries production increased at an average annual rate of 13.3 percent and in 1957 rose to 3.11 million mt. But at the end of the second Five-Year Plan, it dropped to 2.28 million mt. In the three-year readjustment period (1963-1965), fisheries production went up again at an average annual increase of 9.3 percent. In the following three Five-Year Plans (1966-1980), the yearly production increased at an average rate of 1.3 percent, 6.7 percent, and 0.4 percent respectively. During the 25 years from 1953 to 1978, the total production of fisheries increased by 2.75 million mt, only an average increase of 110,000 mt/year (Table 1).

In 1978, reform started and the government placed unprecedented emphasis on economic development and modernization of the country. Fisheries grew rapidly again. In 1988, China became the third country in the world whose yearly fisheries production was over 10 million mt; then from 1990 on, China's yearly fisheries production ranked first in the world. In 1994, fisheries production was 20 million mt, and in 1995 it reached 25.17 million mt, contributing about one fifth of the world total. The past ten years have been the fastest growing period, with an annual increase of 51.4 percent, much higher than the world average.

The economic reforms in fisheries, begun in 1978 included:

i) the introduction and implementation of a production responsibility system with the household or boat as the basic accounting unit;

ii) the change of the fisheries operational system to allow private/individual fisheries and fish farming operations;

iii) the shift of fisheries trade from being a completely government controlled system to a free market system; and

iv) the gradual relaxation of price controls for all aquatic products.

These changes in the management and production systems are considered the most successful and thorough reforms in the process of fisheries economic reforms.

In 1995, there were 407 fisheries townships, 6,690 fisheries villages, 3,834,729 fisheries households, 16,827,473 full-time fishermen and 11,428,655 part-time labourers. Fisheries households, full-time fishermen and part-time labourers accounted for 1.64 percent, 1.96 percent and 2.53 percent of the total agricultural households, full-time and part-time labourers respectively. These fishermen produced 23.07 million mt, or 91.7 percent of the total fisheries production of the country. The state-owned fisheries enterprises produced 2.07 million mt, only 8.3 percent of the total production, with a work force of 293,985. The production of state-owned fisheries enterprises, though comparatively small, is beneficial to market allocation and supply and is therefore still an important part of fisheries production.

During the past ten years, the number of Chinese fisheries labourers has greatly increased. There is no land conflict between fisheries and agriculture and no grassland conflict between fisheries and animal husbandry. When China develops her fisheries, the national revenue increases with funds for national development. Compared with agriculture, forestry and animal husbandry, the average yearly growth rate of the value of fisheries is the highest. The proportion of the total fisheries output value to the total agriculture output value is rising each year. In 1949, it was only 0.2 percent. By the end of 1978, it had gone up to 1.6 percent. In 1995, it was 8.5 percent. The export of aquatic products is important in earning foreign exchange and promoting international trade, particularly with other developing countries. Some aquatic products have high export value, and the cost is lower than that of many other agricultural products for export.

According to the customs statistics of 1995, the total amount of aquatic products imported and exported reached 2.08 million mt and the total value was US$ 4.25 billion. Exports amounted to 740,000 mt with a value of US$ 3.29 billion and the volume of imports was 1.34 million mt with a value of US$ 0.96 billion. The fisheries import and export value was 1.52 percent of the total national foreign trade. The volume and value of exported and imported fisheries products from 1978 to 1995 is shown in Table 2.

In 1995, the per-caput net income of peasants was 1,578 yuan while that of fishermen was 3,352 yuan, more than 100 percent higher than that of peasants. The development of fisheries not only creates many job opportunities but increases income.

The development of Chinese fisheries, particularly the development of aquaculture, has created employment opportunities and promoted the adjustment of the rural industrial structure and the comprehensive development and utilization of land resources. Now the Chinese fisheries is a comparatively integrated industrial system composed of aquaculture, capture fisheries, processing, marketing, boat building and machinery industries, fisheries science and technology, fisheries administration, etc. This system has played an important role in accelerating the development of the national economy, especially by stimulating the rural economy and improving the economic structures and living standard.

2.2 Marine Capture Fisheries

Marine capture fisheries is a major part of fisheries production. In 1949, the output of marine capture fisheries was 342,927 mt, or 76.5 percent of the total fisheries output. In recent years, owing to the speedy development of marine and freshwater aquaculture and the growth of freshwater capture fisheries, the proportion of marine capture fisheries has been going down steadily. In 1995, the output of marine capture fisheries reached 10,268,373 mt, still ranking first in total output, but the proportion went down to 40.8 percent.

As mentioned earlier, China borders four seas which cover a total area of 4.7 million km^2: the Bohai 77,000 km^2; Huanghai or Yellow 380,000 km^2; East China 770,000 km^2 and the South China 3.5 million km^2. The continental shelf within an isobath of 200 m, covers about 1.5 million km^2. In 1995, 91.7 percent of the output of marine capture fisheries came from the four sea areas. The total output was 9,416,001 mt (the Bohai 954,020 mt; the Huanghai or Yellow 1,706,250 mt; the East China 4,378,364 mt and the South China 2,377,387 mt), of which 6,458,959 mt came from coastal and inshore areas within a water depth of less than 80 m. The output from distant fisheries was only 852,372 mt, or 8.3 percent of the total output.

Along the coastal zone, thousands of rivers discharge into the seas, bringing large quantities of nutritive substances which support the fish populations. There are 1,500 species of fish along the coast, of which over 200 are of economic value and are fished commercially. The fish composition in different sea areas varies greatly because of a great disparity in environment. In terms of biomass, warm water species make up more than two thirds of the output.

In 1995 there were 273,978 marine motorized boats and about 40,000 non-powered boats. Of these, 2,928 were state-owned. Over 80 percent of the motorized boats had a power of less than 44 HP and 18.4 percent, 45-440 HP. Less than 0.6 percent had more than 440 HP. There were 1.1 million full-time fishermen and a number of part-time labourers with an output of 9,292,494 mt, while 47 state-owned enterprises with a labour force of more than 47,000 produced 975,879 mt, only 9.5 percent of the total marine capture output.

The marine capture fisheries output consisted of: fish, 7,436,035 mt, or 72.5 percent; crustaceans, 1,732,115 mt or 16.8 percent; shellfish, 827,979 mt or 8.1 percent; algae, 10,637 mt or 0.1 percent and others, 261,607 mt (including jellyfish, 171,905 mt) or 2.5 percent. Fish exceeding 100,000 mt were hairtail, round scad, anchovy, chub mackerel, mackerel, red coat, pomfret, conger pike, small yellow croaker, and filefish. The output of crustaceans included northern mauxia shrimp, swimming crab, southern rough shrimp and prawns. The output of shellfish included cuttle fish (Table 3). In the order of the amount of production, the different types of fishing operations were: trawlers 5,357,999 mt, or 52.2 percent; set-nets 1,927,813 mt, or 18.7 percent; gill and drift nets 1,263,800 mt, or 12.3 percent; purse seines 552,513 mt, or 5.4 percent; lines and hooks 341,314 mt, or 33.3 percent; and miscellaneous fishing gear 824,934 mt, or 8.1 percent.

During the 1950s, marine fisheries resources were developed and exploited. In the 1960s, inshore resources were fully developed and utilized. In the 1970s, motorized fishing boats increased in number and inshore resources were overfished, with fishing intensity exceeding fish recruitment. Big and small yellow croaker became nearly extinct in the Bohai and Huanghai seas. The proportion of valuable fish species became lower in all sea areas, and fish size, smaller. The per unit output of motorized fishing boats, in terms of engine power, went down. In the early 1970s, output stayed at more than 1 mt/HP; but by the end of the 1970s it was less than 0.6 mt/HP. In spite of the fact that in that period, the capture of off-shore pelagic fish progressed steadily, at the end of the 1970s and in the early 1980s, the total output decreased. After 1985, thanks to the measures of strengthening fisheries administration and management as well as development of stocking, marine capture output went up once again. But at the same time, the number of fishing boats increased by 141,193, or 106.3 percent in ten years. At present, the declining trend of inshore fisheries resources has not been effectively managed. The problem of the increasing number of fishing boats and the destruction of fisheries resources in the coastal areas continues.

2.3 Inland Capture Fisheries

China is rich in inland waters. According to statistics issued by the fisheries department in 1984, inland waters cover an area of 17.6 million ha, or nearly one fiftieth of the land area; ponds cover 1.92 million ha, or 7.2 percent; lakes, 7.53 million ha, or 42.1 percent; rivers, 5.28 million ha, or 39 percent; reservoirs, 2.30 million ha, or 11.7 percent. In these waters, the conditions for developing freshwater fisheries are good.

The freshwater areas abound in fishery resources. There are more than 800 freshwater species in the country, and about 60 or so are migrant species. In recent years, more than 30 species have been introduced from abroad. Carps make up about 50 to 60 percent of the total. Most of the high-value species are warm water fishes; cold water species are found in the northern areas.

Freshwater capture is the oldest method of fisheries production. At the beginning of the new China, freshwater fisheries became a focal point and developed swiftly. In 1950, the freshwater fisheries output was 365,960 mt, of which capture output was 300,000 mt, or 82 percent, and about one third of the total fisheries output. At the end of 1960, the freshwater capture output reached 668,523 mt, an increase of 1.23 times in ten years. But because the freshwater aquaculture output of the same period increased, the proportion of freshwater capture decreased to 57.2 percent of the freshwater fisheries output. After 1960, not only did the proportion decrease but the absolute yield of freshwater capture went down as well, owing to a severe decline in the natural resources. The annual yield in the 1950s was 524,000 mt; it fell to 451,000 mt in the 1960s and declined further to 316,000 mt in the 1970s. In 1978 the yield was only 296,441 mt, the lowest level in thirty years. In the first five years of the 1980s, the yield went up slightly, but was still far from the highest level of 1960. By 1988, the yield of freshwater capture fisheries had been restored and in 1995, it reached 1,372,864 mt. Compared with 1988, it had increased by more than 100 percent, but the proportion in freshwater fisheries was only 12.7 percent, or less than 5.5 percent of the total fisheries output.

In the 1950s freshwater capture output increased by a big margin. It was mainly because the number of fishing boats, nets and labourers grew, fishing areas were expanded and new ones developed. For example, in 1950 the number of fishing boats was 153,000, and in 1959 there were 311,000. In the Inner Mongolia Autonomous Region, the fishing areas increased by more than 30 percent from 1958 to 1960. Qinghai Lake, Eling Lake, etc., the highest and biggest lakes in the world, located on Qing-Tibetan plateau, were virgin lakes which remained unnoticed for thousands of years but are now developed and utilized.

In the 1960s and 1970s the yield of freshwater capture fisheries continued to decline for a number of reasons, but the most important was that the ecological balance had been destroyed, resulting in a serious decline in natural fisheries resources. For example, with the rapid development of water conservancy and hydroelectric power generation, a large number of culverts, sluice gates, dykes and dams played an important role in industrial and agricultural production, flood control and drought resistance, but most of them were not equipped with appropriate fishways. The passage of migrating fishes and crabs was blocked. Thus parent fishes and crabs could not migrate to spawning grounds and the juvenile fishes and crabs could not swim into lakes to grow. The most affected were the anadromous fishes such as silver carp, black carp, grass carp, bighead carp, hilsa herring, river eel and river crab. In these affected water bodies, not only did the yield decline, but the fish fauna, population structure, and age composition changed a great deal. The stretch of the Yangtze River in Hubei Province is the main producing ground for fry. During 1958-1980 the fry yield decreased from 1,143 billion to 239.6 billion, a decline of 80 percent.

Land reclamation plays a direct role in reducing water areas used for freshwater capture. In the 1960s the decline in freshwater capture was directly related to large-scale land reclamation during this period. The reclaimed lake areas in the four provinces of Hubei, Hunan, Jiangxi and Anhui exceeded one million ha. Reclamation not only reduced the water areas, but also destroyed spawning and feeding grounds. Before 1976, the reclaimed water surface in Poyang Lake averaged 5,500 ha/year, most of it being spawning grounds for common carp and crucian carp. It is known that in the 1960s there were 55 spawning grounds in the southern part of the lake, but in the 1970s the number had decreased to 33, and later only 14 were left. Thus the ecological balance in the lake as a whole was severely damaged. Moreover, some of the natural water bodies used for capture fisheries were converted into culture areas, thus narrowing capture fishing grounds and reducing yield.

To account for the serious decline in freshwater capture output, in the late 1970s, many provinces pursued large-scale investigations, and found the main causes for the decline. With great effort from various quarters, appropriate measures were taken to improve the ecological environment in the lakes and apart from that, artificial propagation and stocking programmes were adopted. Therefore from 1979 on, the situation took a favourable turn. The output has steadily on the increase.

In 1995, 573,368 full-time fishermen engaged in freshwater capture fisheries and part-time fishermen may have far exceeded that number. There were over 500,000 fishing boats, but the majority were small and non-motorized. The motorized boats, on the average, only had about 10 HP each. Only a few big boats operated in large lakes and reservoirs; the rest were small, widely scattered, and moved here and there, with low production. This is a distinguishing feature of China's freshwater capture fisheries.

2.4 Aquaculture

For quite a long time aquaculture did not receive enough attention. As a result, it developed slowly. In 1949 the national aquaculture output was about 20,000 mt, of which 15,000 mt were from freshwater and 5,000 mt were from marine aquaculture, amounting to only 4.5 percent of total fisheries output. Though output had reached 22.7 percent of the total fisheries output by 1958, there was little change in the proportion in the following 20 years. The proportions were 23.2 percent in 1968, and 26.0 percent in 1978. Since 1978, aquaculture has developed rapidly. Output rose from 1.2 million mt in 1978 to 5.32 million mt in 1988, a net increase of 4.11 million mt and yearly growth rate as high as 16 percent. Marine aquaculture output was 1.425 million mt and freshwater output, 3.89 million mt, or an average annual growth rate of 12.3 percent and 17.7 percent respectively. During the same period, capture fisheries output went up from 3.44 million mt to 5.28 million mt, an average annual growth rate of only 4.4 percent. This led to a radical change in the Chinese fisheries production structure. In 1988, aquaculture output exceeded capture output for the first time, making up 50.2 percent of the total fisheries output. In the years from 1978 to 1988, 70 percent of the increased output came from aquaculture. By the end of 1995, aquaculture output had reached 13,530,557 mt, accounting for 53.7 percent of the total fisheries output, of which marine aquaculture output was 4,122,924 mt and freshwater output, 9,407,633 mt, increases of 189.4 percent and 141.3 percent respectively over 1988. Aquaculture has become the fastest growing sector of fisheries.

In 1995, the nation-wide areas for aquaculture reached 5,385,090 ha, of which the freshwater aquaculture areas were 4,669,340 ha (ponds, 1,857,810 ha; lakes, 824,330 ha; reservoirs, 1,515,620 ha; rivers, 3,447,330 ha and others, 124,250 ha), and marine aquaculture areas were 715,750 ha. The number of full-time fishermen engaged in aquaculture was 2,869,493 (freshwater, 2,470,778; marine 398,715). There were also a large number of part-time fishermen engaged in aquaculture activities.

The freshwater aquaculture output of major species in 1995 was: silver and bighead carp, 3,713,271 mt; grass carp, 2,070,988 mt; common carp, 1,398,618 mt; crucian carp, 533,740 mt; breams 335,934 mt; tilapia, 314,093 mt; black carp, 102,557 mt; freshwater prawn, 25,711 mt; river crabs, 41,515 mt; soft shell turtles, 17,445 mt; etc. The marine aquaculture output included: finfish, 144,957 mt; crustaceans, 115,881 mt; shellfish, 3,099,099 mt; seaweeds, 738,503 mt and others, 24,484 mt.

According to types of feshwater areas, the output in 1995 was: ponds, 6,952,742 mt or 73.9 percent; lakes, 585,300 mt or 6 percent; rivers, 464,370 mt or 4.9 percent; reservoirs, 815,076 mt or 8.6 percent; paddy fields, 272,9442 mt or 2.9 percent; and others, 317,203 mt or 3.4 percent. Marine area output was: shallow waters, 2,265,657 mt or 54.9 percent; gulfs and bays, 304,864 mt or 7.4 percent; and mud flats, 1,552,403 mt or 37.7 percent. Nearly three fourths of freshwater aquaculture output came from pond culture and more than half of the marine aquaculture output came from culture in shallow sea waters. The water areas of the country and per hectare output are shown in Table 4.

From 1978 to 1995, aquaculture output increased by a big margin. First of all, the culture areas were expanded. In the 1980s, pond culture developed swiftly and became a major source of output in freshwater aquaculture. From 1978 to 1988, pond culture areas in the provinces of Guangdong, Jiangsu, Zhejiang, Hunan, and Anhui were expanded by 433,000 ha. In North-central China, the North-East, and North-West where freshwater aquaculture was underdeveloped, pond culture also rose sharply. Compared with 1978, pond culture areas in the northern regions increased by 156 percent, 190 percent and 229 percent respectively. At the same time, the culture areas of lakes, reservoirs and rivers were also increased. Compared with 1978, the total culture area had increased by 90.7 percent by 1995. Thanks to the improvement of culture technology and management, the per-unit output of aquaculture was greatly increased. On average the per unit yield of freshwater aquaculture rose from 227.5 kg/ha in 1978 to 2,015 kg/ha in 1995, and marine aquaculture increased from 2,571 kg/ha in 1985 to 5,760 kg/ha in 1995. Apart from this, the introduction and transplantation of fine quality species, and the development of net cage culture all played an active role in the development of aquaculture production.

A breakthrough in artificial propagation and kelp seedling raising laid the foundation for the rapid development of aquaculture production. In the past, fish culture depended completely upon natural fry collected in the Yangtze and the Pearl River valleys. Harvests were variable and aquaculture production was hampered. In 1958 China was the first to artificially propagate silver and bighead carp with success. In recent years, the artificial propagation of many cultured species, including fish, shrimp, crab, shellfish, algae, etc., has been successfully carried out. This not only guarantees that aquaculture undertakings will develop fast but also accelerates the development of fisheries science and technology. In 1995, the production of freshwater fish fry was 277.9 billion, of which 259.8 billion were produced by artificial propagation, making up 93.5 percent. Artificially propagated river crab fry amounted to 51,948 kg; shrimp fry, 33.3 billion; scallop seeds, 69.5 billion; abalone seeds, 190.4 million; kelp seeds, 8.9 billion; laver seedlings, 154.2 million, etc. The development of aquaculture equipment and facilities such as pumps, aerators, pond diggers, feeding machines and net cages also promoted aquaculture production.

3. Contribution to Food Security

3.1 As food

Aquatic products are high in protein and low in fat. They contain amino acids essential to human health. They strengthen the brain, promote longevity, contribute to fitness and improve one's looks. They are of value in dietary balance and are important to children's growth. Studies also show that they help prevent cardiovascular disease and are useful in the prevention and treatment of goitre. An increase of aquatic products leads to more protein intake, which improves nutritional level and physical condition.

The fisheries output of 1995 reached 25.11 million mt and played an important role in supplying food, particularly protein. Fish, shrimp, crab, shellfish, etc., contain more protein than meat or eggs. It has been determined that 100 g of hairtail contains 18 g of protein; silver carp, 18.6 g; lean meat, 16.7 g; beef, 17.7 g; mutton, 13.3 g; and an egg, 14.8 g. On average 100 g of fish protein contains 10.6 g of lysine, more than milk, eggs or meat. In recent years, the output of aquatic products has increased greatly and the per-caput consumption rose from 4.4 kg at the end of the 1970s to 20 kg by 1995, equivalent to the world average. At present, one third of the animal food consumed comes from aquatic products. But the animal protein share in the total protein intake in China is still low, only 10 percent; which is below the 17 percent world average. The Government regards the development of fisheries and increasing the supply of aquatic products as one of the most important measures in improving living standard and promoting social and economic development.

The important role fisheries plays in food security is obvious, particularly in the periods when there are food shortages. At the beginning of the establishment of the People's Republic of China, in order to overcome the problem of food shortage, the government actively developed fisheries and encouraged people to consume more aquatic products. From 1949 to 1957, fisheries output increased from 450,000 mt to more than 3 million mt, a five-fold increase. This contributed significantly to social stability and economic improvement at that time, and to a certain extent, lightened the pressure on food supply. During the early 1960s, China's economy experienced serious difficulties. Aquatic products played a major role in easing the serious food shortage in urban and rural areas. In the 1960s and 1970s, there was a shortage of aquatic products in large and medium-sized cities. This was gradually remedied.

According to the statistics of eight large cities, not including the suburbs, average per-caput consumption in 1995 was 38.5 kg/year, of which Beijing was 23.0 kg; Tianjin, 27.3 kg; Shanghai, 42.6 kg; Guangzhou, 60.2 kg; Harbin, 11.4 kg; Wuhan, 38.9 kg; Chendu, 21.4 kg; and Fuzhou, 60.5 kg. The differences are significant. In these eight cities, the turnover of aquatic products was 1.24 million mt or 13.37 billion yuan. Of this, the turnover handled by the state-owned enterprises was 207,573 mt or 1.88 billion yuan and by others was 1.03 million mt or 11.49 billion yuan. Open markets handled 833,320 mt or 9.38 billion yuan. This shows that large quantities of aquatic products were directly supplied to markets by producers themselves or vendors. Of the aquaculture production scattered in the vast countryside, a certain amount is consumed by rural people and the rest is sold at open markets. It is becoming the major source of animal protein in the diet.

It is worth mentioning that the large-scale construction of fish ponds in cities and suburbs in the 1970s played a major role in solving the "difficulty in buying fish" problem. There is a lot of water surface in urban districts and suburbs which can be used to culture fish. Many cities have excavated ponds in wastelands for this purpose. With subsidies from the State, and three years effort, by the end of 1974, 14,666 ha of stable and high yield ponds had been built in 16 cities. For example, from the winter of 1971 to the spring of 1973, in Wuhan, 805 ha of intensive culture ponds were excavated in low-lying land and on the shores of lakes, while in Harbin, 400 ha of ponds were built from the winter of 1975 to the spring of 1976. According to the statistics of 135 large and medium-sized cities, the area of stable and high-yield fish ponds reached 230,666 ha in 1974, making up 7 percent of the total freshwater aquaculture area at that time. The per-unit yield was higher because the culture conditions in the suburbs were very good. Average yield was 2,490 kg/ha, 2.6 times higher than the national average of the same year. The total output was 125,000 mt, accounting for 12 percent of the total freshwater production of the country. The degree of self-sufficiency in fish supply has increased year by year. Then, with the development of freshwater aquaculture, "commercial fish bases" were set up. The development of fish culture in the suburbs and the setting up of commercial fish bases have proved that developing fisheries is a quick and effective way to increase aquatic products and food security.

Animal protein is converted from animal feed. But fish contains fine animal protein with little feed or none at all. Capture fisheries is carried out directly, using the natural resources; in aquaculture, the feed conversion rate is rather high. Generally, 1 kg of fish is produced from 1-3 kg of feed. Shellfish and algae culture consume the least feed. This feed conversion efficiency is higher than those of the animal husbandry and poultry industries. Thus, fisheries has an obvious advantage in reduced feed consumption, and at the same time provides fine quality feed for the poultry industry.

Capture fisheries output comes from natural fisheries resources, without providing any feed. Most traditional freshwater culture species are filter-feeder species, such as silver and bighead carp which account for 56 to 65 percent of the total production. The herbivorous species such as grass carp and Chinese bream, amount to 20 percent. The omnivorous species such as common carp, mud carp, crucian carp and tilapia make up 12 to 21 percent. The carnivorous species such as black carp and crustaceans make up only about 7 to 8 percent. On the whole, the food chain of the majority of cultured species is comparatively short. The fish are mainly dependent upon natural feeds. Such is also the case with algae and shellfish culture. Even though some cultured species need a certain amount of feed, the conversion rate is high. In short, capture fisheries contributes a lot but demands little, so in terms of food security, it has advantages.

China is famous for its integrated fish farming. Fish farmers develop and utilize their local water bodies and land resources and form a circle of the whole production procedure so as to gain maximum economic benefits. An example of fish-cum-feeds is raising fish in ponds and planting sorghum sudeness, lolium pereme and soybeans on the pond dikes to provide green-feed for fish. Other integrated systems are fish-cum-pig-cum-grain-cum-grass, fish-cum-livestock-cum-fowl, fish-cum-fruit-cum-herbs-cum-vegetables and even fish-cum-small fish processing industries. As a result, while developing aquaculture, other kinds of food are produced.

3.2 As Income/Employment

According to the fixed price of 1990, the total fisheries output value of 1995 was 111.15 billion yuan or according to the present price it was 174.37 billion yuan. The proportion of fisheries in the total agricultural output in value was 0.2 percent in 1949, 1.9 percent in 1959, 1.7 percent in 1969 and 1.5 percent in 1979. In 1989 it reached 3.4 percent and in 1995, 8.5 percent. Though the proportion is not very high, the growth rate is the fastest of any agriculture sector.

The volume of exported aquatic products and values from 1985 to 1994 are shown in Table 2. During this period, the export volume went up from 124 thousand mt to 684 thousand mt, an increase of 426.4 percent. The value also rose from US$ 271.64 million to US$ 2,606.99 million, an increase of 859.7 percent. By the end of 1995, the export volume had further grown to 740,000 mt, and the value had risen to US$ 3.29 billion, an increase of about 60,000 mt and US$ 6.8 million respectively compared with 1994. The major exports in 1994 are listed in Table 5.

China also imports aquatic products. From 1985 to 1994, the import volume and values are shown in Table 2. In 1985, the import volume was 329,000 mt, worth US$ 91.47 million; in 1994, the volume and value were 1.26 million mt and US$ 868 million respectively. In 1995, the volume rose to 1.34 million mt with the value being US$ 960 million, 70,000 mt and US$ 90 million over the previous year. The major imported fisheries products are listed in Table 6. The volume of imports is high, but imported fish meal formed a large proportion, and the sum of the imports is far lower than that of exports. Thus China has had a favourable balance of trade in fish and fishery products for many years.

The development of fisheries creates job opportunities on an extensive scale and increases personal income. The proportion of the Chinese agricultural population was 85 percent of its total in

1970, 83 percent in 1980 and 80 percent in 1984. Along with the development of the national economy and science and technology, the proportion will go down. This is an inevitable tendency of social development. Alongside the reform of the agricultural economic system, more and more agricultural labourers will leave the land. The development of aquaculture is no doubt an effective way to absorb these labourers.

Fisheries and related occupations are an important source of livelihood in the rural areas of the country. In 1995 there were 11,428,655 million labourers engaged in fisheries production, of whom 5,071,940 were full-time labourers (capture fisheries, 1,672,822; aquaculture, 2,869,493; service logistics, 529,625), and 6,356,715 part-time labourers (the period for fisheries production is less than 3 months per a year). There were 300,000 people employed by 3,133 state-owned fisheries enterprises. The increase of fisheries labourers from 1978 to 1995 is shown in Table 7. In fact, in 1995, fisheries labourers increased by 9,027,447 over the 2,401,208 in 1978, a rise of 375.9 percent. Of them, more than 7 million were engaged in aquaculture. It is the input of large numbers of labourers that has ensured sustained production.

With the development of fisheries, services before and after production develop simultaneously. These include building fishing boats and facilities; and manufacturing fishing nets, freezing and processing equipment, transportation tools, farm machinery, etc. This phenomenon is quite obvious in those areas where people are mainly engaged in fisheries; in these areas if fisheries is growing prosperously, other related industries also flourish. The economy in the whole area is vigorous.

The higher income of fisheries labourers is important in attracting many rural labourers to take part in fisheries activities. According to investigations made in different parts of the country, from 1978 to 1995, the average annual net income of all workers increased from 93 yuan to 3,545 yuan while each fisheries labourer's average annual net income increased from 269 yuan to 7,147 yuan. The increment of income involves the enhancement of labour productivity, but in 1995, on average, each fisheries labourer's output was 2.2 mt compared with 1.93 mt in 1978, an increase of only 14 percent. It is clear that income increased by a wide margin because prices of aquatic products went up. The prices of aquatic products are much higher than those of agricultural products and therefore a fisheries labourer's income is higher than that of other agricultural labourers.

4. Role of Public and Private Sectors

4.1 Political Commitment and Government Intervention

Since the implementation of the policies of reform and opening to the outside world in 1978, the State has achieved a great deal in different fields. The national economy has been significantly strengthened and the socialist market economy is being formed. The Ninth Five Year Plan (1996-2000) for the development of the national economy and society, and the Long-Range Plan of 2000 were formulated by the Government not long ago. It is believed that efforts should be concentrated on the economy and attempts should be made to solve the major problem of a weak agricultural base with a fundamental policy of strengthening agriculture as the first priority in the development of the national economy. Leaders at different levels are being asked to deal with agriculture on their own, to treat properly the relationship between agriculture and other industries, to fully mobilize the initiative of peasants, scientific and technology workers engaged in agriculture, and rural cadres. People in all walks of life should make contributions to agricultural development so as to develop the rural economy. It is also stated in the Ninth Five-Year Plan (1996-2000) that, on the premise that a steady increase of grain output is ensured, a diversified economy should be actively developed in line with local conditions; rural collectives and individuals will be encouraged to develop and utilize uncultivated land and rural resources in a comprehensive way to develop forestry, animal husbandry, sideline production and fisheries. It is pointed out that freshwater and inshore aquaculture should be expanded and distant-water fisheries developed. Under the guidance of these national policies and principles, Chinese fisheries should develop in a sustainable way, and make a greater contribution to food security.

The Ministry of Agriculture is responsible for nation-wide fisheries. The plan of the ministry stipulates that by 2000 aquatic products output should be 32 million mt; with a total output value of 168.42 billion yuan (1990 constant price); the share in the total agricultural output value should be 13 percent and per-caput consumption of aquatic products should be 24 kg/yr. It is estimated that 24 kg will exceed the world per-caput level. The annual net income of fisherman should reach 3,800 yuan on average and the earnings of foreign currency through exported aquatic products should amount to more than US$ 4 billion. The output target is about 7 million mt more than 1995, an average increase of 1.4 million mt every year. The objective can surely be met with hard work.

The Fisheries Bureau under the Ministry of Agriculture is in charge of the routine fisheries administration of the country. Its duties are to put forward policies and principles of fisheries development; guide the reform of the fisheries economy; formulate fisheries regulations and rules, and supervise their implementation; manage fisheries activities involving foreign countries; protect the fisheries resources; develop fisheries science, technology and education and safeguard fishermen. The organizational structure of the Bureau of Fisheries is shown in Figure 2. The present responsibilities of the Bureau of Fisheries are:

i) to closely link reform with development; to set up and make an integrated system of fisheries, industry and trade so as to form an all-round system with the sectors linked together in an economic community, in which leading enterprises and fisheries households share common benefits and risks; to promote standardized products so as to further link production and processing with marketing; to widen domestic and foreign markets; to speed up the progress of fisheries science and technology; to enhance quality on the whole and increase economic benefits;

ii) to organize and construct the “2 x 6 project”. The first 6 include: the construction of 6 large systems. They are an original and high quality aquatic seeds system; a standardized system of aquatic science and technology; a fisheries technology extension service system; a system of aquaculture fish disease prevention and control; an aquatic products marketing system; and a system of fisheries management, including resources and environmental protection. The second 6 development and construction projects include: the development of commercial fish bases and comprehensive fisheries; the development of off-shore fisheries; the development of distant fisheries; the development of processing and comprehensive utilization of aquatic products; the development and construction of fishing ports; and reform of industrial technology of fishing boats and machinery;

iii) to further strengthen fisheries technology extension services; to continue to extend effective technologies and good strains of fish; to pay special attention to technical training, and to enhance fisheries labourers' capacities. Science and technology development and extension services should contribute to a fisheries output increment of 55 percent. It was 45 percent in the 1991 to 1995 period;

iv) to continue to strengthen the fisheries legal system;

v) to pay special attention to resources and environmental protection; and

vi) to establish a system of economic order and management suited to sustainable development. The Chinese fisheries management system should be compatible with the international management system.

4.2 Inter-country Cooperation

Since the founding of the new China, while establishing good relations in fisheries with neighbouring countries, China has been developing friendly contacts through scientific and technological exchange and economic and technical cooperation.

In 1955, the China and Japan Fisheries Associations signed the Yellow Sea and East China Sea Fisheries Agreement. In 1975, the two governments signed another Fisheries Agreement, and in August of the same year, they signed the Yellow Sea Fisheries Agreement. In 1986 the two governments signed a fisheries borderline agreement. In 1957, China and Vietnam signed a fisheries agreement on the Beibu Gulf relating to non-motorized fishing boats and in 1962 and 1963 they signed the Honghe River Resources Protection Agreement and the Beibu Gulf Fisheries Agreement respectively. In 1975, China and the Democratic People's Republic of Korea signed an agreement on fish farming in Shuifen Reservoir, and in 1985, China and the USA signed an agreement on fishing off the USA coast.

According to the incomplete statistics of 1987, China has created contacts in fisheries with more than 60 countries, regions and international organizations, formed bilateral fisheries cooperative relations with more than ten countries, and established fisheries trade links with over twenty countries. In scientific and technological cooperation, China has received study groups from more than 50 countries and provided them with various kinds of fisheries technical information and data. China has also supplied parent fish and fry of grass carp, black carp, silver carp, bighead carp, as well as seedlings of kelp and laver to a dozen countries. In addition, China has invited foreign experts in different fields to give short term assistance and lectures. A number of advanced fisheries technologies and aquaculture species have been introduced from abroad. Examples of helpful cooperation carried out are:

i) Cooperation with Japan carried out mainly in the Shanghai Technical Development Center of Aquatic Products Processing. Experimental bases of fisheries resources propagation and enhancement were set up in the Bohai Sea. The Japan International Cooperation Agency helped to establish a freshwater fish farming center in Beijing.

ii) From 1963 to 1966, China provided Vietnam with 284 instruments for freshwater fisheries research as well as chemical agents. In 1963, China also sent specialists in marine aquaculture to give guidance in oyster culture.

iii) China assisted Sri Lanka to build an experimental station for fish culture.

iv) China helped Afghanistan to build experimental farms for fish breeding.

v) Aid projects in Iran included the construction of fisheries ports, a fishing net factory, cold storage and processing plants, and supplying shrimp culture technologies, fry and technical training.

vi) In 1987, China and Mexico held talks on fisheries technical cooperation. Cooperation included cooperative research, personnel training, exchange of data and cultured species and exchange of specialists.

vii) According to the Scientific and Technological Cooperation Agreement in Oceans and Fisheries signed by China and the USA in 1979, cooperative research was carried out in aquaculture; there was a comprehensive investigation of tuna, studies of fisheries species biology, and cooperation in marine fisheries management and development.

viii) The Norwegian government presented China with an advanced research vessel (1,165 mt) named “Bei Dou” to be used to investigate fisheries resources, train personnel, and make investigations and an assessment of the pelagic fish resources in the Yellow and East China Seas, all with very satisfactory results.

ix) Before the 1960s the Russian Federation sent 13 specialists to China to give lectures at fisheries research institutions and in 1987, the two countries signed a fisheries cooperation agreement. Cooperation involved fisheries investigations and research, protection, propagation, rational utilization and management of biological resources in the northern part of the Pacific Ocean and boundary-line rivers, the supplying of fishing boats in common fishing areas, the transportation of fish products, the development of marine aquaculture, assistance to each other in building and repairing boats, improvement of fishing gear and improvement of processing techniques.

x) In 1959, China helped Albania build a fish farm with an area of 4 ha, and taught techniques of artificial propagation and raising. In 1972 and 1973, China helped with artificial propagation and breeding of large quantities of fry, and thus Albania achieved self-sufficiency in fry supply.

Moreover, China began to establish trade in fisheries products with other countries. This cooperation is classified into three patterns. The first is compensatory trade, that is, the acceptance of materials for processing. The second is the setting up of joint ventures in China. The last is the setting up of joint ventures or cooperative enterprises outside China. According to the statistics from 9 coastal cities and provinces, by the end of 1988, more than 130 fisheries joint enterprises had been established with foreign investment exceeding US$ 100 million.

4.3 Private Sector

The implementation of a fisheries production responsibility system is an important part of fisheries economic reform. The system has mobilized fishermen's initiative and freed production forces. Due to the implementation of the responsibility system, a diversified production system with cooperatives as the mainstay and individual business as a supplement has been formed. To account for fisheries production activities, capture fisheries is carried out with boats as the basic accounting unit, and aquaculture with households as the accounting unit. Private ownership is no longer forbidden. By the end of the 1980s, 87 percent of marine capture fishing boats were owned by a few individuals who paid a small management fee to the township or village.

In 1995, 91.6 percent of the total fisheries output was from cooperative and private sectors. In freshwater capture and marine aquaculture output, the proportions of cooperative and private sectors reached as high as 95 percent and 94.2 percent respectively. Out of 432,674 fishing boats, 97.8 percent belonged to cooperatives and individuals.

Before 1978, no cold storage units were owned by cooperatives or individuals. Economic reform promoted the development of cooperatives and private fish processing industries. By 1992, cooperatives and private industries owned 2,215 cold storage units with a daily ice making capacity of 23,000 mt and refrigeration storage capacity of 280,000 mt.

4.4 External Assistance

In 1983, international donor agencies began to assist China to develop her fisheries in various fields such as aquaculture, fisheries resources management, fishery education and training. The major international organizations were the World Bank, the World Food Programme, the United Nations Development Programme, and International Funds for Agriculture Development. By the end of 1992, China had accepted funds of US$ 900 million, including about US$ 200 million in contributions and US$ 700 million in credit. More than 20 projects have been implemented (Table 8). At the same time, the Food and Agriculture Organization of the United Nations, the Canadian International Development Research Center, and the Japan International Cooperation Agency supported various projects. It is believed that external assistance has played a significant role in increasing fisheries production in China. The projects have not only rendered support to developing fisheries production, but have also provided important assistance for the improvement of fisheries infrastructure and management. Some of the projects are described below.

a) The development of Fishery Resources in Hongze County, (WFP-2633 Project): This was the first WFP fisheries project initiated in China. Its main objective was to resettle 2,000 fishing families living in poverty on houseboats on Hongze Lake and provide them with an alternative livelihood, with houses, schools, and a hospital. It is considered one of the most successful projects in China.

b) The Sino-Norwegian Fisheries Cooperation Project: As mentioned before, the Norwegian Government gave a fisheries research vessel named “Bei Dou” to China. A significant result of the project was the identification of a large amount of anchovy resources and the development of fishing methods for exploitation of these resources. The project completed a survey on the sardine stocks in the Yellow Sea and the East China Sea.

c) Development of Coastal Aquaculture in Bohai Bay (WFP-2771 Project): The project sites were in Huanghua County, Hebei Province, and Lijin, Shonguang and Changyi counties, Shangdong Province. The objective of this project was to raise the living standard of submarginal fishermen whose income had dwindled due to depletion of the Bohai Sea marine resources and to provide a new livelihood through shrimp farming. Major construction converted nearly 4,000 ha of unproductive mud flats and saline plains into 2,200 ha of shrimp ponds as well as other infrastructure such as roads, bridges, pumping stations, hatcheries, feed mills, and cold storage units.

d) Development of Integrated Fish Farming In Nine Cities (WFP-China 2814 Project): The project converted 9,735 ha of unused and marginal land into 6,833 ha of fish ponds in nine cities to increase their fish supply and to create job opportunities. The Fisheries Project Office of the Ministry of Agriculture as the executive agency provided direct supervision and advice in all aspects of the project implementation including fish farm design, construction and management. The result was highly satisfactory.

e) China Agriculture Scientific Research and Education Project: As a component of this project the Shanghai Fisheries University, Dalian Fisheries College and Shangdong Fisheries School from 1983 to 1987 obtained US$ 4.6 million, US$ 2.60 million and US$ 0.34 million respectively from the World Bank to purchase laboratory equipment and send staff abroad for training and study. It greatly upgraded the educational facilities, staff quality and fisheries education system in China.

f) China Freshwater Fisheries Project (Credit 1689-CHA): The project was financed by the World Bank and the principle objective was to develop freshwater fish culture in the outskirts of eight cities (Beijing, Shanghai, Hangzhou, Chengdu, Chongqing, Harbin, Nan Chang and Shenyang) by improving 6,100 ha of existing fish ponds and using land unsuitable for crops to construct 11,100 ha of new ponds, providing techniques and equipment for pond management, and strengthening support facilities for production and marketing of fish. This project was regarded as highly successful.

g) Pilot Project to Increase the Output of Fish Farms (NA 85/28): The project was financed by the EEC as a grant. Two feed mills with annual production capacities of 10,000 mt each were constructed and technologies transferred in the fields of intensive fish culture management and fish feed formulation and processing. It greatly increased fish farm efficiency both in terms of production and net income.

h) Fisheries Development in Qinghai (UNDP/FAO Assisted Project CPR/88/077): This was the first international assistance to the fishery sector in Qinghai Province. Its two major objectives were: i) improvement of the naked carp fishery in Qinghai Lake by introducing practices and management on a scientific basis and developing hatchery techniques for production of juveniles of this little-known species; and ii) demonstration of the technical and economic feasibility of commercial rainbow trout farming in Qinghai Province. It was a successful project, particularly the rainbow trout farming in the Longyangxia Reservoir. Rainbow trout farming has become one of the priorities of fisheries development in Qinghai.

4.5 Non-Governmental Organizations and Fisheries Associations

The China Society of Fisheries is a registered academic non-governmental organization specializing in fisheries. Promoting scientific knowledge and providing technical services are the most important activities carried out by the society. Fifteen thousand scientists, professionals and people related to fisheries all over the country have voluntarily joined the society. There are 14 professional commissions under the Society and it holds academic workshops annually. Owing to the increasingly serious fish disease problems existing in aquaculture and the needs in developing high density culture technology, the Fish Disease Prevention and Treatment Network, and the High Density Intensive Culture Technology Cooperation Network were set up recently. They hold conventions, seminars, workshops and field visits every year. Thus the society takes an active part not only in academic activities, but also in technical extension and production. Eight professional fisheries magazines are edited and published by the society. It is also a member of the Asian Fisheries Society and the World Aquaculture Society.

In China, there are many professional associations related to fisheries, such as fishing boat and machinery, fish processing, and refrigeration associations. They are active and have made contributions to fisheries development. In the vast countryside, fishermen’s associations set up in the early 1990s, are growing and playing a positive role. Since economic reform began, the former highly concentrated and rigid management system has disappeared. Following the advances of production forces and the enlargement of the market economy, some problems have emerged in small-scale/individual fisheries, such as weak resistance to natural calamities, weak economic strength, difficulties in procuring supplies, selling fish products and obtaining credit. To overcome these difficulties, the fishermen’s associations have expanded rapidly. They are a new kind of non-governmental organization, in which the members are allowed to join or withdraw from the association freely. An association is usually organized by administrative village, township or even at a higher level, and there are free elections. It is also an organization which helps fishermen to help themselves in all aspects of fisheries. It is estimated that there are several hundred fishermen’s associations throughout the country.

5. Policy Framework for a Sustainable Contribution to Food Security

5.1 Policy Issues and their Resolution

In China, the natural conditions for developing fisheries are superior but during the 30 years before 1979, the resources were not rationally and effectively utilized. Apart from political factors, the guiding ideology was not clear; for quite a long time marine fisheries was regarded as more important than inland fisheries, inland capture fisheries as more important than aquaculture, output as more important than quality and production as more important than management. Output was increased mainly by raising the number of fishing boats and nets. As a result, the fisheries resources in inshore and inland waters were seriously depleted. In 1979 the policy was changed with emphasis on rationally utilizing resources, devoting major efforts to aquaculture development, and paying special attention to increasing output.

In 1985, the State firmly put forward a fisheries development policy with the following emphases: marine and freshwater aquaculture were the most important; then capture fisheries in inshore and inland water areas, and then the protection and enhancement of the resources. At the same time handling and processing of aquatic products were to be developed with concentrated effort. Recently the State further made it clear that during the Ninth Five-Year Plan (1996-2000) and after, the fisheries development policy would be to accelerate the development of aquaculture; conserve and rationally utilize inshore resources; actively expand distant-water fisheries; pay serious attention to processing and marketing; and strengthen fisheries management and the enforcement of laws and regulations. It is believed that with this policy, the Chinese fisheries will enter into a phase of sustainable development.

The Fisheries Law of the People's Republic of China was discussed and adopted at the 14th Meeting of the Standing Committee of the National People's Congress on 20 January 1986, and put into effect on 1 July 1986. The Law provides that the State will encourage people to develop aquaculture, actively propagate fishery resources, protect fishery workers' lawful rights and interests, develop offshore and distant-water fisheries as well as restrict inland and inshore fishing intensity. According to the initial statistics, in the ten years since the Fisheries Law was issued, the central and provincial governments have issued more than 500 fisheries rules, regulations and standardized documents. In major aspects such as fisheries management, resources conservation and production activities, there now are laws and regulations to go by. Thus is a fundamental legal basis for sustainable fisheries development.

The Government further stated that to achieve success with the Ninth Five-Year Plan and the 2010 objectives, two radical changes would be necessary: one was the transformation of the economic system from a traditional planned economy to a socialist market economy, and the other was the change of the pattern of economic expansion from an extensive one to an intensive one. These changes will accelerate the sustainable development of fisheries.

There is great potential for the sustainable development of the Chinese fisheries and at the same time there also exist many constraints. The Ministry of Agriculture recently put forward that by 2000, fisheries output should reach 32 million mt. So far, no official figures for fisheries output in 2010 have been issued, but it is generally believed that it is entirely possible to exceed 40 million mt by then.

5.2 Potential for Fisheries Development

The potential for fisheries development includes:

a) Vast water areas

There are 2.6 million ha of shallow seas and mud flats suitable for aquaculture, but only 27.5 percent is being utilized at present. There are 6.75 million ha of inland water areas suitable for aquaculture with 70 percent being utilized and there are nearly 7.0 million ha of paddy fields which can be used for rice-cum-fish culture with less than one fifth being utilized. Of the water areas now being used, a considerable part is being managed in an extensive way, so there is a potential for raising unit yield. There are also 2.33 million ha of undeveloped low-lying wasteland suitable for aquaculture. In addition, there are more than 300 km^2 of sea areas for marine capture fisheries development.

b) Manpower resources

China is strictly controlling population growth, trying to limit the population to less than 1.3 billion by 2000, but it is growing rapidly. It is estimated that the agricultural population will increase by 7.0 million by 2000. The surplus labour in the rural areas can be used in fisheries development.

c) Market expansion

At present, fish consumption levels vary in different parts of the country. In inland cities, per-caput consumption of aquatic products is less than 1 kg/year. With the improved living standard, residents' demands for aquatic products are on the increase. International trade in aquatic products is also steadily increasing. A large potential exists in domestic and international markets.

d) Application of science and technology and improvement of extension services

On the whole, aquaculture, capture fisheries and processing are extensively managed at a low technical level, but aquatic science and technology have made remarkable progress and are playing a greater role in increasing output. According to an evaluation made by a specialist, from 1980 to 1985 aquatic science and technological achievements brought about an increase in fisheries output, equal to 35 percent; from the 1986 to 1990, progress in aquatic science and technology, input of funds and labourers made contributions to the growth of fisheries equal to 43 percent, 37 percent and 20 percent respectively, and from 1991 to 1995, the progress of aquatic science and technology, input of funds, input of labourers and the expansion of aquaculture areas contributed to a growth of 46 percent, 44 percent, 6 percent and 4 percent respectively. Science and technology, and extension services will continue to contribute to increasing production.

e) Availability of feed

Of the fisheries output to be increased in the next 5 years (1996-2000), 85 percent or about 6 million mt will be from aquaculture. Of the 6 million mt, about 21 percent or 1.22 million mt will be converted from feed grain. It takes 2.24 million mt of feed to produce 1.22 million mt of aquatic products. Actually it takes 1.5 million mt of feed grain in addition to fish meal and bean cakes, or 3 percent of the planned increase in grain yield. Therefore the feed supply is ensured in China.

From 1991 to 1995, on average, the output of aquatic products increased by 2.56 million mt per year, an average growth rate of 15.3 percent. From 1996 to 2000, aquatic products are expected to increase by 1.4 million mt per year or, a 5 percent growth rate is anticipated. The absolute increase in yield and average annual growth rate will apparently be lower than the preceding 5 years. This is a policy which leaves room for unforeseen circumstances.

5.3 Constraints in Fisheries Development

The constraints in Chinese fisheries development are as follows:

a) Weak infrastructure and low unit output

Of the 270,000 marine motorized fishing boats, 93.7 percent are small boats, of less than 10 mt each, with an engine power of less than 60 HP. There are 156,000 freshwater motorized fishing boats, of less than 6 mt each, with an engine power of less than 10 HP. Nearly 80 percent of aquaculture ponds are still natural earthen ponds in poor condition and with low output. In 1995, the average output of a fisherman was 2.2 mt per year, only 1/5-1/4 of the output of some countries where fisheries is more developed. Small-scale and individual fisheries are difficult to incorporate into a strategy for fisheries sustainable development.

b) Weak management capacity

The Chinese fisheries legal system has made great progress, but laws and regulations are not strictly enforced due to insufficient personnel and equipment. Fisheries resources protection and environmental protection are not carried out throughout the country; in some districts the number of fishing boats, gear, and fishing intensity continue to grow without control; operations in violation of the regulations and rules frequently occur and fisheries disputes involving foreign countries are on the increase.

c) Low quality of fish and fishery products

Of the output of capture fisheries, small fish and low-value fish constitute a considerable proportion. Owing to poor processing methods, post-harvest losses are high and some products deteriorate rapidly and thus nutritive value is lost. It is difficult to compete in international markets because of poor quality. It is necessary to establish quality standards for products.

d) Environmental pollution

About 90 percent of freshwater capture output comes from seven rivers. The total length of the river sections which do not conform to the fisheries water quality standards has exceeded 5,000 km. At present, near many large and medium-sized cities, there are belts of highly concentrated waste water causing mass mortality of fish. In seriously polluted rivers, the sections where fish die of pollution, range from 30 to 60 km. In Zhejiang Province alone, polluted water areas which cannot be used have reached 24,000 ha. The harbours, mud flats and river mouths along the sea coast are getting increasingly polluted. According to the incomplete statistics from 15 provinces, in 1993, there were nearly 500 incidents due to pollution. This caused losses of 520 million yuan, of which, losses of marine and freshwater production were 420 million and 100 million yuan respectively.

5.4 Concrete Policies and Measures

Marine capture fisheries

For marine capture, protection and rational utilization of inshore resources, and active expansion of distant-water fisheries are the general policy of development. Owing to the fact that the tendency of the resources to decline has not been stopped, measures will be taken:

i) To further control fishing intensity. In the next 5 years the marine capture fishing intensity will be limited to that of 1995. The fishing boat quota set by the State should be strictly controlled.

ii) To reduce access for fishing in inshore waters and promote aquaculture, processing, transportation, and marketing activities.

iii) To ensure that the non-fishing season every year in the East China and Yellow Sea is 2.5 months, and perhaps extend it to 3 months.

iv) To stop illegal use of poison, dynamite and electricity in fishing.

v) To restrict fishing boats to the designated fishing areas.

vi) To strengthen the protection of the inshore ecological environment, particularly that of fish and shrimp spawning grounds.

vii) To insist on large-scale stocking activities to propagate and enhance the resources.

viii) To further strengthen the enforcement of laws and regulations.

ix) To intensify fisheries resources investigations.

x) To continue to render preferential treatment through fund allocations and tax policies to distant fisheries.

Freshwater capture fisheries

During the past ten years, freshwater capture output has been increasing, but its proportion of the total fisheries output is getting smaller. Its growth rate is not as high as those of other sectors. As in marine capture fisheries, the main problem is the decline of the resources caused by changes in the ecological environment and pollution. Policies and measures for improvement are as follows:

i) The institutions which have built sluice gates and dams across fish passages which prevent fish from migrating, should construct fishways or take other remedial steps.

ii) The water bodies used for fisheries and irrigation should have a minimum water level to protect fishery resources and fishery activities.

iii) At present, not only should reclamation of land be prohibited, but reclaimed areas should be converted to lakes.

iv) For fishing activities, there is a licensing system; the institutions or individuals that are engaged in fishing must operate in accordance with the rules and regulations with respect to registering kinds and numbers of fishing gear, fishing areas, fishing time limits, etc.

v) The Law of Prevention and Treatment of Water Pollution clearly provides that the ecological environment of water bodies be protected and improved. Recently the State made some amendments to the above laws: those who cause pollution to fisheries should be punished by the fisheries administration concerned and fined according to the damage and losses caused, thus putting an end to the usual practice of environmental protection departments handling these cases. This is an important function the State entrusts to fisheries administrations. In this way, fisheries departments will strengthen the monitoring of fisheries water bodies and the collection of evidence. These measures are also suitable for the protection of the marine fisheries environment.

vi) Stocking in large water bodies is an important measure to enhance natural fisheries resources. During the past ten years, the restoration and increase of freshwater capture output has been closely related to stocking activities in different places. The country will pay more attention to this and develop it on a larger scale at a faster rate.

Aquaculture

For more than ten years, aquaculture has been the fastest growing sector in terms of output. The State, while paying attention to grain production is giving increased emphasis to the development of culture activities, particularly aquaculture and livestock and poultry, to strengthen food security. By 2000, the proportion of aquaculture output is expected to be over 60 percent of the total fisheries output.

i) Aquaculture areas will continue to be expanded, particularly marine aquaculture areas have great potential, and with more technical knowhow, the cultivable water areas can be further expanded. Freshwater aquaculture areas will be expanded mainly by developing untapped land and water areas, low-lying saline-alkaline wasteland, and making further use of large and medium-sized water bodies. Concrete stipulations will be worked out for auctioning land or transferring the rights of use of untapped land

and water areas. Freshwater ponds will be reconstructed according to high standards. Some fish ponds have been taken over owing to the competition between land and water use. Therefore, in some major producing areas, protective zones around culture ponds will be set up.

ii) Intensive high-yield technology to raise per unit output will be spread and a large-scale and balanced increase in production will be promoted. The increase in output will be changed from an extensive pattern to an intensive one by promoting net-cage, net-enclosure and net-screen culture. Three-dimensional ecological culture technology will be developed.

iii) Integrated culture will continue, combining fisheries, agriculture, animal husbandry and sideline productions to raise the utilization ratio of water bodies and land areas, as well as the degree of self-sufficiency in fish feed supply.

iv) The propagation of original species and improved-variety bases will be promoted, directional systematic selection will be made, seed and fry quality will be improved, and improved-variety coverage will be raised. The seed and fry as intermediate products in the course of production will be exempt from the agriculture special products tax so as to increase initiative in seed and fry production.

v) Improved technologies for keeping aquaculture products alive or fresh will be used, as well as those for processing and integrated utilization. Pre-production and post-production service facilities will be perfected and distribution channels will be set up to open up urban and rural markets.

vi) Commercial fish bases will be established to ensure supplies for large and medium-sized cities as well as for export.

vii) Paddy field fish culture will be expanded and new ways of farming fish in rice fields will be promoted, and finally,

viii) Pollution produced by aquaculture itself and the outbreak of fish diseases have become a great hindrance making it necessary to further study and control shrimp diseases to ensure sustainable, healthy development.

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Table 1. China fisheries production by sector (1949-1995)

(000 mt)

Year	Marine capture	Freshwater capture	Aquaculture	Total
1949	342 927	85 000	20 000	447 927
1950	535 579	300 000	75 000	911 539
1951	784 817	400 000	147 193	1 332 010
1952	1 000 062	470 204	196 000	1 666 266
1953	1 148 135	499 604	252 000	1 899 739
1954	1 305 390	622 311	365 781	2 293 482
1955	1 549 129	542 773	425 984	2 517 886
1956	1 642 039	602 312	403 196	2 647 547
1957	1 814 811	614 457	685 946	3 116 214
1958	1 623 934	549 290	637 838	2 811 062
1959	1 753 607	634 240	701 341	3 089 188
1960	1 748 795	668 523	620 505	3 037 823
1961	1 336 236	528 630	439 762	2 304 628
1962	1 409 953	469 931	403 122	2 283 006
1963	1 670 668	495 951	726 627	2 614 246
1964	1 803 509	524 340	476 285	2 804 134
1965	1 909 756	455 797	618 744	2 984 297
1966	2 056 356	396 933	644 783	3 098 072
1967	2 052 675	358 961	639 945	3 051 581
1968	1 775 506	305 319	630 247	2 711 072
1969	1 890 658	305 924	699 715	2 899 297
1970	2 097 147	321 717	785 661	3 184 525
1971	2 330 653	315 927	849 324	3 495 904
1972	2 658 658	306 682	876 986	3 842 326
1973	2 690 684	361 032	879 338	3 931 054
1974	3 005 872	317 253	959 065	4 282 181
1975	3 063 017	312 369	1 031 374	4 411 760
1976	3 122 281	315 827	1 038 019	4 476 127
1977	3 195 060	307 781	1 191 811	4 694 652
1978	3 145 249	296 411	1 211 792	4 653 482
1979	2 772 864	302 555	1 229 253	4 304 672
1980	2 812 689	338 472	1 345 824	4 496 985
1981	2 774 128	359 414	1 472 202	4 605 744
1982	3 098 364	354 824	1 701 862	5 155 050
1983	3 072 296	412 577	1 973 270	5 458 143
1984	3 305 220	438 571	2 449 646	6 193 437
1985	3 485 166	475 127	3 091 482	7 051 775
1986	3 896 140	530 249	3 809 086	8 235 475
1987	4 381 079	587 424	4 584 687	9 553 200
1988	4 633 306	654 440	5 321 993	10 609 739
1989	5 036 394	734 360	5 745 894	11 516 648
1990	5 508 862	778 507	6 083 170	12 370 548
1991	6 096 358	912 602	6 530 516	13 539 476
1992	6 912 314	900 800	7 762 544	15 575 658
1993	7 673 429	1 018 824	9 569 562	18 261 815
1994	8 958 917	1 152 562	11 352 594	21 464 073
1995	10 268 373	1 372 864	13 530 557	25 171 794

Table 2. Exports and imports of fisheries products by weight and value (1978-1995)

Year	Export (thousand mt)	Export (million US$)	Import (thousand mt)	Import (million US$)
1978	92.04	258.68		
1979	97.83	348.46		
1980	105.70	356.37		
1981	102.18	343.12	57.89	15.37
1982	101.14	313.11	163.31	57.93
1983	104.59	280.68	126.65	39.82
1984	99.71	269.64	240.52	81.21
1985	124.28	271.64	329.00	91.47
1986	172.77	490.45	308.00	78.46
1987	227.22	720.95	305.00	123.90
1988	275.72	768.53	574.00	333.00
1989	306.18	1 038.99	656.00	360.00
1990	370.67	1 369.79	601.00	207.00
1991	377.86	1 181.16	791.00	488.00
1992	514.91	1 678.12	1 042.00	688.00
1993	548.82	1 646.77	945.23	583.31
1994	684.18	2 606.99	1 268.56	867.07
1995	740.00	3 290.00	1 340.00	960.00

Table 3. Major species of marine capture production (1995)

Species	(mt)
Big yellow croaker	67 031
Small yellow croaker	153 048
Hairtail	1 039 684
Chinese herring	46 635
Mackerel	226 520
Conger pike	154 867
Red coat	224 574
Pomfret	209 031
Porgy	58 576
Chub mackerel	372 038
Round scad	515 298
Anchovy	489 066
Sardine	58 434
Pacific herring	2 325
Filleted fish	122 358
Prawn	43 043
Southern rough shrimp	151 746
Northern mauxia shrimp	390 402
Swimming crab	243 485
Cuttle fish	213 772
Jelly fish	171 905

Table 4. Water areas of China and 1995 hectare output

	Total area (ha)	Cultivable area (ha)	Cultured area (ha)	Average production (kg/ha)
Inland:	17 471 300	6 749 250	4 669 340	2 015
Ponds	1 921 560	1 921 560	1 857 810	3 742
Lakes	2 524 250	2 150 540	824 330	710
Reservoirs	2 301 630	1 883 830	1 515 620	538
Rivers	5 277 750	766 130	347 330	1 337
Marine:	-	2 600 110	715 750	5 760
Shallow water*	7 848 153	1 622 560	131 760	17 195
Mud flats	1 966 386	797 000	424 570	3 656
Bays and gulfs	-	180 550	159 420	1 912

* Shallow water area – within 10-meter water depth.

Table 5. Chinese exports of fisheries products by major kind (1994)

Commodity	Kg	Value (US$)
Live fish	67 325 788	188 705 348
Fish (fresh/frozen)	42 669 576	118 944 277
Fish (refrigerated)	69 561 394	187 324 464
Fish (prepared and preserved)	33 725 209	428 144 119
Fillets	93 208 854	167 181 291
Crustaceans	101 327 386	570 931 912
Invertebrates	185 272 714	451 217 834
Crustaceans and invertebrates (prepared and preserved)	28 412 679	95 070 281
Seaweeds	35 567 860	56 921 081
Gelatin (brown algae)	11 007 277	30 378 012
Pearls	469 237	167 116 925
Others	15 633 669	145 058 703
Total	684 181 643	2 606 994 247

Table 6. Chinese imports of fisheries products by major kind (1994)

Commodity	Kg	Value (US$)
Live fish	416 398	95 276 766
Fish (fresh/frozen)	18 339 531	13 351 138
Fish (refrigerated)	470 858 464	252 695 916
Fish (dry/salted/smoked)	11 932 684	26 407 963
Crustaceans	29 960 889	126 029 007
Invertebrates	37 970 681	46 597 153
Fish-meal	667 841 877	277 381 543
Pearls	48 283	3 461 856
Others	31 197 908	26 869 482
Total	1 268 566 715	868 070 824

Table 7. Number of fisheries labourers and fishing boats (1978-1995)

Year	Fishery labourers	Fishing boats (motorized)	Fishing boats (non-motorized)
1978	2 401 208	47 176	350 360
1979	2 653 615	52 225	344 190
1980	2 950 344	61 022	382 583
1981	3 283 649	75 109	403 873
1982	3 825 352	99 328	423 909
1983	4 256 968	124 368	475 052
1984	5 113 810	152 606	560 678
1985	5 954 193	185 336	570 757
1986	7 307 657	221 917	540 544
1987	7 988 479	267 990	574 283
1988	8 540 723	303 935	533 264
1989	8 780 465	336 254	523 974
1990	9 092 926	362 377	548 249
1991	9 202 780	373 964	534 684
1992	9 664 534	384 531	560 452
1993	10 071 681	397 735	494 468
1994	10 843 890	409 346	519 487
1995	11 428 655	432 674	530 467

Table 8. Major external assistance to the China Fisheries sector

Project	Year	Funding agency	Cost (million US$)
1. Development of fishery in Hongze County, Jiangsu Province	1982-1986	WFP	10.07
2. Developing aquaculture in the low-lying areas on Hangzhou Bay, Zhejiang Province	1984-1987	WFP	11.79
3. Development of fish and forage production in low-lying saline-alkaline areas in Tianjin City	1984-1987	WFP	12.19
4. Development of aquaculture in low-lying areas, Boyang Lake, Jiangxi Province	1984-1987	WFP	8.75
5. Development of coastal aquaculture in Bohai Bay	1986-1988	WFP	21.90
6. Development of integrated fish farming in nine cities	1987-1990	WFP	37.64
7. Sino-Norway Cooperation Project	1984-1996	Norway Govt.	18.0 (NOK)
8. Mariculture Demonstration Project	1985-1987	UNDP	0.68
9. China Freshwater Fisheries Project	1986-1992	World Bank	65.95
10. Rural Credit II	1986-1990	World Bank	96.80
11. Coastal Lands Development Project in Jiangsu and Zhejiang Provinces	1988-1994	World Bank	152.00
12. Hebai Agriculture Development Project	1991-1995	World Bank	29.80
13. Guangdong Agriculture Development Project	1992-1997	World Bank	111.50
14. Shanddong Agriculture Development Project	1989-1994	World Bank	111.30
15. Songliao Agriculture Development Project, Jilin and Liaoning Provinces	1994-1999	World Bank	26.10
16. Pilot plant for compound fish feed, Shaoxing County, Zhejinag Province	1987-1991	FAO	0.27
17. Pilot project to increase fish farm output, Tianjin City and Zhejiang Province	1987-1991	EEC	2.31
18. Marine fisheries development, Fujian Province	1991-1995	EEC	5.30
19. Fisheries Development in Qinghai Province	1991-1992	UNDP/FAO	1.40
20. Guangdong integrated freshwater fish-farming project	1987-1992	IFAD	12.00

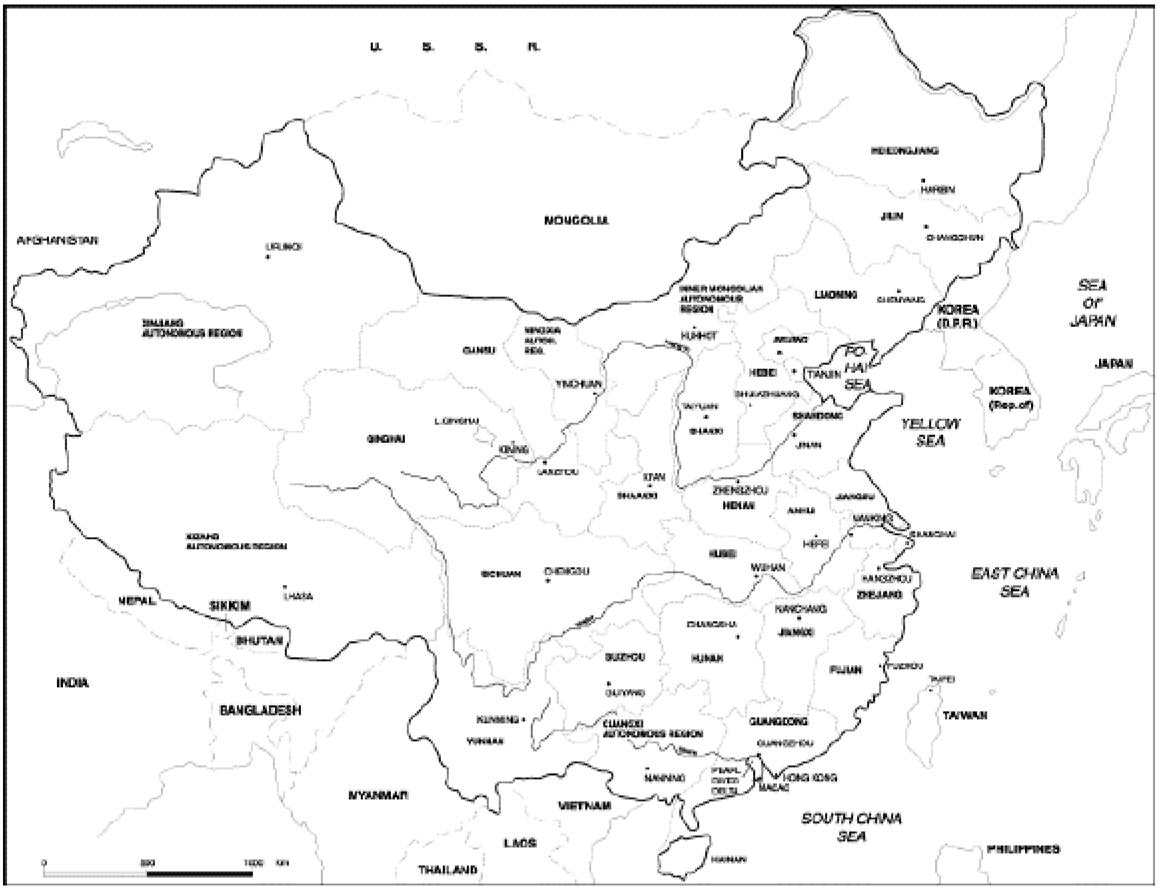

Figure 1. Map of China

Ministry of Agriculture

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Bureau of Fisheries

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Staff Office

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Personnel Division

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Fisheries Policies, Laws and Regulations Division

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Planning and Statistics Division

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Finance Division

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Scientific Technology and Education Division

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Environment Protection Division

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Capture Fisheries Division

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Aquaculture Division

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Market Information Division

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Quality Standard and Fishery Machinery Division

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Aquatic Products Processing Division

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Fisheries Administration Division

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Aquatic Wildlife Protection & Management Division

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Telecommunications and Navigation Division

↓

Fishing Port Superintendence and Safety Division

↓

International Cooperation Division

↓

Distant Water Fisheries Division

Figure 2. Organizational structure of Bureau of Fisheries

THE SUSTAINABLE CONTRIBUTION OF FISHERIES TO FOOD SECURITY IN SOUTHEAST ASIA

by

Deb Menasveta

1. Introduction

This study is a contribution to the FAO Regional Office for Asia and the Pacific's TSS-1 project entitled "the Review on Food Security Issues and Challenges in Asia and the Pacific Region". It was prepared under contract by Dr. Deb Menasveta, fisheries consultant to FAO/RAP, in compliance with the following terms of reference:

1. To discuss and analyze the present fish production situation in Southeast Asia, future opportunities and outlook for fish supplies to 2010 and beyond;

2. To analyze the contribution of the fisheries sector to the overall food security with special reference to production of fish for household consumption and generation of income/employment;

3. To analyze the present policy issues/measures for fisheries management and development and identify the constraints to sustainable development of fisheries in Southeast Asian countries;

4. To recommend mechanisms and approaches to be followed by these countries for maximizing fisheries contribution to the sub-regional food security; and

5. To recommend policy framework (issues/measures) for sustainable contribution of fisheries to food security in the sub-region.

The paper was prepared following the outline as agreed upon by the RAP/TSS-1 Task Force.

2. The Southeast Asian Sub-region

The Southeast Asian sub-region is located roughly between lat. 10^{o} South and 25^{o} North and long. 94.5^{o} East and 140^{o} East. It covers the land mass of the mainland Asian continent that lies between the basins of the Irrawady and Mekong river systems. There are ten countries in this sub-region. The mainland peninsular countries are Cambodia, Laos, Malaysia, Myanmar, Singapore, Thailand and Vietnam. The remaining three countries are Brunei Darussalam, a small country on the island of Kalimantan, and two archipelagic States; namely, Indonesia and the Philippines. According to the international ocean regime established under the 1982 United Nations Convention on the Law of the Sea (UNCLOS), Brunei Darussalam, Cambodia, Malaysia, Myanmar and Thailand are considered zone-locked countries; Singapore is geographically disadvantaged; Laos is the only land-locked State in the sub-region; and Vietnam does not fall into any of the above categories as it has the open sea to the East (Kittichaisaree, 1993). The total land area of the Southeast Asian sub-region is approximately 4,482,000 km^2 (Table 1).

The Southeast Asian sub-region also covers a large expanse of marine waters; viz., the South China Sea and its contiguous waters, which contribute to the food security of the sub-region by producing a large quantity of marine food. The South China Sea is a semi-enclosed sea. It contains a deep basin and two expansive continental shelf areas which are relatively shallow, estimated to be about 20 percent of the shallow shelf areas of the world. These shallow areas are the Mainland Shelf in the north and northeast of the South China Sea and the Sunda Shelf including the Gulf of Thailand in the south and southwest. The total area of the South China Sea is about 3.5 million km^2, of which 1.5 million km^2 are contained in the South China Sea basin and 2 million km^2 in the shelf areas which are less than 500 meters in depth (Menasveta and Hongskul, 1988). Contiguous to the South China Sea are the Malacca Straits, the Java, Flores, Banda, Ceram, Molluca, Celebes and Sulu seas and the Philippine Sea. The total area of Southeast Asian waters is about 9 million km^2, which represents about 3 percent of the world's ocean surface. Most of the contiguous waters are under the jurisdiction of the archipelagic States, Indonesia and the Philippines. The South China Sea does not have any high sea area.

The sub-region is influenced by the tropical monsoon regime and the climate is dominated by two monsoons annually, namely, the southwest monsoon (May to October) and the northeast monsoon (November to April). Hence the region has, in general, a high ambient temperature (35-38^o C.) in the dry season and a high rainfall (200-250 mm per month) in the rainy season. The rainfall occurs during the southwest monsoon period, and the dry period prevails during the northeast monsoon.

The climate greatly influences the richness and productivity of the living resources in Southeast Asia. The tropical monsoons bring about nutrient enrichment of the waters in the shallow shelf areas and induce discharges during the rainy season from large rivers such as the Irrawady, the Chao Phraya and the Mekong, and from many other rivers and streams in the region. This has led to high biodiversity and high production of fish and shellfishes in the region in floodplain areas, inland waters, and in the seas.

Table 1 indicates selected economic and social parameters of the Southeast Asian countries. There exists a great diversity of ethnic, cultural, political, religious and language backgrounds among the countries and peoples of Southeast Asia. Diversity also exists with respect to the size of the countries and their populations, GNP, the state of development of the fishing industry, rate of economic and social development, etc. Notwithstanding these differences, there are a number of similarities including the generally low level of income; high birth rate in many countries of the region; and steadily rising fish production due primarily to technology transfer and improvements of technologies employed.

In the fisheries sector, there are several common features. These include the same types of aquatic fauna and flora (Indo-Malay region) exploited by both inland and marine capture fisheries; the currently intense exploitation of the fishery resources in inland waters and coastal areas of the exclusive economic zones (EEZs) of the countries in the region; the high per capita consumption of fish by the peoples; the nature and role of capture fisheries and aquaculture in the national economies; and the problems experienced in the management and development of fisheries by these countries (Marr, 1976). It should be mentioned, however, that fisheries interests of the countries in the region are influenced by the differences in political geography of the ten countries as indicated earlier, and in the levels of economic and social development. The conflict of national interests has presented challenges to national fisheries policy-making of the individual countries and to regional diplomacy (Kittichaisaree, *op. cit.*).

3. Fisheries and Food Security

3.1 Concepts

The definition of food security was endorsed by the International Conference on Nutrition (Rome, December 1992) as "a state of affairs where all people at all times have access to safe and nutritious food to maintain a healthy and active life". FAO has also defined the term food security at the household level as "physical and economic access to adequate food for all household members without undue risk of losing such access" (FAO, 1995d).

It is generally recognized that the root cause of food insecurity is poverty. The people who are susceptible to food insecurity are predominantly those living in rural areas, including fishing and fish farming communities. In Southeast Asia, the majority of fisherfolk and their communities, who are the primary producers of food fish, are still underprivileged and live a very poor life. The eradication of poverty and the maintenance of food security to ensure food for all are, therefore, given high priority by almost all of the governments of the region.

Fish and rice have constituted the staple diet of the Southeast Asian people since time immemorial, as fish is acceptable to all ethnic and religious groups. Fish, including seafood, provide from 25 to 65 percent of the total animal protein consumption; they have, thus, an important role in the food security of the Southeast Asian countries in providing a supply of nutritious food, which includes protein, essential amino acids, fish oils and essential micronutrients such as calcium, iodine and some vitamins. The average annual per-caput consumption of fish in the region, during 1991-93, was high, being 21.0 kg/person (Table 1), as compared with the world average of 13.0 kg/person (FAO 1996b).

Fish provide a wide range of food at a wide range of prices, depending on species and size. They occasionally serve as famine crops, being subject to heavy exploitation when other sources of animal protein are scarce (FAO, 1995d). In Southeast Asia, the rate of utilization of fish, especially freshwater fish, is high, as almost all kinds of fish are eaten and in practically any state of preservation (Doulman, 1993; FAO, *ibid*.). Fisheries has, thus, an important role to play in ensuring food security for the steadily expanding populations of Southeast Asia, especially the low-income rural communities and urban poor.

Fisheries also contributes to the economic and social betterment of the countries in question. More than four million people are engaged in the primary economic activity, viz., capture or culture fisheries, either on a full-time or a part-time basis, both in small-scale and commercial capture fisheries and in fish farming. The estimated number of persons employed in fisheries-related industries such as processing, distribution and trade amounts to some 20 million.

Besides its contribution to employment and income earnings, fisheries also provides benefits to the economic wealth of the regional countries. The trade of fisheries commodities has developed rapidly during the past two decades, and they have become one of the most important commodities in international trade. Indonesia, Malaysia, the Philippines, Thailand and Vietnam have earned substantial foreign exchange through the export of their fish and fishery products. This will be detailed later in this report.

4. Fisheries Sector

Although the contribution of the fisheries sector in terms of GDP, as compared to other economic sectors, has gradually declined during the last two decades due to industrialization in a number of the countries, its significant contribution to food security and economic wealth is still recognized by the governments of the region. This can be seen from policy statements regarding the development of the fisheries sector in Cambodia, Indonesia, Malaysia, the Philippines, Thailand and Vietnam. Several countries have, since the sixties, incorporated fisheries in their individual economic and social development plans (Menasveta, 1995).

The fisheries sector is unique when compared with other economic sectors, as it operates on limited resources. The steadily expanding population of the Southeast Asian countries has created an increasing demand for fish for animal protein, because of either custom or preference. Together with the rising demand for quality fish and fishery products from developed markets outside the sub-region, facilitated by trade liberalization, and the increase in efficiency of fishing boats and gear, the exploitation of fishery resources in the sub-region both in inland waters and coastal waters has increased greatly in intensity. On the other hand, the rapid development of capture fisheries and aquaculture in recent years, without wise and effective management, has led to a steady decline in the abundance of fishery resources in many fishing grounds in freshwater and marine coastal areas as well as in the degradation of fish habitat and coastal environment. The problems affecting the sector have also been aggravated by the rapid and uncontrolled development of other economic sectors, e.g. agriculture, irrigation, transportation, tourism, etc., some of which have had a negative impact on fishery resources and their habitat. The problems are more pronounced in inland and coastal waters. It is now generally recognized that such a pattern of fishery resources use and uncontrolled development will not lead to the sustainability of the resources and fisheries. If the situation continues to prevail without any remedies, it will have a severe impact on food security of the countries concerned in the future and, in particular, on the less fortunate groups therein. The individual governments in the region are now endeavouring to address relevant issues confronting the fisheries sector with a view to ensuring its sustainable contribution to food security and economic wealth.

To facilitate a better understanding of the fishery sector of the Southeast Asian sub-region, an analysis of the state of the fishing industry, fishery resources, and levels of exploitation thereof appears below.

4.1 Status of the Fishing Industry

Southeast Asian capture fisheries can be categorized as a multi-gear, multi-species fisheries. The fisheries in both inland and marine waters are operated by a large number of small-scale fishermen and their families, employing a vast variety of fishing gear, many of which are of traditional types. Only a small part of the total fishing work force are engaged in semi-commercial or commercial fisheries, employing bigger and more efficient fishing boats and gear such as trawlers, purse seiners and tuna longliners. It is, nevertheless, this latter group that has contributed to the rapid increase in fisheries production and economic wealth and, rather unfortunately, to the depletion of fish stocks in several fishing grounds of the sub-region.

There are no reliable statistics in any country of the region concerning the number of fishermen and the divisions of their employment, e.g., in aquaculture, inland or marine capture activities. The figures, only approximations, are obtained primarily from reports occasionally submitted to sessions of the Indo-Pacific Fishery Commission (IPFC), now referred to as the Asia-Pacific Fishery Commission (APFIC), and its subsidiary bodies and to the meetings of other regional organizations such as the Southeast Asian Fisheries Development Center (SEAFDEC), or fisheries conferences and workshops convened in the sub-region.

Whilst there have been these reports on the state of the fishing industry of the Southeast Asian sub-region in the past, the most recent comprehensive analysis for South and Southeast Asia of the industry is given by Hotta (1996), from which the data on Southeast Asia were excerpted for this report.

In Southeast Asia, the total fisheries work force consists of full-time and part-time fishermen, estimated to be about 5.4 million in 1993/94, of which 3.2 million (60 percent) were engaged in marine capture fisheries, 900,000 persons (17 percent) in inland capture fisheries, and 1.2 million (23 percent) in aquaculture. Indonesia has the highest number of fishermen, estimated to be about 2.9 million, of whom more than 50 percent are engaged in marine capture fisheries, 35 percent in aquaculture and the remaining in inland capture fisheries. Part-time fishermen are used in both inland and marine capture fisheries (during the high season) in Indonesia. In Thailand, due to the decreasing number of local fishermen in the fishing sector in recent years, foreign labourers have been employed as boat crew on the Thai fishing fleet in offshore marine capture fisheries. In Cambodia and Laos, fishermen are engaged primarily in the inland capture fisheries and aquaculture.

Assuming that each employment in the primary economic activities generates not less than four more employment opportunities in secondary and related economic activities (e.g., fish marketing, processing, boat building, construction, maintenance and repair of gear and equipment, input supplies), it can be said that fisheries supports the livelihood of more than 20 million people in Southeast Asia (Hotta, *ibid*.).

It should be noted, however, that the annual rate of increase in the number of fishermen during the past decade (1985-1994) was rather modest, being only 2.4 percent as compared to the 9.5 percent estimated for the period 1975-85. There were several factors which influenced this reduction. One seems to be the increasing availability of alternative employment opportunities in the newly industrialized countries, such as Malaysia and Thailand. The other reasons include the increasing use of labour-saving devices in the fishing industry; entry restrictions through licensing systems; and the increasing difficulty of earning a satisfactory income in capture fisheries due to the decline in the abundance of marine and inland fishery resources in many fishing grounds.

In analyzing the fleet structure of the fisheries in South and Southeast Asia, Hotta (*ibid*.) grouped the region's fishing boats into three broad categories; viz., those less than 25 mt, those less than 100 mt and those more than 100 mt. In Southeast Asia, the total number of fishing boats was roughly estimated at 280,000 in 1992, of which 70 percent were small open traditional fishing boats classified as "without tonnage" used in inland and coastal waters by small-scale fishermen. The number may have been underestimated as there are a number of fishing boats unaccounted for in the registration or records of several countries. Thailand is now trying to legalize previously non-registered fishing vessels amounting to more than 8,000 small trawlers and push netters (less than 5 meters in length).

Approximately 40 percent of medium-sized or large-sized vessels are trawlers which catch mainly demersal fishery resources including shrimps (*Penaeus* and *Metapenaeus* spp). Thailand has the largest trawler fleet in the sub-region, followed by Malaysia. Gill-netters, targeting small and medium-sized pelagic fish, e.g., scads (*Decapterus* spp.) and Spanish mackerels (*Scomberomorus* spp.), and accounting for about 30 percent of the total fishing fleet, are used in all countries. Approximately 20 percent of the fleet are purse seiners of various sizes which capture mainly small-sized pelagic fish such as Indo-Pacific short mackerel (*Rastrelliger brachysoma*); Thailand has the largest purse seiner fleet. Longliners are mainly operated by Indonesia to catch large pelagic fish such as tuna.

The analysis mentioned showed a declining trend in the number of fishing vessels of less than 25 mt in some major fish producing countries in the region, but an upward trend in the number of vessels between 100 and 1,000 mt. For instance, the number of fishing boats of less than 25 mt in Malaysia dropped from 30,000 in 1984 to 24,000 in 1992, a decline of about 20 percent. A decreasing trend of this category during the same period was also observed for the Philippines, Singapore and Vietnam. However, Indonesia and Thailand expanded the size of their fleets to fish in offshore waters and the high seas. The Philippines and Indonesia had the highest number of fishing boats of more than 100 mt, accounting for about 80 percent of the fleet of this category; these vessels are used mainly for capturing large pelagic fish such as tuna in offshore waters and the high seas. With a plan to develop its tuna fisheries in the Indian Ocean, Thailand may acquire larger-sized fishing vessels, particularly large purse seiners, in the near future.

Regarding the age of the vessels, it was reported that about 95 percent of the fishing boats of over 100 mt in the Philippines were more than 10 years old, whilst 70 percent of the Indonesian vessels were more than 20 years old (Hotta, *op. cit.*).

With substantial investment both from domestic and foreign sources in the fisheries sector, Indonesia, Malaysia, the Philippines and Thailand now possess modern ice plants and fish processing facilities including canneries to ensure the quality of their fish and fishery products for export. However, the quality of the products for domestic consumption in these countries still leaves much to be desired. Other countries in the region such as Brunei, Cambodia, Myanmar and Vietnam still need to improve their infrastructure, distribution, and processing industries to cope with future expansion.

4.2 Trends in Fish Production

Prior to the sixties, the contribution of fisheries of the ten Southeast Asian countries to the world's fish production was rather insignificant, with an average annual production of less than two million mt. This was due mainly to the lack of modern harvesting technologies, lack of demand and market outlets, and perhaps to unreliable and inadequate statistics (Menasveta, 1995).

After 1960, the fisheries situation changed dramatically. There was rapid development in the marine fisheries sub-sector as a result of technical assistance through bilateral or multilateral arrangements and increased investment in fisheries by the private sector. With an increasing demand for fish from both domestic and foreign markets, fish production of the sub-region continued its rising trend from the seventies to the early nineties (Figure 1).

Table 2 shows the total fish production trend of Southeast Asia during 1984-94. The period registered an average annual increase in fish production of about 5 percent. The annual contribution of the sub-region to the world's total fish production rose from 10.1 percent in 1984 to 11.8 percent in 1994. The major fish producing countries of the region are Indonesia, Philippines and Thailand, with a combined production in 1994 of 10 million mt or 75 percent of the total fish production of the sub-region.

Marine capture fisheries

During the sixties, when trawling was first introduced in the Thai waters, marine fisheries of the sub-region developed at a faster pace, and production has continued to rise. The total marine fisheries production increased from 1.7 million mt in 1960 to 5.9 million mt in 1980.

During 1984-94, the total catch of marine capture fisheries steadily increased from 6.7 million mt in 1984 to about 8 million mt in 1989, and to nearly 10 million mt in 1994, representing an average annual increase of about five percent. The contribution to the world's marine capture landings rose from 9.4 percent in 1984 to 12 percent in 1994 (Table 3). Indonesia, Thailand and the Philippines were the major producers of marine catches in 1994, with a combined production of 75 percent of the total marine landings. Approximately 70 percent of the catches came from the South China Sea and its contiguous waters (FAO Statistical Area 71). Indonesia, Malaysia and Thailand also fish in the Eastern Indian Ocean including the Andaman Sea (FAO Statistical Area 57), and those landings contributed to the remainder of the total marine landings of the sub-region. As Indonesia, the Philippines and Thailand have distant water fishing fleets, part of the marine catch probably comes from the high seas. The rising trend in marine fish production of these countries therefore conceals the declining productivity or depletion of fish stocks of local fishing grounds.

Table 4 shows the estimated marine catches in 1994 of the Southeast Asian countries, sorted out by country and by group of species. Demersal food fish are those caught mainly by trawl net fishing; small and medium-sized pelagic fish by purse seining and gill netting; tuna and tuna-like fishes by gill netting, purse seining and longlining; marine crabs, shrimps and prawns and cephalopods mainly by trawling. The reported marine catches of Myanmar and Vietnam were aggregated and could not be broken down. It should be noted that some of the reported fish, crustacean and mollusc catches may include those from aquaculture; e.g. a substantial amount of prawn (*Penaeus monodon*) in the catch may be those produced by brackishwater aquaculture, perhaps about 40 percent.

The breakdown of the marine catch of 1994 indicates that about 20 percent of the total landings were small and medium-sized pelagic species (e.g. mackerels and scads), followed by demersal fishes (16 percent) and tuna and tuna-like fishes (9 percent). Shrimps and prawns *(Metapenaeus* and *Penaeus* spp.) and cephalopods constituted about 11 percent.

A large amount of catch unfortunately consisted of miscellaneous species and juveniles of commercially important species caught mainly by trawl net fishing. The bycatches or unsorted fish, referred to collectively as trash fish, of Indonesia, Malaysia and Thailand alone amounted to some two million mt or 20 percent of the total marine catches. Of the total trash fish caught, 65 percent were produced by Thailand. Trash fish are converted to fish-meal in Malaysia and Thailand, which is in heavy demand to support aquaculture and livestock production. The remaining portion of the total marine catches consisted of unsorted small decapods and other organisms such as marine turtles, sea cucumbers, jelly fish, etc.

The state of exploitation of marine fishery resources in Southeast Asia has been reviewed regularly, at its past sessions, by the Committee on Marine Fisheries (COMAF) of the Asia-Pacific Fishery Commission (APFIC)[1]. Some fisheries conferences, seminars or workshops convened in the region in recent years, such as the ASEAN Conference on Fisheries Management and Development for the ASEAN Region for the Year 2000 (Bangkok, Thailand, 26-29 July 1994) also reviewed the state of fishery resources in the sub-region. It is generally recognized that, because of increasing fishing pressure in most of the inshore and coastal water fishing grounds, the fishery resources, especially of demersal fish, have been fully or over-exploited and more effort will be unlikely to increase the total catches in the future. The marine areas with intense fishing pressure include the northern mainland shelf of the South China Sea, the Gulf of Tonkin, the Gulf of Thailand, the coastal waters off Thailand in the Andaman Sea, the Malacca Straits and the Java Sea.

Despite limited information and statistical data, sustainable yields of the fish stocks in parts of the South China Sea and its contiguous waters were roughly estimated in the past, employing certain theoretical models (Gulland, 1971; Aoyama,1973; Menasveta *et al*., 1973; South China Sea Fisheries Development and Coordinating Programme, 1976a, b; 1977a, b; 1978; 1980; Chikuni, 1987). In the eighties, the International Center for Living Aquatic Resources Management (ICLARM) and scientists of several countries in the sub-region in collaboration with FAO, equipped with more reliable catch and effort data, contributed valuable knowledge about the current state of the fish stocks in some fishing grounds e.g., the Gulf of Thailand, the waters around the Philippines and Indonesian waters.

In order to have a general picture of the current levels of exploitation of the various groups of fishery resources as compared to their estimated potential yields, the potential yield estimates of Chikuni, (*ibid*.) are presented in Table 5. The 1994 marine catch data from Table 4 are used for comparison, assuming that 70 percent of the total catch reported was obtained from the South China Sea and its contiguous waters and that 60 percent of the total prawn catch was from capture fisheries. Table 5 indicates that the amount of catch in the South China Sea and its contiguous waters is approaching its sustainable limit. Demersal fish and prawn and tuna resources may have been fully or over-exploited. The table also indicates that there is room for further expansion of fisheries on small pelagic fish, cephalopod and mollusc resources.

Chikuni was of the opinion that a moderate expansion of the skipjack and yellowfin tuna fisheries could be made, as the stocks exploited in the South China Sea were part of the entire stocks widely distributed in the Pacific Ocean beyond the eastern border of the region, and that they were moderately fished during that period.

<u>Inland capture fisheries</u>

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1 Formerly the Indo-Pacific Fishery Commission Committee for the Development and Management of Fisheries in the South China Sea (CDMSCS of IPFC).

Inland capture fisheries has contributed significantly toward the maintenance of food security, especially for the rural communities living in the interior of the Southeast Asian countries, which possess more than 500,000 km^2 of natural swamps, marshes, natural lakes, reservoirs, rivers and streams (FAO, 1993a). Table 6 indicates the trends in the catches of inland capture fisheries. It should be noted that the statistics used are the FAO inland fisheries production statistics minus the production from inland aquaculture. The table shows that the inland capture fisheries of the region apparently stabilized at about one million mt over the period 1984-94. The sub-regional contribution to the world inland capture fisheries production declined steadily from 19 percent in 1984 to 15 percent in 1989, and to 14 percent in 1994.

The major inland capture fisheries countries are Indonesia and the Philippines, with a combined production of slightly more than half of the sub-region's total. In Thailand and Vietnam, the annual inland capture fisheries production during the period under study was on the average 114,000 mt and 134,000 mt, respectively. In Cambodia, inland capture fisheries produced about 63 percent of the country's total fisheries catch in 1994, mainly in Tonle Sap and the floodplains. However, production is on the decline due to environmental degradation and increasing fishing pressure which is a result of the increasing demand from the country's expanding population. Environmental degradation has, likewise, affected the production of the inland capture fisheries of Malaysia, whose declining trend was also observed. There was a moderate increase in the inland fisheries production of Myanmar, mainly from seasonally inundated areas during this period.

Aquaculture

Aquaculture has been practised in Southeast Asia for generations, employing traditional systems which are site specific, i.e., the systems are integrated with surrounding activities (Menasveta, 1995). Prior to the sixties, aquaculture was limited to a few species, mainly freshwater fish and molluscs, and the production from this sub-sector of fisheries was insignificant. Since the beginning of the seventies, however, with increasing attention given to aquaculture by most of the governments as an important source for augmenting the protein food supply for the expanding populations as well as for income and export earnings, the development has been rapid. Another impetus is the increasing demand from economically developed countries for higher-valued fish products such as shrimps and prawns, sea bass and groupers. This has accelerated the development of aquaculture, especially brackishwater culture, and the increase in both quantity and value of cultured shrimp in the sub-region has been spectacular.

Table 7 shows the trend in the production of aquaculture in Southeast Asia during 1984-94. The sub-regional production in 1994 was about 119 percent over that of 1984, but the contribution to the world aquaculture production slightly declined during the same period due to the rapid expansion of aquaculture worldwide. On the other hand, the annual growth rate of aquaculture production of the sub-region was about 12 percent per annum. Three countries that produced more than half a million mt in 1994 were Indonesia (777,000 mt), the Philippines (784,000 mt) and Thailand (519,000 mt). The production of these three countries accounted for about 83 percent of the total aquaculture production of the sub-region. Myanmar produced approximately 80,000 mt in 1994, but the growth rate of aquaculture production during 1989-94 was much higher when compared with that of 1984-89 in that country.

Whilst Thailand's aquaculture production in 1994 was less than that of Indonesia and the Philippines, in terms of value, it accounted for US$ 1,866 million or 20 percent of the sub-regional total. The rate of expansion in value (i.e., from US$ 108 million in 1984 to US$ 1,866 million in 1994) was higher than that in quantity (i.e., from 112,000 mt in 1984 to 519,000 mt in 1994). This was due mainly to the rapid growth of giant tiger prawn (*Penaeus monodon*) culture in the country, with the 1994 production estimated at 261,964 mt as compared to 110,200 mt produced by Indonesia, 90,426 mt by the Philippines and 27,000 mt by Vietnam (FAO, 1996c).

The breakdown of the aquaculture production in 1994 (Table 8) indicates that finfish accounted for 1.2 million mt (48 percent of the total production), crustaceans about 600,000 mt (24 percent), followed by aquatic plants at about 500,000 mt (21 percent) and molluscs at 176,000 mt (7 percent). Of the total production of 1.2 million mt, about 69 percent came from freshwater, 29 percent from brackishwater, and 2 percent from marine water. The freshwater fish under cultivation included tilapia (*Oreochromis* spp.), Indian carps (*Roho*, *Catla* spp. and Mrigal carps), Chinese carps, barbs (*Puntius* spp.), catfishes (C*larias* spp.) and snakehead (*Channa* spp.). The brackishwater species included milkfish (*Chanos chanos*), barramundi or seabass (*Lates calcarifer*) and crustaceans (mainly giant tiger prawn, *Penaeus monodon*). Freshwater fish, cultured under the traditional pond-based farming system, are important for food security as they are cheap and affordable for rural people.

Malaysia and Thailand produced a substantial quantity of molluscs, mainly cockles (*Anadara granosa*), amounting to about 152,000 mt, or 86 percent of the total mollusc production of the sub-region.

Only three countries produced aquatic plants in appreciable quantity in 1994: the Philippines produced about 400,000 mt of green seaweeds (*Eucheuma* spp., mainly *E. cottoni*), whilst Indonesia and Vietnam produced red seaweed (Rhodophyceae) amounting to 115,000 mt and 6,000 mt respectively. The seaweeds are harvested mainly as a source of carrageenans and agar for the food industry.

5. Contribution to Food Security

5.1 As Food

Post-harvest development in Southeast Asia

As mentioned earlier, fisheries has contributed significantly toward the food security of the Southeast Asian countries. The utilization of aquatic organisms for food has greatly improved since the end of the second world war. During the past two decades, especially, there has been a great improvement in facilities, including cold storages and ice plants, as well as infrastructure for fish handling, product development, and distribution and marketing, notably in the major fish-producing countries. Imported harvest and post-harvest technologies have helped improve fish catch handling on board, product quality, and introduced new processed products, thus enhancing the value of the catches.

Whilst traditional processed products such as fish sauce and cured fish are still produced in large quantity, mainly for local consumers in rural areas, modern fish processing factories have been established in Malaysia, Indonesia, the Philippines and Thailand for processing high-valued and high-quality fish and crustaceans, including tuna and shrimps as frozen, filleted or canned products, with an increasing amount of them destined for export. Concurrently, many new fish products have been developed and are available in local supermarkets in urban centres, including fish balls, fish cakes, imitation crab sticks, breaded squid rings, breaded fish or shrimps, etc.

Another noticeable development is the production of fish-meal in Malaysia and Thailand from trash fish or bycatches, for use as livestock and poultry feed and for aquaculture. By-catches or trash fish amounting to about 1.2 million mt annually from trawl fisheries in the Gulf of Thailand can produce about 250,000 mt of fish-meal.

In their endeavour to develop fisheries, Brunei Darussalam, Cambodia, Myanmar and Vietnam have indicated their need for further improvement of facilities and infrastructure for fish processing and distribution.

Post-harvest technology development has, therefore, played an important role in maximizing the use and minimizing the wastage of the limited fishery resources of the region, thus contributing toward the sustenance of food security. Despite considerable achievement, bycatches discarded at sea and post-harvest losses mainly in marine capture fisheries, especially during peak seasons, still remain in the order of 15-30 percent[2]. The Southeast Asian countries have therefore paid particular attention to the strengthening of post-harvest technology development, including prevention of post-harvest losses and waste management; development of human resources on fish post-harvest technology; development of added-value products from low-value and small pelagic catches; and establishment of regional standards for fish inspection and quality control and procedures for monitoring compliance of the same (Menasveta, 1996).

Pattern of consumption

The majority of the Southeast Asian people, particularly those living in rural areas, prefer whole fresh fish. It is estimated that almost half of the food fish produced in the sub-region is eaten fresh (Hotta, *op. cit.*). Because of custom and habit, Cambodians and Myanmarans have a preference for freshwater fish over marine fish. A high fish utilization rate reportedly prevails among the Southeast Asian rural populations (FAO, 1995a; Doulman, 1993). These people also consume, on a regular basis, various traditional processed products whose shelf life is generally short and whose quality could be improved further. On sale in local markets are fish sauce (Thailand, the Philippines, Vietnam) and cured fish; viz., sun-dried, salted and dried, steamed/boiled and fermented.

The pattern of consumption was analyzed by Hashim (1995) based on the data of per-caput supply of fish and percentage of fish/animal protein intake during 1970-90. He noted that several Southeast Asian countries, especially the newly industrialized ones, had a per-caput supply of fish and fishery products well above the world amount and that the percentage of fish to animal protein intake for all the countries, except Laos, was higher than the world level in 1990. In Singapore and Thailand, the consumption of shellfish, crustaceans and cephalopods was gaining popularity as these countries became more affluent. In Malaysia, the consumption of shellfish had decreased by a considerable proportion as these high-valued species were exported to Singapore. Small and medium-sized pelagic fish were still consumed widely in Brunei, the Philippines and Indonesia.

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2 See the Strategies and programmes of action for ASEAN fisheries cooperation. Report of the Conference on Fisheries Management and Development for the ASEAN Region for the Year 2000, Bangkok, Thailand, 26-29 July 1994. Department of Fisheries, Thailand.

In his analysis, Hashim (ibid.), believed that the following factors would influence the future demand and consumption pattern of fish and fishery products in the Southeast Asian countries:

1. The economic growth experienced by several countries in the region, such as Malaysia, Indonesia, Thailand, and Singapore, would enable their people to afford other animal protein in addition to fish. Hence, there might be a decline in the share of fish in animal protein intake, despite a rising trend in the per-caput consumption of fish.

2. With the population growth rate higher than the rate of increase of per-caput consumption of fish, people might consume other protein food such as chicken which would be available at a more competitive price.

3. Consumer preference might change in the future as more people could afford more diversified fish and fishery products other than traditional ones because of the convenience in the preparation of meals.

4. Expected demand of fish would continue to rise with vast market potential created by the countries in the region as well as those outside the region such as Hong Kong SAR, Japan, Korea and Taiwan Province of China.

Anticipated demand for fish in 2010

Table 9 indicates that the consumption of fish of the ten Southeast Asian countries during 1991-93 amounted to 9 million mt as against the total production of 11.6 million mt, of which 1.5 million mt were used for non-food purposes; 1.4 million mt were imported into the region; and 2.4 million mt exported. With the population of the sub-region during the period estimated at 458 million and the production of food fish at about 9 million mt, the average per-caput consumption was calculated as 19.8 kg/year. Table 9 also indicates that Singapore had the highest fish consumption rate (37.4 kg/yr), followed by the Philippines (36 kg/yr) and Malaysia (29.4 kg/yr). Laos had the lowest consumption rate in the sub-region (6.7 kg/yr). The import per-caput figures indicate the importance of imported fish for the food security of Singapore, Malaysia and Brunei.

The anticipated demand for food fish by the year 2010 was calculated on the basis of the projected population growth, assuming a constant per-caput consumption of food fish of 19.8 kg/year. If the annual population growth of the sub-region continues to rise at the rate of 1.6 percent/year as indicated by Hotta (*op. cit.*), the population of Southeast Asia in 2010 would be approximately 640 million. The projected demand for food fish would therefore be in the order of 12.7 million mt, or an additional 3.6 million mt of food fish over that of 1991-93.

Nevertheless, there has apparently been a rising trend in the consumption of fish in Southeast Asia since 1970. Hashim (*op. cit.*) reported that the per-caput consumption of the Southeast Asian population rose from 16.2 kg/yr in 1970 to 18.3 kg/yr in 1990, and to 19.8 kg/yr in 1991-93 (compared with the world per-caput consumption rate of 10.9 kg/yr in 1970, 13.3 kg/yr in 1990 and 13.0 kg/yr in 1993 respectively). If this rising per-caput consumption trend (which Hashim estimated to be at 0.61 percent per year) continues to prevail until 2010, the projected demand for food fish would be higher, on the order of 14 million mt, or 5 million mt over that of 1991-93.

Therefore the additional demand for food fish for the expanding population of the Southeast Asian sub-region by the year 2010 would be between 3.6 and 5 million mt.

Implications of the demand on fishery resources

The projected requirement of food fish of Southeast Asia by the year 2010 of between 3.6 and 5 million mt would mean a substantial increase in the total fish production over the 13.5 million mt produced in 1994, if an increase in the volume of fish for export is also taken into account. Thus, the total fish production by 2010 would have to be over 17 or 18 million mt to satisfy the anticipated demand. If the development in capture fisheries and aquaculture in the sub-region cannot sustain the expected demand, some countries in the region may have to resort to importing fish, including low-valued small pelagic species for local consumption.

The expected demand will definitely put more stress on the already depleted fish stocks in several coastal fishing grounds of the sub-region. It is felt that the contribution from marine capture fisheries will not be substantial. Whilst governments would like to expand their fisheries further offshore, the economic feasibility of such development should be assessed and a cautious approach should be adopted as recommended by the FAO Code of Conduct for Responsible Fisheries (FAO, 1995c).

At present, the waters in which fishery resources have not yet been fully utilized include the South China Sea basin, which is under disputed claims, and the central Sunda Shelf. Many parts of the contiguous waters to the South China Sea, such as the Celebes, Flores and Arafura Seas can still sustain expansion of marine capture fisheries, but these waters are under the jurisdiction of the coastal States of Indonesia and the Philippines.

Perhaps the most difficult task facing the governments of the sub-region is to have the political will to ensure the sustainable development of marine fisheries in the waters under their jurisdiction. This will entail, on a priority basis, the implementation of various actions within an effective fisheries management framework, including monitoring, control, and surveillance. At the sub-regional or regional level, fisheries management frameworks, particularly for the management of transboundary fish stocks, should also be developed through active collaboration of the concerned countries[3]. It should be noted that, during the past decade, there have already been several instruments and/or initiatives developed by the world community aimed at assisting the countries in their endeavour to achieve sustainable development in fisheries (Menasveta and Phasuk, 1996).

Without the above-mentioned programmes of action, the severely depleted fish stocks may lead to the further reduction of the total catches and/or the eventual collapse of the fisheries; increasing conflict between small-scale and commercial fishermen competing for the

[3] The FAO/SEAFDEC Workshop on Shared Stocks in Southeast Asia, convened in 1986 by FAO in collaboration with SEAFDEC, identified at least 40 commercially important fish stocks which are commonly exploited by more than two countries and frequent inshore and coastal waters of more than one country. They may be called transboundary stocks which move freely between exclusive economic zones (EEZs) of neighboring countries. Chullasorn and Martosubroto (1986) give information on the distribution and biological characteristics of these shared or transboundary fish stocks in Southeast Asia.

exploitation of depleted stocks; a low rate of return to the fishermen; and the eventual adverse effects to the economies of the countries concerned. These negative effects would lead to food insecurity.

In any case, it is felt that the contribution from marine capture fisheries to fish production by the year 2010 will not be much more than the present 10 million mt. With effective fisheries management enforced, fish habitats rehabilitated and additional catches obtained from new fishing grounds of the sub-region, it might be possible to raise the total marine capture fisheries production to approximately 11 million mt by 2010, or a 20 percent increase over the present production.

As regards the contribution from inland capture fisheries to food security, it is felt that, in the long term, the production, in particular from the peninsular countries of the Asian continent, may not increase substantially from the present level (Interim Committee for Coordination of the Lower Mekong Basin, 1992). There are a number of factors limiting the expansion of inland fisheries, including population expansion with resultant increasing demand; decline in the abundance of the resources due to increasing fishing pressure; degradation of water quality and fish habitat arising from water pollution and deforestation; increasing conflicts in land and water use; and the ineffective management of resources and fisheries based on insufficient and unreliable data (Menasveta and Phasuk, *op. cit.*).

FAO (1995a) analyzed the trend of production in recent years of inland capture fisheries of the sub-region and came to the following conclusions:

"It can generally be assumed that the degree of exploitation of inland waters of this sub-region is close to, or greater than, the sustainable maximum. There is little prospect of finding new techniques or new stocks that may be exploited to provide significant increases in overall catch. Enhancement of the present stock levels, and thus potential offtake, can only come about by reversing current trends in pollution and over-exploitation, offsetting the effects of engineering works by stocking or otherwise mitigating the adverse effects on the fish populations..... Aquaculture is better able to expand in line with population growth and consumer demand."

Future attention to inland fisheries of the region should be directed toward effective fisheries management as in the case of marine capture fisheries and environmental management, with a view to at least maintaining the present level of production and preventing further environmental degradation and damage to the fish habitat. Management should also include the sustainable development of culture-based fisheries which have been successfully demonstrated in China.

If wise management of inland capture fisheries and environment is effectively enforced and culture-based fisheries in natural lakes, reservoirs, rivers and streams are carried out, the production of this sub-sector could be increased by 20 to 30 percent over the present production of one million mt annually, i.e., 1.2 or 1.3 million mt by the year 2010.

Aquaculture is playing an increasingly important role in the strengthening of food security. The potential for aquaculture expansion in the next two decades exists, noting that at least 6 million ha. are still available for aquaculture expansion in the sub-region (FAO, 1993a). It is recommended, however, that a balanced approach for aquaculture development be adopted, as until recently, emphasis in aquaculture has been on the culture of prawns and other high-valued species to obtain increased foreign exchange through export.

The balanced approach should include the development of rural aquaculture and the intensification of fish culture to enhance culture-based fisheries development in natural lakes and reservoirs. Rural aquaculture should be integrated in the overall rural development of the countries in the sub-region, using indigenous species low in the food chain, such as snakeskin gourami (*Trichogaster pectoralis*), Java barb (*Puntius javanicus*), and Thai silver barb (*Puntius gonionotus*) etc. as cultivable species. Effective management of aquaculture activities, both extensive and intensive, supported by appropriate legislation and enforcement, should be carried out to effect ecologically friendly aquaculture practices as recommended by the FAO Code of Conduct for Responsible Fisheries.

With a balanced approach and good aquaculture management and considering the availability of technical knowledge and interest of the private sector, government and financing institutions, the growth rate of aquaculture production in the sub-region, forecast to be about 9.6 percent per year by Csavas (1994), is feasible. Hence, the projected additional contribution of aquaculture could be about 6.4 million mt by the year 2010.

Based on the rough estimates outlined above, the contribution to food security, in terms of production, from capture fisheries and aquaculture by the year 2010 could be approximately 18.7 million mt, which should be sufficient to satisfy the expected demand for 2010, provided various management measures are properly carried out.

5.2 As Employment/Income

As indicated earlier, more than 20 million people depend on fisheries and its allied industries. Assuming that the minimum wage of a worker is US$ 5 per day, and that this person works 20 days per month for 8 months, as some are part-time workers, the income generated by the fisheries sector would be at least US$ 16,000 million per year, a significant figure in the economies of the countries in Southeast Asia.

5.3 Supporting Economic Wealth

Besides its contributions to food security and employment opportunities for millions of people in the sub-region, the fisheries sector has, in recent years, augmented the national economic wealth of several countries in Southeast Asia, through export earnings. Fish trade has developed rapidly during the past decade and fishery commodities have become prominent in international trade, especially in intra-regional trade.

Table 10 indicates the values of the imports and exports of fish and fishery products of the ten Southeast Asian countries in 1994 as compared to those of 1984. The total import into the region was estimated at more than US$ 1,976 million in 1994 as compared to 472 million in 1984, or a fourfold increase during the period. The regional import accounted for about 3.8 percent of the world's total import value in 1994 as compared to 2.8 percent in 1984. The leading import countries in 1994 were Thailand, Singapore and Malaysia. Thailand and Malaysia import raw materials such as frozen tuna for reprocessing and export, and Singapore imports fish for both domestic consumption and reprocessing. Singapore, Brunei Darussalam and Laos are the only net importers in the sub-region. The principal import commodities into the sub-region are fish-meal and frozen tuna. Thailand, the Philippines, Indonesia and Malaysia import fish-meal in response to increased local demand from the livestock and shrimp culture industries. The main suppliers are Chile, Denmark, Peru and New Zealand. Thailand and the Philippines import frozen tuna from Taiwan Province of China, the Republic of Korea, Japan, Micronesia, USA, France, Spain and Maldives for reprocessing as canned tuna for export (Hotta, *op. cit.*).

Table 10 also indicates that the total value of the export trade of these countries was more than US$ 7,700 million in 1994, a nearly fourfold increase over that of 1984, accounting for 16.6 percent of the world's export of fish and fish products in value terms. Since 1993 Thailand has been the world's leading fish and fishery products export country, with annual exports worth US$ 4 million million in 1994. Indonesia with US$ 1.6 million million and Singapore with US$ 560 million are the next most important sub-regional exporters. These three countries accounted for 81 percent of the sub-regional aggregate export value. Even though the export value of Vietnam was less than the others, the rapid growth of its fish export is noticeable.

The principal export commodities from the sub-region are frozen shrimp and cephalopods and canned tuna. Exports from Thailand consist of shrimp and cephalopods, which constitute more than half of the total export value. Cambodia mostly exports freshwater fish, mainly to its neighboring countries, viz., Thailand and Vietnam.

At past regional and international fora including APEC Sessions and the 1994 ASEAN Fisheries Conference, delegations of the Southeast Asian countries have expressed concern over the tariff and non-tariff barriers imposed by some economic groupings and developed countries on fish and fishery products exported from the sub-region, in order to protect their domestic industries and to safeguard their consumers' health. These include the strict quality standards for imported fish and fishery products. In response to the increased requirements of the importing countries, the processing industry in several countries of the sub-region has implemented programmes concerned with the inspection of fishery products based on the Hazard Analysis Critical Control Points (HACCP) principle. In order to alleviate some of the above-mentioned problems, the countries concerned must adopt concerted action in global fora such as the World Trade Organization (WTO) under the General Agreement of Tariffs and Trade (GATT), with a view to supporting more liberal trade of fish and fishery products at the global level.

Despite the problems mentioned, trade of fish and fishery products seems to have a bright future and is expected to expand, as many countries in the sub-region have endeavoured to boost exports through product development and market diversification. Intra-regional trade is expected to grow further, as many countries in the sub-region are experiencing economic booms, and there is an increasing liberalization in the region in trade through lower tariffs and removal of quotas. The reduction of import duties in some countries such as the Republic of Korea may open up additional markets for exporting countries in the region.

Nevertheless, with the growing populations and increasing demand for fish, an expanding fish trade would mean less fish for domestic consumption, thus implicating food security, especially in the low-income food-deficit countries of the sub-region and in some

of the zone-locked countries. The governments concerned should formulate suitable strategies to ensure food security; these may include the importation of low-value small pelagic fish to feed the poor, using part of the income from fish exports to cover importation expenses.

6. Role of Public and Private Sectors

Both public and private sectors have an important role to play in a country's endeavour to sustain the contribution of fisheries to its food security and economy. Without concerted action, the long-term goal of achieving fisheries sustainability is unlikely, however. This section highlights the role of governments, the fishing industry, intercountry collaboration, non-governmental organizations and fisheries cooperatives in the sustainability of fisheries.

6.1 Political Commitment and Government Intervention

The essential role of the Southeast Asian governments, in light of dwindling fishery resources and expanding populations, is to implement effective policies and strategies aimed at the rational use of the fishery resources and the prevention of environmental degradation. Such policies and strategies should be supported by appropriate research, effective legislation and enforcement.

Almost all of the Southeast Asian Governments recognize the importance of fisheries in their countries' food supply and economies. The analysis of the objectives for fisheries development within the national economic and social development plans of the Southeast Asian countries, carried out by FAO in 1985, revealed that the common objectives were: (i) to ensure adequate food supply for the expanding populations; and (ii) to augment foreign exchange earnings through increased export of fish and fishery products (SEAFDEC, 1986). Other objectives in the development plans vary from one country to another. These include increased employment opportunities, accelerated rural development, and distribution of economic wealth; all of these reflect concern for social implications.

To achieve the above long-term development objectives, the governments have adopted policies and strategies for fisheries development and management which seem to follow a similar pattern; viz., in the early sixties, priority was assigned to the development of deep sea and offshore capture fisheries, with the common belief that fishery resources in the South China Sea and its adjacent waters were plentiful. With the marked decline in marine fishery resources, especially demersal resources, in the late sixties and the early seventies after increased exploitation and rising conflicts between commercial (mainly trawlers) and traditional/small-scale fishermen, the governments in the seventies gave increased attention to alleviating those conflicts and to the development of small-scale fisheries. Also, since the early seventies, the common policy has been to develop aquaculture; the development of brackishwater aquaculture was especially pursued to alleviate fishing pressure induced by inshore and coastal waters capture fisheries. In the eighties, emphasis was given to accelerated aquaculture development, especially intensive shrimp culture to boost revenues from export products. At the same time, more attention was given to the reduction of post-harvest losses; to quality assurance of exported fish and fishery products; and, in a lesser degree, to the management of capture fisheries.

Fisheries management has been recognized as an essential tool for rational development of fisheries. For example, the Government of Indonesia has taken into account the need for effective fisheries management in its development policy and strategies since the launching in 1968 of the country's first-five year development plan (Wahyono, 1993). Since 1977, the conservation of fishery resources and fish habitat rehabilitation have been included in Thailand's national economic and social development plan (Phasuk, 1993). The Philippine Government, based on the recommendations of the National Conference on Fisheries Policy and Planning in 1987, formulated and implemented the Fisheries Sector Programme (1990-1994) with emphasis on the devolution of management authority from the central Government to local governments at the municipal level (Reyes *et al.,* 1993). The Malaysian Government adopted in 1981 a comprehensive fisheries licensing policy and fishing zones in order to solve problems arising from conflicts between traditional fishermen and semi-commercial or commercial trawlers in coastal waters (Hashim, 1993).

Nevertheless, the majority of the governments in the region have come to realize in recent years that the fisheries management measures that they have adopted have not been effectively implemented. The pervasive cause of ineffective fisheries management is the free and open access to fishery resources in the sub-region. Other common problems experienced by all countries include the lack of effective enforcement of the adopted management measures due to shortage of personnel and budget; and lack of understanding of the management measures and cooperation by fishermen and the industry, as they did not participate in the planning and implementation of such measures. As indicated at recent regional fisheries fora, including the Twenty-fifth Session of the Asia-Pacific Fisheries Commission (Seoul, Korea, 21-24 October 1996), the governments of the sub-region are endeavouring to strengthen or reorient their fisheries management policies and strategies with a view to achieving fisheries sustainability.

6.2 Role of the Private Sector

Besides its role in producing food and generating income and wealth through fish trade, the private sector should also share the responsibility of ensuring the sustainable development of the fishery resources they exploit. It is envisaged that the private sector will play an increasingly important role in the sustainable development of fisheries in Southeast Asia, in particular, in the management of fisheries resources; habitat rehabilitation; and the prevention of environmental degradation. Close cooperation must be enhanced between the government and private sectors in these endeavours. An example of successful cooperation is that between the Norwegian authorities and fishermen in their mutual effort to restore the yield of the cod stocks harvested. In this case the fishermen have actively participated in the formulation and implementation of the management measures aimed at such restoration. Compliance with the agreement on the management scheme by the Norwegian fishermen has resulted in an increased catch of cod up to 700,000 mt annually in the past few years (The Economist, October 19-25, 1996).

For Southeast Asia, it may be recalled that the IPFC (Indo-Pacific Fishery Commission) Symposium on Socio-economic Issues in Coastal Fisheries Management held in 1993 strongly recommended that community-based management (with active participation of fishermen) should be considered as one of the future measures to manage the dwindling coastal fishery resources in the region. In this connection, the Government of the Philippines has endeavoured to devolve management authority to local government units with active participation of the private sector and NGOs in the management of inshore and coastal resources. Silvestre (1996), in his report on ICLARM's effort in response to the request of the Government of the Philippines to formulate research and planning activities in support of an integrated fisheries management scheme for San Miguel Bay, the Philippines, during 1992-94, highlighted key lessons and constraints learned from the San Miguel experience, one of which was the essential nature of stakeholder participation at key points of the research, planning and management effort.

6.3 Inter-country Cooperation

Cooperation between countries at the bilateral, trilateral or multilateral level is also essential in the sustainable fisheries development of the sub-region. Intercountry cooperation helps harmonize policies and strategies required; accelerates the outcome of fishery research and economizes its costs; and promotes inter- and intra-regional fish trade.

In Southeast Asia, a number of economic groupings including the Association of South East Asian Nations (ASEAN), ASEAN Free Trade Area (AFTA), Asia Pacific Economic Cooperation (APEC), East Asia Economic Caucus (EAEC), East Asia Growth Area (EAGA) and the Indonesia/Malaysia/Thailand Growth Triangle (IMT-GT) will have a long-term impact on shaping trade channels in the future. The continued trade liberalization and deregulation policies of many countries in the sub-region will stimulate trade in fish and fishery products of these countries in the international market.

Besides the above economic groupings there are more than 20 sub-regional and regional fishery bodies whose objectives are to assist the countries in the region in various aspects of fisheries management and development. Among these, 13 organizations, namely, FAO, APFIC, ASEAN, SEAFDEC, UNDP, ADB, BOBP, INFOFISH, ICLARM, IOFC, IOTC, MRC and NACA have a broad scope of fisheries management and development and are actively promoting collaboration among the countries concerned (Menasveta, 1993). As not all of these countries are members of the same organizations, it was suggested that a permanent mechanism such as an inter-secretariat committee be established to coordinate the activities of these bodies in order to economize their operating costs and reduce the duplication of efforts (Menasveta and Phasuk, *op. cit.*).

To facilitate the effective contribution of a regional organization towards the long-term objective of self-reliance of its members in the management and rational development of their fisheries, the Members concerned should make better use of that body by actively participating in its work. For example, APFIC, which is the oldest fishery development organization in the Asia-Pacific region and whose membership covers almost all of the Southeast Asian nations, should be strengthened with adequate funding support and priority programmes of action decided on and supported by its Members. The latter may include the establishment of an APFIC information network to support a rational management regime for the region; a regional study on the Asia-Pacific fishery sector outlook to gain a better understanding of the trends of fishery production in the region towards the next century; planning for the management of transboundary fish stocks; the organization of workshops on fishery policy and planning; and capacity building and human resource development.

Bilateral and multilateral donors and financing institutions will continue to play a prominent role in the sustainable development of fisheries, notwithstanding rapid economic growth experienced by a number of countries in the sub-region. Countries such as Cambodia, Laos, Myanmar and Vietnam will continue to seek substantial input from these bodies or institutions to accelerate the rehabilitation of their fisheries industries and to put into effect their fisheries and environmental management schemes.

6.4 Non-governmental Organizations, Cooperatives, and Fisheries Associations

Non-governmental organizations (NGOs), both international and local, can play a useful role in sustaining the contribution of fisheries to food security. In Cambodia, a number of international and local NGOs have been involved in activities related to food security. Many have programmes in community development, health, education and training in aquaculture and fisheries, whilst some are endeavouring to find suitable indicators for monitoring food security and to assess the impact of their efforts on the food security of different groups of the Cambodian population (Tickner, 1996).

The Philippine Government, since the late eighties, has been attempting to devolve fisheries management to local governments. The devolution under the Government Code of 1991 did not foresee the need to build up the capability of manpower of the local government units to implement the resource management programmes. For example, in preparation for the management of the fishery resources in Carigara Bay, one of the big fishing grounds in the country, two local NGOs were contracted to undertake necessary actions including the implementation of the strategy, community organization, education, a public awareness campaign, and the formation of the Carigara Bay Management Council. The involvement of the NGOs in management has proven to be effective. Being area-based, they have a better perception of the community's dreams and aspirations (Munoz, 1996).

In Indonesia, Dahuri (1996) reported that local NGOs (Lembaga Swadaya Masrakat, LSM) had played an increasingly prominent role in resources conservation and environmental protection by actively participating in public debate on environmental management and in community development. They have promoted public awareness for environmental protection and encouraged active participation of the public in conservation and environmental issues. It was pointed out, however, that the capabilities of NGOs varied and that many had limited access to up-to-date information and lacked well-trained staff. Despite these shortcomings, they can work together with government institutions at the local level in the implementation of coastal community support programmes and projects.

Fisheries cooperatives and fishermen's associations can also play an important role in the sustainable development of fisheries. A case in point is that of fisheries cooperatives in Japan with their effective role in the rational development and management of coastal fisheries resources (Ando, 1995). In Southeast Asia, notwithstanding the recommendations of the IPFC since its Eleventh Session (Kuala Lumpur, Malaysia, October 1964), the development of fisheries cooperatives in the region still leaves much to be desired.

To help the private sector to form effective cooperatives, the technical and financial input of the government sector, especially in the beginning phase is essential. Good extension work and follow-up activities are required from the government sector to help such cooperatives flourish. If the governments in the region give importance to the community-based management strategy for the restoration of the coastal resources and environmental protection, it is time to help the fishermen groups have their own fisheries cooperatives or other organizations which can manage the fishery resources available to them for the benefit of future generations.

7. Policy Framework for Sustainable Contribution to Food Security

Since the adoption of the United Nations Convention on the Law of the Sea (UNCLOS) in 1982 (United Nations, 1983), several global fisheries-related instruments and initiatives have been adopted by the world community with the broad objective of facilitating the implementation of UNCLOS to ensure the sustainable contribution of fisheries to global food security and economies. Notable among them are Agenda 21 adopted by the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, Brazil in 1992 (United Nations, 1992); the Code of Conduct for Responsible Fisheries by the Twenty-eighth Session of the FAO Conference in 1995 (FAO, 1995c); the Agreement for the Implementation of the Provisions of the United Nations Conference on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks by the UN Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks in August 1995 (United Nations, 1995); and most recently, the Kyoto Declaration on the Sustainable Contribution of Fisheries to Food Security by the International Conference on the Sustainable Contribution of Fisheries to Food Security, organized by the Government of Japan in collaboration with FAO in Kyoto, Japan, in December 1995 (FAO, 1995d).

All of these instruments and initiatives, whether legally binding or just principles and guidelines, are inter-related. They provide a conceptual framework to assist governments in their individual or collaborative efforts to develop and implement policies and strategies for the rational management and conservation of fishery resources as well as for environmental protection to ensure their sustainability for the benefit of mankind.

7.1 Policy Issues

Policy issues concerning fisheries sustainability are familiar to fisheries administrators and policy makers in Southeast Asia. The issues were raised and discussed at past sessions of regional and sub-regional fishery bodies such as the Asia-Pacific Fishery Commission (APFIC, formerly Indo-Pacific Fishery Commission, IPFC) and its subsidiary bodies; the Indian Ocean Fishery Commission (IOFC) and its subsidiary bodies; Southeast Asian Fisheries Development Center (SEAFDEC); ASEAN, especially its fisheries conference in 1994; and at various fisheries symposia, meetings and seminars organized in the region.

With limited technical manpower and funding support as experienced by several countries in the region, it is felt that priority should be assigned to certain policy issues. It should be pointed out also that the resolution of many of them could be enhanced through regional or sub-regional fishery bodies to economize the costs and to accelerate the outcome of their results, especially on the issues related to the management of shared or transboundary stocks. It is proposed that the following policy issues receive priority attention:

i) sustaining the contribution of marine capture fisheries in EEZs (inshore and coastal waters) at the optimal level;

ii) sustaining the contribution of shared or transboundary fish stocks at the optimal level;

iii) augmenting fish production by expanding fisheries to offshore or deepsea waters;

iv) sustaining or, if possible, increasing the contribution of inland capture fisheries;

v) augmenting fish production through aquaculture development;

vi) reducing wastage, including fish discarded at sea and post-harvest losses;

vii) environmental issues confronting the fisheries sector;

viii) enhancing trade of fish and fishery products;

ix) strengthening fishery research; and

x) accelerating technology transfer and capacity building.

7.2 Resolution of the Above Policy Issues

Sustaining the contribution of marine capture fisheries in EEZs at the optimal level

Almost all of the countries in the sub-region have expressed concern about the depletion of their coastal fishery resources due to intense fishing activities and the lack of effective management and enforcement schemes to rectify this problem. Unfortunately, the governments concerned still recognize the common property nature of and free access to the fishery resources in their exclusive economic zones by their fishermen. Furthermore, many still promote increased exploiting capabilities as a means to better the livelihood of small-scale fishermen, and there is no real attempt to adjust the level of fishing efforts commensurate with the capacity of the resources. Hence, **the most important strategy with respect to this issue is the need for governments to have a strong political will and a commitment to conserve the depleted fishery resources through improved and more effective fishery management systems.** Fisheries management policy will have to be shifted from maximizing physical yield to optimizing the net socio-economic benefits over the long term as well as to increasing emphasis on the prevention and control of environmental degradation (Miles, 1994).

A more effective fisheries management system or framework will require close examination, adjustment or revision of the existing system, taking into account, as appropriate, the frameworks and guidelines embodied in major global instruments or initiatives. This would mean the strengthening of the existing laws and regulations, including the establishment of an effective monitoring, control and surveillance system. A reinforced fisheries management system should also see to it that the amount of fishing effort is in good proportion to the capacity of the resources. It should include ways and means of reducing the excess number of fishing vessels, and of providing alternative employment opportunities outside the fisheries sector for surplus fishermen and training as required. Coastal fisheries management should be a part of an integrated coastal area management system, as there are many players involved in the development of coastal lands and waters.

Besides the conventional fisheries management measures which are currently in use, the authorities concerned should consider in their management systems the feasibility of employing licensing systems similar to those implemented in Australia and New Zealand, as well as traditional management systems as practised elsewhere in and outside the region. They should also consider the applicability of community-based or integrated coastal management as recommended by the 1993 IPFC Symposium on Socio-economic Issues in Coastal Fisheries Management, which is being pursued in the Philippines.

A good fisheries management framework should be flexible so that it can be adjusted from time to time and it should be supported by good scientific evidence. This will entail input from research, especially management-oriented resources research to back up management decisions. The research will in turn require real-time and reliable data and information from a good fisheries database. Hence, strengthening collection, collation, analysis, dissemination and exchange of fisheries information and statistics are prerequisite to an effective fisheries management framework.

APFIC can play an important role in helping its member countries to attain self reliance in the sustainable development and management of fishery resources in their individual exclusive economic zones.

Sustaining the contribution of shared or transboundary fish stocks in Southeast Asia at the optimal level

More than 40 commercially important fish stocks are believed to move freely through EEZs of two or more countries in Southeast Asia and are subject to exploitation by more than one country (FAO, 1986). There is a dearth of knowledge on the biology, distribution and levels of exploitation of these transboundary fish stocks (Chullasorn and Martosubroto, 1986). For these fish stocks, management action taken by one country on a part of their life cycle without cooperation of the other parties involved in the exploitation will be futile, resulting in the wastage of funds and eventual depletion of the resources.

Strategies to sustain the contribution of these resources should include both medium- and long-term approaches. For the medium-term, the countries concerned should have a suitable agreement for the collaborative management of the stocks they exploit, including the establishment of a monitoring, control, and surveillance system, and they should adhere to the management measures as agreed upon. Impartial organizations such as FAO could assist the member countries in preparing such a collaborative agreement based on available scientific knowledge and relevant data on the stocks in question. For a long-term approach, it is recommended that the governments in the region consider establishing a suitable mechanism for coordinating cooperative research programmes, harmonizing fisheries management policies and making recommendations to fishery bodies at the national level. A technical seminar could be convened by APFIC to assess the pros and cons of this proposal.

Effective schemes for managing transboundary fish stocks will also require scientific input from research and a good database of fisheries information and statistics, as in the case of the management of fisheries in EEZs. Regional bodies such as APFIC should be useful vehicles for promoting and implementing cooperative research on and coordinating the management of shared or transboundary fish stocks.

Augmenting fish production by expanding fisheries into offshore or deep seas

The development of offshore fisheries seems to be a general policy of ASEAN countries[4]. It was recommended that Cambodia extend marine capture fisheries into the offshore waters of its EEZ, as the resources in inshore and coastal waters have been overfished (Doulman, 1993). Indonesia and the Philippines have the advantage of partially exploited fishing grounds in their archipelagic waters. Some countries in the sub-region, however, are not in such an

4 Department of Fisheries of Thailand, 1994. Strategies and programmes of action for ASEAN fisheries cooperation. A paper submitted to the 1994 ASEAN Fisheries Conference. Document ASEAN CONF/TECH/26.

advantageous position, for example, deep sea fisheries development for Thailand means the exploitation of tuna and other pelagic resources in the Indian Ocean. In both cases, fishing in new areas and in offshore or deep seas will involve investment for bigger boats and suitable gear and increased operating costs. Economic feasibility should therefore be assessed in any new venture. Information and data concerning the sizes of the resources, if available, are an asset for planning such an investment. Cooperative surveys of the resources to be exploited will help in the investment decision and lower the costs of planning and operation.

Sustaining or possibly increasing the contribution from inland capture fisheries

In the face of declining inland fishery resources, their sustainable contribution should be realized through effective fisheries management as in the case of marine capture fisheries, i.e., the adjustment of fishing effort commensurate with the capacity of the resources and the strict prohibition of illegal fishing practices. As environmental degradation induced by the negative impact of agriculture, deforestation and pollution from municipal and industrial sources is another major cause of the decline of inland fishery resources, environmental management should be carried out in an integrated catchment basin management, which involves various users, e.g., those of the agriculture, forestry and industrial development sectors. Alternative management systems, including territorial use rights should also be considered.

Another important strategy is to enhance culture-based fisheries through stocking fish in natural waters and reservoirs. Ways and means should be sought to economize the hatchery costs and ensure the survival of the stocked fry through proper management of those waters. Such stocking practices should have no detrimental effects on the ecosystem as a whole.

An effective inland fisheries management system will require supporting research on the resources, the fisheries and the ecosystems, and adequate extension work. Governments will have to provide infrastructure such as hatcheries to produce fry for stocking, etc., and take initiatives in environmental protection.

Again, regional fishery bodies such as APFIC through the Aquaculture and Inland Fisheries Committee (AIFIC) and its the Working Party can assist the countries in the region in research, policies and planning required for the sustainable development of inland fisheries.

Augmenting fish production through aquaculture development

Aquaculture contributes significantly towards economic and nutritional benefits as indicated in the earlier section. Unfortunately, rapid development of aquaculture in the sub-region during the past decade, especially intensive shrimp culture without proper management, has caused in many areas the destruction of mangroves and other fish habitats; euthrophication and discharge of wastes; and modifications of currents. These have resulted in environmental damage and consequently unsustainable aquaculture development. The clearing of mangrove forests may also have a negative impact on the ecosystems nearby, viz., sea grass beds and coral reefs (Sudara, 1996).

Policy issues and strategies for resolving these problems have been discussed at several fora, including the FAO/NACA Regional Study and Workshop on the Environment and Management of Aquaculture Development (Bangkok, Thailand, 21-26 February 1994); the IPFC Working Party on Aquaculture (Bangkok, 19-25 October 1994); the SEAFDEC/FAO/CIDA

Expert Meetings on the Use of Chemicals in Aquaculture in Asia (Iloilo, Philippines, 20-22 May 1996); and most recently the APFIC Symposium on Environmental Aspects of Responsible Fisheries (Seoul, Republic of Korea, 15-18 October 1996).

The policy issues and strategies aimed at sustainable aquaculture development in the sub-region have thus been well discussed and documented. However, the necessity of having a good aquaculture management framework to effect ecologically friendly practices should be highlighted here. Such a framework should be supported by adequate legislation aimed at the reduction of environmental impact of aquaculture practices and vice versa, as heretofore there has apparently been a lack of such an instrument in almost all of the countries in the region.

Another strategy which should be underlined is the development of low-input aquaculture in rural areas. This was launched in Thailand many years ago and was called “fish for the people programme”. Although this simple fish farming may not be economically viable on a commercial scale, it can provide a ready source of high-quality protein for the rural poor and also an opportunity to augment income for the farmer and his family. Moreover, these low-input culture systems do not cause any environmental problems as reportedly occurred in intensive aquaculture systems.

Under the subject of rural aquaculture development, special reference should be made to integrated farming systems for the self-reliance of small-scale farmers as envisaged by His Majesty the King of Thailand and being planned by the Thai Government for implementation in the country. His Majesty was of the opinion that in the future small-scale farmers should apportion their land on a 30-30-30-10 basis with a view to being self-sustaining, viz., 30 percent of the land area to be allocated for a water tank; 30 percent for rice farming; 30 percent for vegetables, fruit trees, livestock and poultry; and 10 percent for a homestead. His Majesty emphasized the importance of water security in rural areas and decentralized water management as the key to food security. The water reservoir would not only be used for water security during drought periods but also for rearing fish with overhead duckery, thus reinforcing food security. He also emphasized the importance of research and development support for decentralized agricultural systems. This endeavour to achieve sustainable development for integrated small-scale farming may be applicable to other areas of the Southeast Asian sub-region.

Also to attain sustainability in aquaculture development, better knowledge of the cultivable species is needed. This includes, *inter alia*, an effective means of controlling and preventing fish diseases and epidemics; fish nutrition and feeds which contain protein from inexpensive and sustainable local sources; and farm management with a view to preventing or creating the least possible damage to the environment.

With reference to feeds used in aquaculture, the Consultation on Farm-made Aquafeeds organized by FAO in collaboration with the ASEAN-EEC Aquaculture Development and Coordination Programme (Bangkok, Thailand, 14-18 December 1992) stressed the need for a better understanding of the complexity of nutrition and feeding of finfish and crustaceans in semi-intensive pond farming systems. The bulk of Asian finfish and crustacean aquaculture production (about 80 percent) is realized with this type of aquaculture practice and depends on the use of farm-made feeds. Some intensive systems such as the cage culture of marine fish and some carnivorous freshwater finfish such as snakehead and catfish species also use farm-made feeds. Farm-made feeds have some environmental advantages as they use locally available agricultural products and wastes of agro-processing industries that have limited use within the community. Hence, farm-made feeds will be of value to small-scale fish farmers if appropriate technology is transferred to them (New *et al*., 1995).

Both intensive and extensive aquaculture will require substantial research input, extension services and close cooperation between the government and private sectors involved. Appropriate technology transfers and capacity building should receive high priority. Research should be focused on how to domesticate cultured species in order to facilitate future genetic manipulation to enhance better growth and resistance to diseases of the cultured organisms as well as to lower the costs of production.

<u>Reducing wastage including fish discarded at sea and post-harvest losses</u>

As the exploitation of the Southeast Asian fishery resources approaches full utilization and several countries become net fish importers, the programme of reducing wastage must receive high priority and be considered as part of an effective fisheries management framework. General strategies for resolving the wastage issue are already outlined in the Code of Conduct for Responsible Fisheries. The Ninth and Tenth Sessions of the APFIC Joint Working Party of Fish Technology and Marketing held respectively in Cochin, India, in March 1994 and Colombo, Sri Lanka, in June 1996 proposed programmes to help achieve full utilization including the increased use of low-value species for direct human consumption. It was agreed that research and development efforts should be directed to making better use of low-value catches and bycatches in products for low-income consumers. Research support is also needed to establish new quality assurance arrangements based on the principles of Hazard Analysis Critical Control Point (HACCP) as required by major fish importing countries.

It is hoped that the Technical Consultation on the Reduction of Wastage in Fisheries, convened by the Government of Japan, in collaboration with FAO, during 28 October to 1 November 1996, came up with appropriate action plans to increase fishing-gear selectivity; reduce the mortality of juveniles of commercially important species; and improve the utilization of landed bycatches.

<u>Environmental issues confronting the fisheries sector</u>

Complex environmental issues confronting the fisheries sector, namely, the impact of climate change; impact of fishing and aquaculture; and impact of other human activities and possible resolution thereof were discussed at the APFIC Symposium on Environmental Aspects of Responsible Fisheries (Seoul, Republic of Korea, 15-24 October 1996). Its Proceedings will soon be published by the APFIC Secretariat.

It is apparent that instruments and initiatives for environmental protection are already in existence. They can facilitate the governments' considerations in developing and implementing holistic environmental protection policies and strategies. These include the 1985 Montreal Guidelines for the Marine Environmental Protection Framework of UNEP (Norrena and Wells, 1990); the 1995 Global Programme of Action for the Protection of the Marine Environment from Land-based Activities; the 1995 FAO Code of Conduct for Responsible Fisheries; and the Global Ocean Observing System or GOOS (Naeve, 1996). The essential input for the effective implementation of the above action plans is for the governments to ratify and implement the relevant international instruments and initiatives and to harmonize relevant national laws and regulations accordingly. Another strategy which should be underlined here is to integrate fisheries and aquaculture in coastal zone management schemes to be administered preferably by local authorities, comprising all users of coastal zone resources. In the area where fisheries is important, the fisheries sector should be assigned a leading role in this coordination effort.

As recommended by the above-mentioned Symposium, there is need to monitor the state of the resources, health of the habitats and the welfare of the fisheries communities on a regular basis in the course of implementing the prevention of pollution schemes.

Enhancing trade of fish and fishery products

One of the strategies is to consolidate actions, preferably through such economic groupings as ASEAN, aimed at minimizing trade barriers erected by certain importing countries or groups of countries. These include the implementation of collaborative programmes to ensure uniformity in product quality and to standardize quality assurance procedures, including monitoring and control; coordinate development of marketing strategies; and strengthen fish marketing information mechanisms in the region such as INFOFISH.

Another important strategy should be to intensify intra-regional fish trade and trade with countries with high per-caput consumption of fish in the vicinity of the sub-region in addition to developed markets.

Strengthening fisheries research

There is definitely a need to improve research quality, technical capability of researchers and infrastructure, notwithstanding the remarkable progress of the past two decades. Priority in fisheries research should be assigned to management-oriented resources research; for example, the development of assessment methodologies suitable for the multi-gear, multi-species fisheries of Southeast Asia and the development of standardized methodologies and techniques for domesticating cultured species such as prawns (*Penaeus* spp.).

It should be noted that the Committee on Marine Fisheries of APFIC at its Ninth Session endorsed the establishment of a regional cooperative research programme based on 14 priority areas in coastal capture fisheries, offshore fisheries and coastal aquaculture similar to those initiated by the Bay of Bengal Programme. Regional and sub-regional fishery bodies can play an important role in coordinating the implementation of these cooperative research activities, if they are supported by their respective member countries. As there are a number of international and regional fishery bodies which coordinate and/or are engaged in fisheries research such as ICLARM, FAO/APFIC, NACA and SEAFDEC, there is a need to coordinate closely their research activities to ensure positive benefits to be derived for the countries in the region and to avoid possible duplication of efforts.

Accelerating technology transfer and capacity building

To facilitate the transfer of appropriate technologies to the Southeast Asian region, there is a need to improve the capacity for and methodologies employed in extension services. Closer cooperation among administrators, scientific communities and the industry, including fishermen, should be fostered. The private sector should be requested to provide support for research which is relevant to their needs.

In Southeast Asia, there is a continuing need to strengthen the capacity of personnel in various aspects of fisheries management and development.

Regional cooperation can play an important role in accelerating the transfer of technology, in human resource development, and in capacity building. Regional bodies can promote the exchange of expertise between countries and organize on a regular basis training courses, seminars and working parties of experts on topics of regional relevance, including fishery policy and planning, resources assessments, collection, collation and analysis of information and data which are relevant to rational fisheries management and sustainable development.

8. Summary and Conclusions

Rice and fish have been the staple diet of the Southeast Asian people since time immemorial. Fish, therefore, has a significant role to play in regional food security. Governments of almost all of the Southeast Asian countries recognize the important contribution of fisheries to the countries' economies and social well-being. Fisheries development has become an integral part of the overall economic and social development plans of many of these countries.

Since the end of the second world war, there has been a rapid expansion of the Southeast Asian population. Together with the betterment of the economies of several countries in the region during the past decade, the demand for fish has continued to rise. The present study indicates that by the year 2010 when the population in the region has reached some 640 million, the demand for food fish, calculated at a constant per-caput consumption rate of 19.8 kg/yr, would be in the order of 12.7 million mt, or 3.6 million mt over the 1990-93 level. If the per-caput consumption continues to rise at the rate of 0.6 percent per year, the demand for food fish in 2010 would then be approximately 14 million mt, or 5 million mt over that of the 1990-93 level. Taking into account the amount of fish for export, the total production of fish would have to be more than 17 or 18 million mt to satisfy the demand in 2010.

The increasing demand for fish from the expanding population will create more stress on the already depleted coastal and inshore fishery resources in the region. The study concludes that a significant increase of production from marine capture fisheries seems unlikely. A marginal increase in the production over that of 1990-93 might be realized from offshore waters of the region and from the high seas. However, with better management of the marine capture fisheries, perhaps a 20 percent increase in marine fish production over the 1990-93 level might be achieved by 2010.

As regards the production of inland capture fisheries, the study concludes that an increase of about 20-30 percent by 2010 might be achieved if wise management of inland capture fisheries and environment, including the expansion of culture-based fisheries, is implemented. If the management of inland fisheries and the environment of the countries in the region does not receive proper attention, it is unlikely that the production from the inland capture fisheries sub-sector will increase substantially by the year 2010.

The study forecasts that aquaculture will play an important role in the strengthening of food security, as it has potential for expansion. It was estimated that by 2010 an additional six million mt of fish could be harvested through aquaculture expansion in the region.

With these optimistic estimates, the contribution to food security in terms of fish production by the year 2010 would be on the order of 18-19 million mt which should satisfy the demand as envisaged.

The most important strategy for achieving maximum sustainable production of marine capture fisheries is evidently the implementation of effective management of coastal and inshore fisheries, including the promotion of community-based or integrated coastal area management as recommended by the 1993 IPFC Symposium on Socio-economic Issues in Coastal Fisheries Management. As for offshore or high sea fisheries, there is a need for cooperation among the countries concerned to manage those stocks that are commonly exploited by them. The strategies should include the implementation of an effective monitoring, control and surveillance system, and the promotion of joint ventures for the rational exploitation of these offshore or high sea resources.

To ensure the sustainable contribution from inland fisheries resources, there is a need to have appropriate assessment of the potential of the resources in question and to implement effective fisheries management schemes as in the case of marine capture fisheries. Such schemes should give priority attention to the enhancement of culture-based fisheries for reservoir and water body stocking. Environmental management is another important component for sustainable development of inland fisheries. This should include effective monitoring of the environment and control and prevention of pollution and the degradation of the fish habitat.

To achieve sustainable development of aquaculture, the study underlines the necessity of having a good aquaculture management framework with a view to attaining ecologically friendly practices, noting several factors which impede current intensive and semi-intensive aquaculture systems. It recommends strongly that the development of low-input aquaculture to ensure food security in rural areas receive proper attention. In this connection, it recommends that governments should ensure the availability of fish seed for free distribution to rural fish farmers and endeavour to transfer appropriate technology, through an effective extension service system, to small-scale fish farmers, citing integrated farming systems for reinforcing food security as proposed by His Majesty the King of Thailand. In the development of rural aquaculture as in commercial or intensive aquaculture systems, feeds play an important role in its success. It recommends that small-scale fish farmers should be encouraged, through appropriate extension programmes, to prepare their own feeds suitable for the species they cultivate. The prevention and control of diseases and epidemics of cultivable species should continue to receive priority attention. These may be realized, *inter alia*, through effective farm management systems, monitoring, and control of pollution related to aquacultural activities.

In order to effectively implement the above-mentioned strategies, there is definitely a need for close cooperation between government and private sectors including non-governmental organizations. Governments must have a firm commitment to conserve fishery resources for the maximum sustained benefit for future generations, through the implementation of effective fisheries management frameworks. The governments of the countries that exploit transboundary or shared fish stocks must cooperate in the management of the stocks in question. The main responsibilities of the government sector include the formulation of laws and regulations necessary for the effective management of capture and culture fisheries; the provision of adequate extension work so that the private sector can obtain maximum benefit from the utilization of fishery resources and from aquaculture activities they pursue; the monitoring, control and surveillance of the fisheries to ensure that the fishermen concerned comply with the rules and regulations; and the conducting of research and investigation on various aspects of fisheries management and development.

The private sector also has a very important role to play to ensure sustainable fish production. It must cooperate with the government sector in the planning and implementation of various fisheries management schemes. The commercial sector should, if feasible, provide funds for research on the topics that they might eventually benefit from.

Non-governmental organizations can play a very useful role in the sustainable development of capture fisheries and aquaculture. Their valuable work has been demonstrated in many countries of the region, in the areas of extension, monitoring, education and promoting of public awareness.

With concerted action of the government sector, the private sector and NGOs, the tasks required in the management of fisheries, the conservation of fishery resources, and in accelerated aquaculture development should be easier, and the objective of having an adequate fish supply to ensure food security in the region in the year 2010 should become a reality.

9. References

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Table 1. Selected economic and fishery data of the Southeast Asian countries

Country	Area[1] (1000 km^2)	Length[2] of coastline (km)	Population[3] (millions)	Rate of[3] population increase (% per year)	GNP per capita[3] (in US$)	GDP growth rate[3] (%)	Estimated[4] No. of fishermen (1993/94)	1994 Fish production[5] (1000 tons)	Apparent per caput consumption[6] (1991-93) (kg/yr)
Brunei	6	130	0.3	3.2	20 400	2.0	1 600	5	21.9
Cambodia	181	435	10.2	2.5	215	7.5	85 000	103	8.6
Indonesia	1 905	81 000	197.6	1.6	940	8.1	2 909 000	3 954	15.6
Laos	237	-	4.9	2.9	325	7.1	n.a.	35	6.7
Malaysia	333	4 405	20.6	2.4	3 930	8.0	100 000	1 173	29.5
Myanmar	677	3 000	47.7	2.1	890	7.7	962 000	824	15.6
Philippines	297	17 460	69.3	2.3	1 130	5.9	991 000	2 276	36.1
Singapore	0.6	151	3.1	2.0	26 400	3.9	600	14	36.8
Thailand	514	2 624	61.4	1.5	2 680	8.5	65 000	3 432	25.4
Vietnam	331	3 200	76.3	2.3	250	9.5	266 000	1 150	13.4

Sources:

[1] Asian Development Bank, (1994). Key Indicators of Developing Asian and Pacific Countries, Table 10.

[2] FAO Fishery Country Profiles.

[3] Asiaweek, 17 January 1997, p. 53.

[4] From Hotta (1996). Data on fishermen include part-time fishermen engaged in marine capture fisheries, inland capture fisheries and aquaculture.

[5] FAO (1996). Fishery Statistics Yearbook for 1994, Vol. 78, Table A-2, pp. 95-97.

[6] FAO (1996). Fishery Statistics Yearbook for 1994, Vol. 79, Table I, pp. 342-343.

Table 2. Total fish production of the Southeast Asian countries

(x 1 000 mt)

Country	1984[1]	1989[2]	1994[2]
Brunei	3	2	5
Cambodia	64	82	103
Indonesia	2 252	2 948	3 954
Laos	26	28	35
Malaysia	670	937	1 173
Myanmar	614	734	824
Philippines	1 934	2 099	2 276
Singapore	26	13	14
Thailand	2 137	2 700	3 432
Vietnam	776	930	1 150
Regional total	8 502	10 473	12 966
World total	83 851	100 518	109 585
% of World total	10.1	10.4	11.8

1 FAO Fishery Statistics Yearbook for 1993, Vol. 76 (1995), Table A-2, pp. 95-97.

2 FAO Fishery Statistics Yearbook for 1994, Vol. 78 (1996), Table A-2, pp. 95-97.

Table 3. Marine capture fisheries production of the Southeast Asian countries[3]

(x 1 000 mt)

Country	1984	1989	1994
Brunei	3	2	6
Cambodia	8	25	30
Indonesia	1 704	2 185	2 970
Laos	-	-	-
Malaysia	734	882	1 053
Myanmar	466	591	599
Philippines	1 297	1 512	1 666
Singapore	25	11	12
Thailand	1 914	2 323	2 798
Vietnam	535	637	817
Regional total	6 686	8 168	9 951
World total[4]	71 407	82 117	83 656
% of World total[5]	9.4	9.9	12.0

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3 Data excerpted from Hotta, M., 1996, Regional review of the fisheries and aquaculture situation and outlook in South and Southeast Asia, FAO Fisheries Circular No. 904, FAO, Rome, Table 1, p.3

4 FAO Fishery Statistics Yearbook, Vols. 76 and 78 (1993 and 1994), p. 87.

5 Marine capture figure = catches in marine fishing areas - total marine aquaculture production.

Table 4. Marine fisheries production of the Southeast Asian countries sorted out by major group of species and by country in 1994

Country	Demersal food fish	Pelagic fish (small & medium sized)	Tuna and tuna-like fishes	Other fishes	Marine crabs & lobsters	Shrimps & prawns	Cephalopods	Molluscs	Others	Total
Brunei	31	-	-	3 131	-	69	-	34	1 208	4 473
Cambodia	-	-	-	22 400	2 200	-	-	1 400	4 560	30 560
Indonesia	708 845	116 235	406 630	383 840	24 710	250 350	32 890	56 915	127 581	2 107 996
Laos	-	-	-	-	-	-	-	-	-	-
Malaysia	171 865	319 633	26 053	341 162	11 116	24 783	51 681	92 696	91 758	1 130 747
Myanmar	-	-	-	593 103	-	-	-	-	7 000	600 103
Philippines	383 363	822 225	311 806	14 774	38 642	127 364	58 408	35 534	1 720	1 793 836
Singapore	3 320	1,551	6	4 321	658	14	1 233	1 494	908	13 505
Thailand	286 353	687 392	150 209	1 271 585	59 542	386 748	156 305	136 453	16 266	3 150 853
Vietnam	-	-	-	494 000	213 000	-	35 200	26 600	-	768 800
Total	1 553 777	1 947 036	894 704	3 128 316	349 868	789 328	335 717	351 126	251 001	9 600 873

Source: FAO FISHDAB

Table 5. Estimated potential yields and current catches of major groups of fishin the Southeast Asian waters[6]

(x 1 000 mt)

Species group	Potential yield	Average catch (1982-1984)	Current catch[7] (1994)
Demersal food fish	820	685	1 087
Small pelagic	3 230	2 150	1 363
Tuna & tunalike fishes	360	201	626
Other fish	1 740	1 584	2 190
Total fish	6 150	4 620	5 266
Crustaceans	540	488	823
Cephalopods	600	179	235
Molluscs	290	261	245
Other animals	190	173	175
Grand total	7 770	5 721	6 744

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6 Chikuni, S. 1987. Potential Yield of Marine Fishery Resources in Southeast Asia. **In** Proceedings of the IPFC Symposium on the Exploitation and Management of Marine Fisheries Resources in Southeast Asia, Darwin, Australia, 16-19 February 1987. FAO Regional Office for Asia and the Pacific, Bangkok, RAPA Report No. 187/10 pp. 16-27.

7 Data adapted from Table 4 of this report.

Table 6. Inland capture fisheries production of the Southeast Asian countries[8]

(x 1 000 mt)

Country	1984	1989	1994
Brunei	0	0	0
Cambodia	54	51	65
Indonesia	277	321	322
Laos	23	20	22
Malaysia	7	2	6
Myanmar	143	136	151
Philippines	301	226	230
Singapore	0	0	0
Thailand	111	117	115
Vietnam	123	144	134
Regional total	1 039	1 017	1 045
World total	5 532	6 744	7 437
% of World total	19.0	15.0	14.0

8 Data excerpted from Hotta, M. (1996).

Table 7. Inland and marine aquaculture production of the Southeast Asian countries[9]

(x 1 000 mt)

Country	1984	1989	1994
Brunei	0	0	0
Cambodia	2	6	8
Indonesia	357	529	777
Laos	3	8	13
Malaysia	64	53	116
Myanmar	4	7	80
Philippines	481	631	784
Singapore	1	2	2
Thailand	112	260	519
Vietnam	119	151	204
Regional total	1 143	1 647	2 503
World total	6 911	11 657	18 493
% of World total	16.5	14.1	13.5

9 Data excerpted from Hotta, M. (1996).

Table 8. Aquaculture production of Southeast Asia in 1994 sorted out by country and major group of species

Country	Freshwater fish	Diadromous fish	Marine fish	Crustaceans	Molluscs	Aquatic plant	Total
Brunei	16	51	0	8	-	-	75
Cambodia	7 640	-	-	560	-	-	8 200
Indonesia	303 012	181 390	8 710	169 315	-	115 000	777 427
Laos	12 720	-	-	-	-	-	12 720
Malaysia	14 696	6 045	12 514	6	83 326	-	116 587
Myanmar	73 642	-	-	6 235	-	-	79 877
Philippines	101 530	157 028	2 136	96 734	23 052	403 856	784 336
Singapore	-	204	276	386	1 494	-	2 360
Thailand	167 358	3 929	1 249	277 913	68 571	-	519 020
Vietnam	140 000	-	-	58 500	-	6 000	204 500
Total	820 614	348 647	24 885	609 657	176 443	524 856	2 505 102
% of Total aquatic production	32.8	13.9	1.0	24.3	7.0	21.0	100.0

Source: FAO FISHDAB

Table 9. Production, trade and apparent consumption of food fish of the Southeast Asian countries (average 1991-93, in 1,000 mt live weight)[1]

(x 1 000 mt)

Country	Production	Non-food use	Imports	Exports	Total food fish supply	Population (in million)	Apparent consumption per caput (kg)	Import per caput (kg)
Brunei	1.7	-	4.5	0.3	5.9	0.3	21.9	15.0
Cambodia	112.6	-	-	n.a.	112.6	9.4	12.0	-
Indonesia	3 443.7	28.0	8.7	490.9	2 933.5	188.7	15.5	0.6
Laos	29.8	-	0.2	-	30.0	4.5	6.7	0.03
Malaysia	650.0	186.4	315.3	225.4	553.5	18.8	29.4	16.8
Myanmar	802.0	102.9	-	20.5	678.6	43.7	15.5	-
Philippines	2 282.5	-	157.0	154.6	2 284.9	63.4	36.0	4.3
Singapore	12.3	-	256.2	167.4	101.1	2.7	37.4	94.9
Thailand	3 179.5	1 186.3	662.8	1 210.2	1 445.8	57.0	25.3	11.6
Vietnam	1 066.8	29.3	-	100.8	936.7	69.7	13.4	-
Total	11 580.9	1 532.9	1 404.7	2 370.1	9 082.6	458.2	19.8	3.06

[1] Data taken from FAO FISHDAB.

Table 10. Imports and exports of fish and fishery products (in value) of the Southeast Asian countries (in US$ million)[1, 2]

Country	Import		Export		Net (Export-Import)	
	1984	1994	1984	1994	1984	1994
Brunei	7.0	6.6	8.2	0.5	1.2	-6.1
Cambodia	-	0	0	14	0	14
Indonesia	26	121	228	1 583	202	1 462
Laos	0	0.2	-	-	-	-0.2
Malaysia	123	304	106	325	-17	21
Myanmar	-	-	8	103	8	103
Philippines	3	108	117	553	114	445
Singapore	224	620	164	564	-60	-56
Thailand	89	816	633	4 190	544	3 374
Vietnam	-	-	65	452	65	452
Regional total	472	1 976	1 329	7 784	857	5 808
World total	17 105	51 516	22 486	46 967		
% of World total	2.8	3.8	5.9	16.6		

[1] FAO (1988) FAO Yearbook on Fishery Statistics: Commodities, 1986, Vol. 63, Table A-6, pp. 28-29.

[2] FAO (1996) FAO Yearbook on Fishery Statistics: Commodities, 1994, Vol. 79, Table A-6, pp. 20-21.

THE SUSTAINABLE CONTRIBUTION OF FISHERIES TO FOOD SECURITY IN THE SOUTH ASIAN SUBREGION

by

K. Sivasubramaniam

1. Introduction

Worldwide attention has been drawn to the concern about possible loss of food security by the year 2010. In light of this, the FAO of the UN is reviewing the present state of food production, consumption, demand and supply and trade. Also under study are trends for the future, issues, constraints and challenges and the ways and means of maintaining the sustainable contribution of food to the growing human population of the world to the year 2010 and beyond.

Under the above-mentioned review, the contribution of fisheries to food security is being examined on a subregional basis. This document deals with the fisheries aspects of the seven nations of the South Asian subregion: Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka.

The terms of reference provided to the consultant are as follows:

1. To discuss and analyze the present fish production situation in South Asia, future opportunities and outlook for fish supplies by 2010 and beyond.

2. To analyze the contribution of the fisheries sector to overall food security, with special reference to production of fish for household consumption and generation of income/employment.

3. To analyze the present policy issues/measures for fisheries management and development and identify the constraints to sustainable development of fisheries in South Asian countries.

4. To recommend mechanisms and approaches to be followed by these countries to maximize the fisheries contribution to subregional food security

5. To recommend a policy framework (issues/measures) for sustainable contribution of fisheries to food security in the subregion.

2. The South Asian Subregion

This subregion is located along the north-central border of the Indian Ocean and protrudes southwards towards the central Equatorial. In spite of their geographical proximity to one another, the seven countries are significantly different in size, shape, formation, climate, population, natural resources, religion and political philosophy, but all are developing countries and fall into the same economic category.

To strengthen their economic and social standing vis-à-vis other subregions, these countries formed the South Asian Association for Regional Cooperation (SAARC) to work together for collective improvement in all spheres involving the economic and social well-being of its people. SAARC is still discussing and formulating mechanisms for regional cooperation in various aspects, and implementation of any significance is yet to be realized.

Some of the larger States have been passing through a politically unstable era, and this has affected their economic growth. Religious and cultural factors have a significant influence on the political ideologies and policies of the governments of the larger member States. Differences in political ideologies which evolved out of historical events during the formation of some of the member countries have contributed to the slow progress made by SAARC.

Maldives is a nation of 1,190 islands, and Sri Lanka is a single large island. Both nations are close to the equator. India has a large land mass and also a number of small islands in the middle of the Bay of Bengal (Andaman - Nicobar islands) and the Arabian Sea (Minicoy - Laccadive islands) which are a continuation of the chain of Maldive islands. Pakistan is on the upper part of the Arabian Sea and Bangladesh is on the Bay of Bengal, bordering the Indian Ocean. Nepal and Bhutan are landlocked States north of the Indian mainland.

Surface areas of land, inland water bodies, the continental shelf and the Exclusive Economic Zone (EEZ), and populations, male-to-female ratio, life expectancy and literacy level for each of the SAARC countries are given in Table 1.

Bangladesh has a delta region of 55,598 sq miles, and over 88 percent of the area is flat alluvial and plain. It has borders with Myanmar and India and the Bay of Bengal in the south. The land is crossed by mighty rivers such as the Meghna, Padma and Jamuna and their tributaries. It is divided into 20 physiographic units which are grouped under three areas: the hills, with high-rising ones of 1,000 - 3,000 feet and low ones of about 500 feet; the terrace area and the flood-plains and hill tracts along the eastern border have forest cover. The swampy *sunderbans* along the southeast coast is a large and rich mangrove area significant as the nursery grounds for many of the valuable fish resources in the upper Bay of Bengal. It is inhabited by Bengal tigers and crocodiles which have restricted human intrusion.

The country is subjected to two monsoons, the northeast monsoon (NEM) from December to February and the southwest monsoon (SWM) from May to July. The climate varies from cool to warm weather during the monsoonal seasons (Table 2). Bangladesh suffers severe damage during heavy monsoonal rains and cyclones. There have been over 200 cyclones over the last 180 years, of which 48 were severe; 6 major ones killed about 1.5 million people. Total casualties over the period were 5-6 million.

Fisheries forms an important component of economic activities, but bad weather conditions constrain agriculture and fisheries outputs which contribute a large percentage of the total output. Fishing is more in inland waters. Inland fisheries is widespread and covers all rivers, tributaries and estuaries. With a heavy discharge from the major rivers, estuarine conditions prevail over a very large delta in the coastal waters of the country. The marine sub-sector is restricted to the southeastern part of the coast off the Chittagong and Cox's Bazaar areas.

Bangladesh's economy remains the poorest in South Asia, being subjected to climatic vicissitudes, lack of infrastructure and a high population growth rate. Other parameters are presented in Tables 1-4.

Bhutan is a small, landlocked State surrounded by China, India and Sikkim. It has the smallest population in the subregion. Two of its three rivers start in the high Himalayas and flow south to join the Brahmaputra. All valleys have swift-flowing rivers and streams which merge ultimately with four major river systems in the south: the Ammochu, Wongchu, Sankosh and Manas. These are fed by the perennial snows of the Himalayas. There are three climatic zones: southern, with a hot and humid climate and very heavy rainfall; the central inner Himalayas with a cool, temperate climate and rather heavy rainfall; and the higher alpine climate with less rainfall in summer. There is no evidence of a significant fishing industry. Information on fisheries resources and potentials is poor. Interaction of Bhutan with the other SAARC countries, except India, has remained at a very low level due largely to the geographic location. Transportation is mainly by road; there is no transport by rail or water. India has permitted transit by rail and also for sea shipments. Other parameters are presented in Tables 1-4.

India, the largest of the countries in the subregion, has a wide range of climatic conditions - wet and fertile to dry and arid. It has borders with Pakistan, China, Bangladesh and Myanmar. The rest of its boundaries are with the Arabian Sea and the Bay of Bengal. Sri Lanka is in the Indian Ocean close to its southern tip.

The climate varies from very cold in the northernmost areas close to the Himalayas, to warm and humid in the southern part. Arid zones and desert conditions exist in some parts of the south and the north, respectively. There are many more flat plains than mountains.

Major river systems such as the Ganges, Jamuna, Cauveri and their tributaries total over 22,000 km in length. Rivers and man-made reservoirs, tanks and ponds have an area of millions of hectares.

India is primarily an agricultural nation with over 70 percent of the population engaged in it. Agricultural activities are influenced very significantly by the seasonal and annual changes in weather pattern and rainfall. The SWM and NEM prevail in India, too, and because of the large land mass, the two monsoons are felt noticeably by the eastern side and western side of the mainland, respectively. In the past, fisheries activities were also influenced by the SWM and NEM seasons, but with the development of modern facilities and technology, the fishing pattern is no longer dependent upon monsoonal weather conditions. The desert areas in the north have a rainfall of less than 127 mm and agricultural areas receive a rainfall of 11,000 mm. However, the annual variations are large and agricultural production varies accordingly. Other parameters are presented in Tables 1- 4.

Maldives consists of 1,190 islands formed by 26 atolls, an 820 km-long chain. But only 198 of the islands are inhabited. The atolls are of volcanic origin with subsequent growth of corals. They are coralline islands with very little land suitable for agricultural activities. In 96 percent of the islands, the population density is less than 1,000 and only four islands have a population of more than 4,000. About 25 percent of the total population live on the main island of Male.

Most food items, other than fish, have to be imported. Fishing and tourism are the main economic activities. The climate is warm and humid with rainfall during the two monsoons - SWM (June-Sept.) and NEM (Nov.-Feb.). Other parameters are presented in Tables 1-4.

Nepal has borders with China and India. The climate is sub-tropical and dry with the four-seasonal cycle of the northern temperate climate. The temperature in Katmandu is 30^{o} C in May and as low as 1.6^{o} C in December. Monsoonal rainy seasons are the same as in other South Asian countries, but the rains in June to September are more in the eastern part and less in the northern and western parts. There are three major rivers: the Kosi in the east, the Gandak in the middle and the Karnali to the west, but there are other smaller rivers and tributaries, with a total length of 11,800 km. All are influenced by the annual monsoonal rains. There are no large lakes but smaller bodies of water associated with the river systems. Attempts are being made to control the water supply, to avoid drought and floods. Many rivers are partially controlled with irrigation weirs and dams for hydroelectric power generation. The reservoirs created are used for fish culture. They also have ponds for fish farming. About 15 percent of the arable land is irrigated. It has the tallest mountain in the world - Mount Everest (8,848 m). Other parameters are presented in Tables 1-4.

Pakistan has borders with Iran, India, China and Afghanistan. The country is more mountainous than Bangladesh and the climate, though similar to that in Bangladesh, is not as vulnerable to monsoonal cyclones and floods. The climate is mainly dry and rainfall is variable. The Sind coast, extending from Karachi to the border with India, has a broad continental shelf and the Indus river delta with broad mud-flats, mangrove swamps and many freshwater outlets. The Mekran coast of Baluchistan is situated to the north and west of Karachi. It is mountainous with large bays and a narrow, steep continental shelf. Fish catches are larger along the Sind coast. Besides its own population of 132 million, it has about 3 million Afghan refugees seeking protection from the former USSR. Other parameters are presented in Tables 1-4.

Sri Lanka is situated very close to the southeastern coast of India. Fisheries production has been seriously affected by the ethnic problem which erupted in 1983.

The island has tropical rain-forests in the central hilly area and is generally cool, while the coastal belt is lowland, warm and humid. Some areas are arid. The NEM and SWM influence the weather in Sri Lanka. Heavy rains are associated with these two monsoons and since the island is small, NEM is also felt on the west coast of the country. Cyclonic conditions occasionally affect this country, particularly on the east coast. The NEM weather is generally cooler than the SWM period. Many rivers and tributaries exist in this country, besides the man-made reservoirs, irrigation tanks and ponds which contribute to development of agriculture, fisheries and hydroelectric power**.** Fisheries is an important industry. Major resources of economic importance are tea, rubber, coconut, precious stones, graphite, ilmenite, limestone, tourism and fisheries. Other parameters are presented in Tables 1-4 (Babhani Sen Gupta, 1988; SAARC, 1991).

Some of the poorest of the poor may be found among fishing and fish-farming communities in this part of South Asia, mainly among subsistence fishing households, particularly in Bangladesh. The fishing industry and fishing communities in the countries of South Asia differ significantly in their patterns of development and socio-economic conditions, influenced by their geography: coastal States, landlocked States, island States, and with and without a well-defined continental shelf. In addition, there is considerable difference in the relative areas of inland and marine waters available for fisheries exploitation, ecological characteristics of these environments, kinds of fish resources, primary fisheries, fishery management systems, other natural resources available for exploitation, cultural factors and food habits of the people.

One of the difficulties in dealing with this subject is the incompleteness and inconsistency of statistics on populations of fisherfolk and fishing units, fishing effort, estimates of surface areas of water bodies, etc. One reason for this is the lack of periodic census surveys in the fisheries sector. Table 7 has been created by using the most reliable sets of figures from all available sources. These and other issues concerning resource potentials and fisheries management have been discussed in detail by Sivasubramaniam (1994, 1996 & 1997 a+b).

The fishing industry in this subregion is dependent largely on the small-scale fisher community, both traditional and non-traditional. Only in Bangladesh, India and Pakistan do large-scale or industrial fisheries exist and most of their crews and almost the entire officer category and shore staff come from non-fishery sectors. A very small percentage of the active members of the fishing community are employed as labourers and crew members in large-scale or industrial fisheries activities.

It is estimated that there are about 5.5 million fishermen in the South Asian subregion, including full-time and part-time fishermen (Hotta, 1996). In proportion to the populations of the countries, less than 1 percent of the population appears to be engaged in fishing in any one of the SAARC countries, and more than 50 percent of the estimated number of fishermen are in India alone (Table 6). Considering that on an average there are about four members per fisherman's family, it is estimated that the total population of the fisherfolk community in the subregion may be around 22 million.

Fishing is a very long-standing tradition in this subregion going back more than a century. The traditional fishing community has generally been located along coastal areas. Involvement in fisheries for many generations has resulted in the fishing community being identified as a separate category of people in most of the coastal States, except in Maldives. On the other hand, a significant portion of those engaged in freshwater fisheries were part-time fishermen with agriculture as the other component. Those in other professions also participated in fishing during their inactive period or holidays. Recently, the percentage of full-time fishermen in inland fisheries has increased. This factor has all along been a constraint to the estimation of fisher population in inland fisheries. Except in Maldives where fishermen are engaged only in marine fisheries, the estimated number of fishermen for each State given in Table 6 refers to a total for marine and inland fisheries, including inland culture fisheries.

In Maldives, the entire population is considered to be a traditional marine fishing community. There are no freshwater bodies there. Many of the members of fishing households have diverted from fishing as employment opportunities in other sectors opened up with development of the country and expansion of tourism. The population of Maldives is also very small compared to most countries in the subregion. Consequently, the shortage of fishermen for the growing fishing industry is a continuous constraint there. With this limitation, improvements in the performance of fishing operations through motorization and the use of Fish Aggregating Devices (FADs) has contributed to an increase in productive capacity and income of fishermen. This has been further enhanced by the removal of the purchase monopoly with fixed price that the State Trading Corporation had previously had. Future expansion has to be along the same lines - further improvements to the fishing efficiency of their craft, gear and operations. The fishing community targets mainly one fishery: pole and line for tuna. Live bait collection is an essential component of tuna fishery. However, there is a reef fish fishery (hook and line or handline) during the low-season for tuna and small fisheries for beche de mer (sea cucumber).

With no facilities for storing fresh fish on most of the islands, fisher women in Maldives participate actively in the processing of smoked tuna, smoked and dried tuna, dried reef fish and shark. The living conditions of the average Maldivian small-scale fishermen are not poor, except for the limited choice of locally-produced food items other than fish. Hence they have a very high fish consumption level.

In Sri Lanka, the available figures indicate that the population actively engaged in fisheries has been more or less stagnant for many years. Probably there is an exodus of fishermen into other professions, with the free education scheme and opportunities in other sectors. However, a proper census to clarify the situation is long overdue. Modernization of small-scale fisheries has overtaken the traditional fisheries in a very significant way. Small-scale fisheries are conducting shrimp trawling and oceanic tuna fishing, in addition to other common coastal fisheries. The modernization programme has provided opportunities for better income and living standards to the fisherfolk. Offshore tuna fishermen have a middle-class income or more. Those still engaged in traditional fisheries are not as well off economically. Many of them will have to change from some of the traditional methods which are proving to be uneconomical (beach seine, boat seine) or are considered destructive to fishery resources (dragnet, pushnet, stakenet and setnet). With the significant improvements to fishing efficiency of modern units, fewer traditional fishing units and fewer fishermen will be required in the coastal fisheries. However, the expanding offshore tuna and shark fisheries absorb some of the excess, and new fisheries to be developed for under-exploited/unexploited resources may help to absorb the rest.

India, Bangladesh and Pakistan are nations with a larger percentage of traditional non-motorized boats, gear and fishermen than motorized modern craft. Many of the fishermen in the first category are subsistence fishermen, without assets or other means with which to purchase better and more efficient fishing units. Considering the economic state of these countries, there are too many fishermen for the State to be able to provide financial assistance to them. Many of these fisherfolk attempt to supplement their fishing income during the lean season by working in other sectors, as labourers in agriculture, on construction sites and salterns, or by rearing livestock. In Bangladesh, with higher production from the freshwater sub-sector than from the marine sub-sector, there are proportionately more fisherfolk associated with the former than with the latter. Those engaged in the inland fisheries sub-sector are much poorer, some the poorest of the poor, than those in the marine sector. The leasing and auctioning of inland water areas and flood plains *bheels* result in investors bidding for them and then collecting rent from each individual fisherman opting to fish there. Too many fishermen result in each one catching only a small quantity of fish and getting a small return, of which little is left after he pays the rent. Some of these fishermen who have no land to build a house on, or the means to rent one, live with their families in the fishing craft on the river.

Women participate in the processing and marketing of fish, livestock rearing and small cottage industries. They also participate in certain fisheries such as sea-weed, sea-grass, bivalve and crab collection or even haul beach seine nets. It is in these countries that large-scale or industrial fisheries, such as shrimp and finfish trawling, are conducted. The investments are made by entrepreneurs and do not belong to active fishermen. Trawling targets many of the same species fished by traditional and modern small-scale fisheries and contributes to a number of conflict and management problems. A large quantity of juveniles of the finfish species targeted by artisanal fishermen form the bycatch of shrimp trawlers and are being discarded at sea. The other two coastal States - Maldives and Sri Lanka - do not operate any large-scale fishing vessels within their waters.

It is estimated that at least 30 percent of the traditional fisher families live below the poverty line. Very little is known about the socioeconomic conditions of inland fishermen in the South Asian countries, particularly in Bhutan and Nepal.

Fish farming communities may be of two kinds. Fish farming in freshwater and for certain brackishwater finfish species is undertaken in the backyard or on a very small scale by inland fishermen and even by those engaged in agriculture. Inland fish farming is relatively much more common in India and Bangladesh than in the other countries of the subregion and contributes significantly to the increased fish production in those countries. On the other hand, the lucrative businesses of fish farming for marine shrimp and freshwater ornamental fish are in the hands of entrepreneurs. Seldom are actual fishermen engaged to work on these farms. In Bangladesh, a traditional system of shrimp farming, such as by trapping the larvae in the intertidal zone and paddy cultivation plots, has been practiced by rice farmers and fisherfolk. Non-fisher entrepreneurs have invaded the coastal areas to start modern shrimp farms, and this has created conflicts between them and fisherfolk in the shrimp farm areas. Most of the modern shrimp farms in Bangladesh depend on fisherfolk, particularly women and children, to collect shrimp seed from the estuaries to stock the ponds, and this provides a very small additional income to the fisherfolk. A large number of people are engaged in this activity seasonally. This happens to a lesser extent also in India, Pakistan and Sri Lanka.

Investors in India and Sri Lanka started shrimp farming much later than those in other subregions, and have attempted to expand it too rapidly. This has resulted in many problems, particularly environmental deterioration and shrimp diseases, besides other problems that are linked to the livelihood and habitat of local fishermen. Many of those involved in shrimp trawling also have invested in shrimp farming, because of the decline in catch rate and economic returns from shrimp trawling. Because of the preponderance of non-fisher participation in shrimp culture, reliable estimates of the fisherfolk and non-fisherfolk involved in farming practices are not available for South Asia. The total fisher populations and productions from capture and culture fisheries in each South Asian nation are presented in Table 6.

3. Fisheries and Food Security – the Concept

Food security is a goal of all nations so that the entire population will have access to an accepted minimum level of safe and nutritious food at all times, enabling all of them to maintain a healthy and active life. On the other hand, food security at the household level is the physical and economic access to adequate food for every household member, without undue risk of losing such access (FAO, 1995a).

Food security problems at a national level in the subregion are due to many factors such as population growth rates in the past without parallel growth in economy, unemployment levels, poverty and drastic changes in weather conditions that affect agriculture and fisheries and consequently the food available for domestic consumption, export and trade. At the household level, limited resources, poverty and low literacy are constraints on the procurement and use of appropriate technology to increase production, as well as productivity at the primary sources level and diversified income-generating activities. Poor health and low output of the household become part of a vicious circle.

Fishing, like hunting, was initially for food. Increasing population raised the demand for food, particularly for food that people traditionally ate. Vegetables, the basic energy giver, became the primary food item, but fishing remained important to coastal peoples. However, in this subregion, the predominant religious and cultural traditions consider cattle as animals significant to agricultural activities such as drawing ploughs, driving irrigation mechanisms and pulling carts with agricultural produce. Cattle and sheep were used to provide manure for farms, to eat away weeds and grass and to give milk as food. Meat eating was not considered important; fish has thus become the major animal protein, with occasional consumption of chicken. Maldives, where fish was the sole animal food item, was an exception.

With subsequent developments like a better understanding of nutrition and the need for animal protein for healthy life and political and ideological changes, eating habits changed and meat-eating evolved. However, the fish-eating habit never disappeared. In fact, it continues to grow in India where culture and vegetarianism have been stronger and it took a longer time to make a change to the fish-eating habit.

Though fish is not considered an important source of energy for humans, it does provide energy ranging between 14 to 143 k Calories/gram. Surprisingly, the highest and lowest energy values are provided by a small tuna (frigate tuna) and a large tuna (yellowfin tuna), but the composition of protein and fat are the same, 23.7 percent and 4.6 percent, respectively, in both species. Presently, these two species are popular in Sri Lanka and Maldives. On the other hand, a very cheap variety such as the sardine and one of the most expensive varieties like the Spanish mackerel have almost the same amount of protein (20 percent) and fat (4.5 percent) and also provide almost the same amount of energy (125 k calories/gram) (Tory Research Lab.1989).

With minor exceptions, fish is one of the most important components in the animal protein available to the people of the subregion. Besides its contribution to protein and its nutritive value, it is also used as a condiment - a fried piece of salted and dried fish is considered enough to flavor a whole plate of rice by many poor people in Sri Lanka, Maldives and perhaps in India also. Eating rice and dried fish (fried or curried) is an old habit in Sri Lanka which persists even today, among both the affluent and the poor.

At first, fishing was a form of hunting for food for self-consumption and to share with neighbours. With the passage of time and increase in human population, the demand for fish as a marketable food item, to be sold for domestic consumption and for export to other regions, has increased. Thus, fishing has become an industry to supply this commodity to be sold to people within the countries and to be exported for the economic benefit of the exporting nations. Consequently, it has become an industry that provides income not only to the millions of fishers and fish-farmers and their families but also to millions of others involved in fishery-related industries such as craft, gear and processing plant manufacturers, buyers and users, workshops for repairs, fish-handling and processing, storing, packaging and exporters.

The opportunity created for employment and income to millions of people is very significant at the individual level to improve food security. At the same time, the magnitude of the employment opportunity and the foreign exchange earnings realized are beginning to make a noticeable contribution to the economy at both the national and the subregional level.

As a consequence, the governments of the subregion are showing more interest in this sector: (a) for foreign exchange earnings from fisheries as an export-oriented industry; (b) to increase domestic consumption of fish as an important component of food for their people; and (c) to increase employment opportunities in this sector.

4. Fisheries Sector

4.1 Fisheries in the Coastal States

Bangladesh initially had institutions and administrative machinery geared primarily for freshwater fisheries, and Pakistan had the major components of marine fisheries. Development of marine fisheries in Bangladesh started only about two decades ago and even today, marine fisheries contributes only about 20 percent to total fish production; the balance is primarily from freshwater fisheries and aquaculture. Marine fisheries are primarily small in scale, except for the fleet of about 52 industrial-scale shrimp and finfish trawlers. The vast extent of estuarine waters provides a very large nursery area, including the *sunderbans*, which remain as one of the major nursery areas for larval and juvenile shrimps that maintain the recruitment for the shrimp trawl fisheries of Bangladesh and India. Traditional set bagnet fishery in the rivers and estuaries is more of a subsistence fishery by the poorest of the fisherfolk and is detrimental to the resources. One diadramous species, the hilsa shad (*Tenualosa ilisha*) forms about 20 percent of the total catch and 70 percent of the marine catch. Because the estuarine waters spread very far out to sea, the common coastal pelagic group, clupeids, are virtually absent, and other important groups, mackerels (*Rastrelliger kanagurta* and *R. brachysoma*) and scad (*Decapterus spp*.), live close to the bottom, beyond the 100 m depth.

The entire coastline is subject to some form of traditional shrimp and finfish culture, either with enclosures for trapping juveniles and larvae during high tide or with modern shrimp culture ponds. In recent years, modern shrimp farming practices also have been established, but the traditional system also continues to exist. Frequent inundation of the coastal belt during the rainy season impedes the establishment of hatcheries for shrimp larvae, and shrimp larvae for culture are mainly collected from the lagoons and estuaries. In spite of intensive tiger shrimp larval collection which results in the destruction of other penaeid and finfish larvae, the shrimp stocks do not appear to be affected. Inefficient systems of collection and transportation result in heavy destruction of other species and high mortality of shrimp larvae. Attempts are being made to improve these techniques. Culture of finfish is primarily in the form of culture-based capture-fisheries in freshwater. Considerable developmental activities are being undertaken to increase the productivity of the inland waters (Table 7).

Traditional systems such as water-tenures, leasing and auctioning water bodies, particularly in the flood plains and *bheels* are still in practice. A large number of fisherfolk are engaged in freshwater fisheries, their units small and mainly non-motorized. Their income is poor. Fish production from the marine sector is relatively small; the number of fishermen is less but investment per fishing unit is higher because of the higher price of craft, gear and motorization. There are no small-scale trawlers or purse seiners. Fisheries statistics collection is not under the umbrella of the Ministry of Fisheries and Livestock or the Department of Fisheries but under the Department of Statistics. Licensing of fishing units has not been practicable because of their scattered distribution along the banks of numerous rivers and riverlets. Due to the widely scattered landings of catches, a secondary collection system brings the fish to main centres or cities for marketing. A large quantity of the catches is converted into dried fish, due to lack of ice and preservation facilities close to the landing points. Cultured and captured shrimp, cuttlefish, mud-crab and dried shark, sharkfin, and air-bladder of croakers are some of the major items exported.

Women are less involved in fisheries-related activities and more in firewood gathering, paddy harvesting, straw cutting, livestock rearing, etc. (Ataur Rahman, 1993). Overfishing and intense competition for access to existing water bodies by other users are unsettled issues. However, there is good potential for the development of capture and culture fisheries in the freshwater sub-sector, with proper developmental and management approaches.

The Fisheries Department is under the Ministry of Fisheries and Livestock but the licensing of foreign fishing vessels, fishing gear manufacture and joint ventures are the responsibility of the Ministry of Industries.

India has no major laws restricting entry into the fisheries sectors, but the caste system in the country limits the exit of fisher caste into other vocations and also discourages the entry of other castes into the fishing community, except as entrepreneurs or under extreme strain of poverty and starvation. There is heavy concentration of fishing effort at <50 m depth and coastal resources show signs of excessive exploitation. Fisheries is almost entirely small in scale, with predominance of non-motorized craft. Large-scale fishery is restricted to trawling for penaeid shrimps on the continental shelf on the east coast and the same trawlers operate seasonally for deepsea lobster in the southwest and southeast coasts, at 200-300 m depth range. Deepwater lobster are patchy in their distribution, the catch rate drops rapidly in each patch, and overall production is not increasing significantly. Shrimp trawIing was initially conducted on the west coast but with the decline in catches, the fishery shifted to the east coast. Even on the east coast, the fishery is becoming limited to the Sand-head area in the upper Bay of Bengal, close to the *sundarbans*. In the areas where penaeid shrimp catches have declined significantly, the trawlers target cephalopods and finfish also, to make their operations viable. Artificial reef deployment programmes are also active in the coastal areas.

A mariculture programme has recently proliferated along the coastline and many of the shrimp trawler owners are also investing in this, in view of the declining economic situation in their trawl fishery.

A small tuna fishery (pole and line) exists in the Laccadive - Minicoy islands. Poor demand for tuna in India has retarded the development of their tuna fisheries, and the government has ventured into licensing foreign tuna longliners and trawlers, annually, to conduct tuna longlining in the EEZ on the east and west coasts and in the Andaman Sea, and demersal trawling on the Wadge Bank and in other areas on the east coast (Atul Sinha & Sampath, 1993). In 1993, India licensed 28 tuna longliners (42-60 m LOA & 400-791 Gr.t) from three Taiwanese companies, to collaborate with 34 local companies. Also three stern trawlers (56-66 m LOA & 900-1,100 Gr.t) and five paired-trawlers (42-4 m LOA & 350-360 Gr.t) from two foreign companies (Taiwanese and Spanish), to collaborate with six local companies (Vijeyakumar et al, 1995). The agreement included such conditions as training of Indian crew members, information on exploited resources within the EEZ and 20 percent of the foreign exchange earnings.

Inland fisheries is the significant contributor of fish to people in the interior part of India. Freshwater fish culture systems are of long standing, including the example of sewage-fed fish ponds in Calcutta. Reservoirs and flood-plains suffer from overfishing and environmental degradation. The catch rates and sizes of fish show signs of decline. However, any further increase in catches of fish has to come from reservoir fisheries with improved management (Sugunan, 1995).

Coastal fisheries is under the Ministry of Agriculture, while offshore fisheries is under the Ministry of Food Processing Industries. This arrangement does not seem to have worked very satisfactorily and there is a strong movement towards the reunification of these two sub-sectors under the Ministry of Agriculture (Radhakrishnan & Roy, 1994).

Maldives is unique in having primarily one type of fishery, pole and line or live-bait fishery for tuna, with a very small reef fishery to supply the tourist resorts and expatriates. This situation is the result of tuna, their primary fish resource, being available close to the shoreline because of the steep bottom configuration of the atolls. This presents a picture similar to that of gear restriction for management purposes. The country is facing the problem of manpower shortage because of the small population - about 250,000 people inhabiting only about 120 of the 1,200 islands in the country and because increasing numbers of young people are being absorbed by the growing tourist industry. This situation has indirectly brought about an unavoidable limited entry situation into the tuna fishery. The fishing craft used is basically the traditional *dhoni-masdhoni* (pole and line craft) and *vadhudhoni* (trolling line craft) that have with successive generations undergone improvements such as introduction of a deck and motorization to replace sail-power. All local fishing craft operate only as day-boats. This again gives the impression of a Fishing Area Control, forced by the limitations in the endurance of the craft. Some other improvements, such as water circulation in the bait-carrying tank and a pump-driven water-spraying system, are also being introduced. These improvements contributed to the first significant increase in tuna production without noticeable increase in fleet size.

Most of the tuna caught are exported because the demand for domestic consumption is small. In the past, the state monopoly had a system for fishermen to deliver their catches to collector vessels belonging to the State Trading Corporation for fixed prices of fish. Special carrier vessels delivered the fish to foreign buyers. This system provided a way to collect a tax on the tuna catches that were exported and utilized the tax money to import other commodities. Any excess fish or sizes not delivered to collector vessels were processed into smoked fish for local consumption and boiled and dried fish (Maldivefish) that has been traditionally exported to Sri Lanka. The system of collection and export is undergoing drastic changes at present and is expected to become more favourable to the tuna fishermen of Maldives. The second major step to increase production was to introduce Fish Aggregating Devices (FADs) which provided another leap in production by increasing the catch rate without increasing the number of fishing units (Table 7). Any further increase in production may warrant drastic changes to the fishing system itself - purse seining, perhaps?

In **Sri Lanka**, fisheries contributes 2 percent to the national GDP; 80 percent of the production is from coastal resources and 20 percent from offshore. Of the small-scale fishing crafts, 50 percent or more are motorized. Some of these (28'-38' class) are engaged in offshore tuna and shark fisheries. A new class of offshore fishing crafts, 40'-52' in length, is being fabricated by local boatyards, according to the desires of the fishermen; these are being introduced for long voyages into the offshore range for large pelagics (tuna, billfish and sharks). Some of the craft are owned by small-scale fishermen who purchased them, using their own capital/assets, funds borrowed from banks or with the assistance of middle-men in the fishing industry. Crew members in offshore fisheries may earn around Rs10 to 25 thousand per month, while the owner realizes Rs 60-150 thousand per month. A system of crew working in shifts and appointment of a shore manager to take care of the catch and get the craft ready for the next trip with the shortest possible turn-around time is being established in this small-scale type of fishery. The pelagic fisheries have become more important in the last few decades, compared to the predominantly traditional demersal fisheries that existed prior to motorization of crafts. Fishing in the coastal areas has become intensive and entry is discouraged by the poor fishing performance of the fleets. However, this has encouraged the expansion of offshore/oceanic fisheries for large pelagics and this is the main area for development in capture fisheries. Demersal fisheries are beginning to pick up, once again, due to the rapid increase in the prices of fish. Due to internal conflicts, fisheries in the northern and eastern part of the country have declined very sharply. This has a significant impact on the country's overall fish production. The government has granted licenses to a number of foreign tuna vessels to operate from bases in the country at a time when the local fishermen have started to venture out to take the same resources.

In the freshwater fisheries of Sri Lanka, yields from the perennial tanks and reservoirs have to be increased. If management is ensured, major carps can contribute to more and higher valued yields. More reservoirs also can be brought under improved production schemes. Integrated rice and fish/prawn farming also needs accelerated development. A few years ago, the government took a policy decision to stop supporting freshwater fisheries development, on religious grounds. However, this decision has been reversed and developmental activities are being pushed to revive the fisheries and to raise the production from this sector, which had declined considerably (Table 7).

Fisheries in Sri Lanka is under the Ministry of Fisheries and Aquatic Resources. Steps are being taken to strengthen the Extension and Management Divisions. Fisheries statistics, research and training are also under the same ministry. The National Aquatic Resources Research Agency (NARRA) undertakes not only fisheries research, but also research into non-living resources in the sea and other aquatic environments.

Pakistan's production from the marine fisheries sub-sector is treble that of the inland fisheries sub-sector. However, both marine and inland fishery production have shown unsteady trends in very recent years. It does not have any large-scale indigenous craft but foreign industrial vessels, under licence, are trawling in the offshore areas beyond 35 miles from shore. The majority of Pakistan's vessels are powered and operate primarily in the coastal waters. Penaeid shrimps form the most important category of the commercial varieties. Inland capture fisheries are in rivers, canals and reservoirs. There are about 2,000 trawlers contributing to about 30,000 mt of shrimp production, of which 28,000 mt are from the Indus river delta (Table 7).

Freshwater aquaculture is more active than brackishwater culture. Shrimp culture has yet to develop. Though some private companies have conducted successful trials using seeds imported from Sri Lanka and Malaysia, commercial activities have not begun. However, expert opinion (NACA mission to Pakistan, in 1995/96) is that Pakistan has very good potential for this activity and that 385,000 ha of the Indus river delta is suitable for shrimp culture. Freshwater fish culture has been in traditional earthen ponds for carps polyculture. Aquaculture is responsible for 20 percent of the inland fishery production.

The people of this country do not eat much fish. Though they do consume big fish during some months, small fish are seldom utilized. A massive campaign has been launched to increase the consumption of small fish. Fishermen and fish-farmers are paid a low price due to marketing constraints. Brackishwater culture of shrimp and freshwater culture of trout and freshwater prawn are actively followed at present. Fisheries is under the Ministry of Food, Agriculture and Cooperatives, with a Commissioner for Fisheries and a Department of Fisheries.

Fish production is mainly for domestic consumption, and fish consumption is much higher in the Baluchistan region than in Sind. Fish distribution is limited and consumption is high in the vicinity of the landing places. Exports include frozen shrimp, molluscs and finfish, dried fish and sharkfin. In 1992, Pakistan exported some frozen shrimp to India and dried fish, frozen fish and molluscs, sharkfin and fish maws to Sri Lanka. Marine resources are overexploited, particularly the shrimp resources. There is intensive exploitation and competitive fishing in inshore water and limited scope for expansion of coastal marine fisheries. The government's interventions are leading to fisheries management, and development is directed towards the offshore fisheries. There is a growing fishery for large pelagics and sharks in the offshore range. Foreign vessels are operating under licence. There is potential for Pakistan to venture into the exploitation of tuna, sharks and mesopelagics.

Fish contributes only one percent to the GDP, and shrimp export is a primary contributor to export earnings in this sector. Reduction of trawlers and introduction of a closed season is the main approach to management in the coastal waters. As a means of diverting the fishing effort from the shrimp fishery, shrimp trawlers are being converted into offshore gillnetters and longliners - at least 300 trawlers have already been converted. There are six stern-trawlers and 14 longliners operating offshore, under a 'Pakistan flag' policy. Inadequate infrastructure facilities limit the expansion of Pakistan's offfshore fisheries. The policy is to expand the fisheries to cover the EEZ, and necessary steps are being taken in this direction. Additional shore facilities, besides improvement of the facilities in the Karachi harbour, will reduce the present congestion, accommodate more deep-sea vessels and provide employment opportunities. Aquaculture will expand with more hatcheries and nurseries for shrimps and finfish, pearl oyster under mariculture and also for carps in freshwater aquaculture. Concessions and incentives on import of marine diesel engines, fishing nets, hauling devices, fish-finding instruments, etc., are planned through exemption of customs duty and sales tax for individual fishermen/farmers, Department of Fisheries and Cooperatives tax exemption for five years and electricity tariff exemption for aquaculture, as for agriculture.

4.2 Fisheries in the Landlocked States

Nepal has freshwater rivers (395,000 ha), natural lakes (5,000 ha), reservoirs created for irrigation/hydroelectric power generation (300 ha), village ponds/tanks (5,500 ha) and paddy fields (250,000 ha) for fish production. Development of both capture fisheries and cage culture in lakes and more expanded development of aquaculture are leading to increased production. Rivers in the hills are not considered to be highly productive. Much of the *koshi* river system is unavailable for management, as the lower reaches of the river have been leased to the Indian government for 199 years. There has been a long standing fish trade between Nepal and India, but no record of this is available (Table 7).

Both riverine and lacustrine resources have potential for aquaculture. Development and management of the riverine fishery resources are expected to help increase production. Serious disturbance to the management of fisheries is due to the construction of irrigation weirs and hydroelectric dams which prevent the migration of fish. However, this detrimental effect may be compensated for by improved production of fish in the up-stream reservoirs and dams with an appropriate stocking programme. Though the government's highest priority for harnessing the water resources is for the development of agriculture, aquaculture development will receive equal attention. Common species are the major carps such as silver carp, catla, rohu, mrigal and common carp. Indigenous species in the lakes are the *Tor tor* and *Chizothorax spp*. but carps are presently being stocked. Cage culture is primarily of silver carp. Integrated rice and fish farming is also expected to develop.

Nepal is a net food importer, both commercially and in the form of aid. The drought of 1992, the floods of 1993 and the influx of refugees have had a severe impact on the food security situation. Access to food is a problem in the hills because of poor cultivation, and plant growth is limited by the cold. Agriculture cannot be expanded without destroying the little forest cover that remains.

Though this landlocked country also has the right to enter marine fisheries, their economic status and their desire to develop inland fisheries initially have prevented them from giving any consideration to making use of their rights to the marine resources in the Indian Ocean.

Bhutan also has freshwater resources and some fishery exists in the country. Estimated production is about 400 mt annually. It is expected that freshwater capture fisheries, fish farming and integrated rice and fish farming, may develop in the near future (Table 7).

4.3 Trends in Fish Production

In 1993, marine production from this subregion was 3,728,744 mt (51.4 percent), inland fishery production 2,780,594 mt (54.5 percent) and 1,713,381 mt (57.1 percent) from aquaculture. In 1994, there was a drastic change, particularly with the decline in production from inland fisheries (Table 7). Of the total of 6.5 million mt of fish produced by the subregion, the marine subsector contributed 55.1 percent, aquaculture 29.2 percent and inland fisheries 18.6 percent. India's marine fisheries (71 percent), aquaculture (84.3 percent) and inland fisheries (42 percent) made its overall contribution almost 70 percent in the subregion. Bangladesh was the only country to exceed India's contribution in any of the sub-sectors, with 46.8 percent of the inland fishery production. This has been attributed to the large-scale stocking programme adopted by Bangladesh. In the aquaculture area, India's production nearly tripled in the last decade, to reach 1.6 million mt worth $2,095 million in 1994. Carps were the major species farmed, along with coastal shrimp culture which earned about $712 million. India's aquaculture is second in the world only to China. Indian shrimp output was 92,000 mt, and in Bangladesh it was 29,000 mt. Inland fishery production from this subregion is greater because of the large area of freshwater bodies in countries like Bangladesh and India. Aquaculture production is also greater primarily because of extensive freshwater culture activities. Brackishwater and marine aquaculture development have been much less than in the neighbouring ASEAN subregion.

Overall, total fish production in the region increased at the average rate of 5.1 percent per annum between 1984 and 1994. However, there appears to have been a remarkable increase in the aquaculture sub-sector (19.7 percent per annum) during the same period. On the other hand, while the marine sub-sector increased by a reasonable 4.0 percent per annum, inland fisheries increased by 2.2 percent per annum between 1984 and 1989 but declined by 1.7 percent between 1989 and 1994. The decline was observed in India, and among other reasons, the statistical method used in the estimation may be a factor. Production estimation in inland fisheries in this region has been the subject of concern for a long time.

Freshwater fishery in India has performed well, mainly with poly-culture of herbivorous and carnivorous species cyprinids with low stocking density and traditional semi-intensive pond based farming, as a low-priced source of food for mass domestic consumption. Catla contributed 360,000 mt, mrigal carp about 350,000 mt and roho around 40,000 mt (Table 7).

Marine capture fisheries

a) Coastal fisheries

Up to 1970, marine fish production increased at the rate of 6 percent per year, but between 1980 and 1990 the increase was about 2.3 percent per year. Annual productivity exhibits wide fluctuation, and the world supply of fish is becoming increasingly dependent on low-value species. Though there is an increase in production, the catch composition has changed, with slow but steady decrease of varieties such as the highly-valued demersals. According to statistics available to FAO, 69 percent of the stocks in the world are considered either fully exploited, overfished or depleted.

Among the countries with more than 100,000 mt production level in the early part of the 1980s, only Bangladesh and Pakistan exhibited average annual rates of increase in production (5.5-8.9 percent), which were well above the average for the Indian Ocean between 1984 and 1993. Others like India indicated values (3.9-1.0 percent) which were well below average for the Indian Ocean (FAO Fisheries Statistics, 1984-1993).

The main varieties of demersal fish category are: croakers, bombay-duck, lizard fish, goatfish, threadfins, skates, rays and sharks, catfish, sea bream, ponyfish, carangids, snappers, emperors, groupers. The first five varieties are predominant in the soft bottom in the northern part inside the Bay of Bengal and the Arabian sea, while the last four are predominant in the southern part with rocky bottom and open sea. The rest are common to both areas.

Among the small pelagics, Indian oil sardine, clupeoids, anchovies, sardinella, stolephorus, wolf-herring, and Indian mackerel are dominant in the open sea areas of the subregion. In the upper part of the Bay of Bengal and the Arabian Sea, Bangladesh, Pakistan and India share stocks of major diadramous species such as hilsa shad, toli shad, keele shad and giant perch or barramundi. Hilsa shad is the primary pelagic species available in the coastal and inland waters of Bangladesh. In Maldives, which is without a proper continental shelf, coastal waters are those within the atoll and the outer fringes of the atolls. Various forms of coral fish, baitfish, small tunas, rainbow runner (*Elagatis bipinnulatus*) and Spanish mackerels (Scomberomorous species) are pelagic forms.

In addition to coastal tuna, like frigate/bullet tuna (*Auxis thazard/A. rochei*), kawakawa (*Euthynnus affinis*), longtail tuna (*Thunnus tonggol*), dog-tooth tuna (*Gymnosarda unicolor*) and oriental bonito (*Sarda orientalis*), some of the oceanic tuna, such as skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), bigeye tuna (*Thunnus obesus*) and some billfishes (marlin, swordfish and spearfish), are also caught just outside the Maldivian atolls.

Most noticeable positive trends have been in the production of the tuna group, demersals, jacks and mullets, shrimps and cephalopods. Sharks and skates (primarily the demersal types), and small pelagics appear to be in a sensitive state, fluctuating without a steady trend. However, the specific country-wise situation is quite different - concerning the demersals, the picture is not so bad among the SAARC countries. It should be noted, however, that the quality of statistics is relatively poor in the SAARC region, except in Maldives.

Statistics on fisher and fishing craft/gear populations in marine and inland fisheries are incomplete for some countries, and have not been updated in many others for a number of years. The estimates of fisherfolk population in inland fisheries and aquaculture of any individual State are more uncertain than those in the marine sub-sector. Based on available information and extrapolations, it is estimated that there may be approximately 6.0 million fishers, 24 million fisherfolk and around 400,000 units of traditional and modern fishing craft of different classes in the subregion. The major concentration of fisherfolk (about 76 percent) in the Indian Ocean is in the South Asian subregion. This relative proportion correlates somewhat to the relative proportion of the fishing craft population in the subregion. Non-motorized craft are, on an average, considered to be >45 percent of the total fleets in the subregion. The percentage of industrial fishing vessels among the motorized craft is <8 percent in the subregion. Based on this information, it is evident that a very large proportion of the fisherfolk in the subregion are engaged in small-scale fisheries and predominantly in the traditional sub-sector.

Industrial trawlers operate only in Bangladesh, India and Pakistan. Small-scale trawlers are shrimping in Sri Lanka and trawlers do not operate in Maldives. Those countries employing industrial trawlers are facing more over-exploitation, bycatch and discard problems.

On an average, there are 15 significant types of fishing gear with a total of about 40 different variations (mainly of gillnet and hook and line), used in marine and freshwater capture fisheries. Numerous combinations of the different types and classes of fishing craft, operating different types and variations of fishing gear and targeting different species in different fishing depth zones contribute to many interactive and competitive fisheries in these developing countries. Primary ones concern the demersal fisheries of a majority of the coastal States which have combined small-scale and industrial-scale fisheries.

Assessment of productivity has serious limitations in the developing regions because of the poor recording of catches, particularly those made by artisanal/small-scale fisheries. Also, the classification of trash and discarded species varies significantly among the countries in this subregion, depending on their culture and traditions. Productivity is based on the targeted species harvested. The status of exploited stocks, discarded catch and stocks utilized in other subregions but unutilized in the South Asian subregion because of traditions and taboos are seldom accounted for in the productivity estimates. Trawl fishery data indicate that demersal fish density varied between 1-4 mt per square kilometer in different sub-areas.

With intensive exploitation of demersals, particularly shrimps, by trawlers over a long period of time, this range may have been significantly reduced and the species composition changed. This is particularly true in some of the waters off Bangladesh, Pakistan and India without significant reduction in the total production by weight, as in the case of Thai and Malaysian waters. Estimates of the potential of resources for demersal, small and large pelagic fisheries are highly variable, depending upon the methods of assessment and the author. Though many of these estimates have been

subjected to critical reviews, the States continue to use some of them. Lack of reliable catch and effort statistics for each fishery is one of the major limitations to the assessments made, except in the case of Maldives.

There seems to be a significant decline in stocks of penaeid shrimps and demersals off the coast of India and Pakistan. Small pelagics, deepwater demersals and shark resources appear to have potential for some expansion in the fisheries of India and Pakistan. Recent estimates of potential yields in several fish stocks have had to be revised downwards as natural mortality rates have become better known.

There is also a growing market for the export of marine ornamental fish and other organisms, particularly from the island States. Since this market is expanding very rapidly, many of the States are rushing to establish regulations to control the collection and export of each species and to prohibit the export of rare and threatened species.

There are also fisheries that have ceased to operate or are on the verge of disappearing from some countries. These include window-pane oyster fishery, pearl oyster fishery, chank and other sea-shell fisheries which thrived and earned export income, but one or more of these fisheries have disappeared from countries like Sri Lanka and India. Another fishery that has declined, partly due to overexploitation and partly due to economic reasons, is the sea-cucumber (Holothuria) fishery. Though it continues less actively in many of the States, it declined rapidly in Maldives, due to overfishing in some of the atolls. The giant clam fishery in Maldives also declined rapidly due to intensive exploitation.

Potential. Most of the coastal resources in this subregion, are at the maximum sustainable level of exploitation or have exceeded it. The very few exceptions are: (a) the demersal components of the pelagics such as Indian mackerel (*Rastrelliger kanagurta*) and scad (*Decapterus russelli*), mainly off the coast of Bangladesh and the northeast coast of India; (b) the scattered stocks of rainbow runner (*Elagatis bipinnulatus*) and dolphinfish (*Coryphaena spp.*) which require the use of FADs to aggregate them for viable catches around Maldives, Sri Lanka and India; (c) flyingfish stocks (*Hirundichthys coramandelensis*, *Cypselurus spp*.) which are presently underutilized by Sri Lanka and India. In Sri Lanka, if the ethnic problem is solved, coastal production will shoot up by at least 50 percent above the present level, with the active participation of the northern and eastern provinces. This will also ease the intensity of fishing in the northwestern and southern provinces and enhance management of fisheries in these coastal areas.

With good management measures, yields from the demersal stocks that are being intensively fished, particularly by trawlers, can be considerably improved. Reduction in the bycatch will reduce the discarding of large quantities of edible species and enable the large component of juveniles to grow bigger and be recruited to other well-managed fisheries in countries like Bangladesh, India and Pakistan. Improvement in the small marine fish-eating habit of the people of Pakistan will increase significantly the availability of fish for consumption, even without additional production. Fishing technology improvements for better management and alternatives to industrial-trawling for shrimp can contribute significantly to the management of fish resources and increase the availability of fish for consumption. To improve the food security situation, use of edible fish species for fish-meal production must be discouraged. The viability of using offal and vegetable components as fish-meal must be considered seriously.

Management of State-supported coastal fisheries has not been successful, as it has been difficult for the States to provide financial support for major reorganization and modernization, particularly in countries with large populations of subsistence fishermen, like India, Bangladesh and Pakistan.

b) Offshore/Oceanic fisheries

Offshore/oceanic fisheries in the subregion are primarily for large pelagics such as oceanic-tuna, billfish and pelagic sharks. Intensive fishing with purse seine for surface tunas such as skipjack (*K.pelamis*), yellowfin (*T.albacres*) and bigeye (*T. obesus*) is being conducted by distant nations (France, Spain, Japan and Thailand). Pole and line (live bait) fishery in Maldives and some of the Minicoy - Laccadive islands of India and drift-gillnet fishery in Sri Lanka exploit skipjack and yellowfin tunas. Deep-swimming, larger-sized tunas (*T. albacares, T.obesus, T. alalunga, T. macoyii*), billfish (*I. platypterus, X. gladius, M. mazara, M. nigricans, T. angustirostris, T. audax*) and large pelagic sharks and rays (mainly *Carcharhinus spp., Prionace spp., Alopias spp., Isurus spp., Sphyrna spp.*and *Mobula spp.*), and wahoo (*Acanthocybium solandri*), are being fished intensively with tuna longline by distant nations such as Japan, Korea and Taiwan Province of China and also through joint ventures between these distant nations and coastal States such as Sri Lanka, Seychelles, India, Malaysia and others. Deepwater handlining is also conducted for larger yellowfin tuna, by some of the coastal States. A total of 782,104 mt of tunas and tuna-like species were caught in the Indian Ocean region in 1993 by 41 countries, including 10 distant nations. About 40 percent of this was from offshore/oceanic stocks. A similar estimate for sharks could be calculated due to poor species separation. However, between 12-15 percent of the total catch of sharks and skates from the Indian Ocean may account for offshore pelagic sharks.

Bangladesh has an estuarine condition prevailing up to about 25 miles from the shoreline and has marine conditions close to the southeastern part where the coastal gillnet fishery catches approximately 30 mt of Spanish mackerel and tuna annually. An offshore/oceanic fishery has not been established. India’s catch of 94,368 mt of tuna and tuna-like fish in 1993 represents only about 5,554 mt (5.8 percent) which may be categorised as offshore/oceanic tuna longline catches of yellowfin, bigeye tuna and billfish (sailfish and swordfish). The rest were coastal/small tunas and Spanish mackerels from the traditional pole and line fishery in the Laccadive - Minicoy islands and the gillnet, handline and troll line fisheries off the coast of the mainland.

India has still to develop an oceanic tuna fishery but has licensed foreign vessels to conduct tuna fishery from her bases. Maldives’ 78,681 mt of tuna and tuna-like fish come from their small-scale traditional pole and line fishery, with the second generation *Masdhoni*, within 30-40 miles from the shore. The primary species are skipjack (74.6 percent) and yellowfin (12.8 percent). Since the oceanic waters are at India’s door-step, it has easy access to oceanic stocks. India has not attempted to introduce an industrial-scale tuna fishery.

Pakistan’s production of 28,777 mt of tuna and tuna-like fish is primarily (96.2 percent) small tuna and spanish mackerel caught by gillnets on the shelf area. The 3.8 percent of longline catches may be from the oceanic range, but the catch composition is not available for any consideration of the type of stocks exploited. It too has not ventured into oceanic tuna fishery, though the subject has been discussed and examined for a number of years.

Sri Lanka has a well-established offshore/oceanic tuna fishery, with a fleet of locally designed and constructed, small-scale multiday boats sailing up to and even beyond the edge of the EEZ. There is a gillnet and longline combination in operation that targets tunas and pelagic sharks. Both varieties have almost equal domestic market value. Of the 54,290 mt caught in 1993 (IPTP, 1995) more than 70 percent is from the offshore/oceanic range. Researchers (Dayaratne & Maldeniya, 1995) have identified that the production in 1993 was 79,943 mt and that 73 percent of it was from the offshore/oceanic range. The offshore/oceanic pelagic shark catch in 1993 was between 10,000 and 15,000 mt. Besides the development of shrimp culture, the development of this offshore/oceanic fishery has been the most significant event in the fisheries sector of Sri Lanka in recent years.

According to surveys conducted by Dr R.V. Fridtjof Nansen and the fisheries survey of India, trawling on the continental slope (200-300m depth) for deepwater lobster (*Puerulus sewelli*), and some deepwater demersal finfish may also be considered as potential resources under offshore fishery, because these stocks are not being exploited by any of the coastal fisheries. Statistics on these fisheries are still to be separated and published. Vertical longline fishery for demersals on the continental slope is also commencing.

Potentials. The major offshore/oceanic resources available to all the coastal States are tuna and shark. The Indian Ocean Tuna Commission has been established and the countries in the subregion have the right and the opportunity to claim a share of the Total Allowable Catch. Presently, Sri Lanka, Maldives and India take about 100,000 mt of the oceanic tuna. Sri Lanka, India and Pakistan have allowed distant nations to operate tuna vessels out of their bases under some form of licensing. They should examine the benefits and disadvantages of the licenses they have already issued to foreign vessels, in light of the operational mechanisms to be introduced. All the countries in the subregion should ensure that they establish their rights to get a proper share of the allowable catch. It is anticipated that the subregion may gain another 150,000 mt of the allowable catch under the Tuna Commission (IPTP Tuna Catch Statistics, 1994). **Considerable attention has to be given to this by the subregion.**

The large demersal finfish on the continental slopes of the coastal nations are unutilized at present and offer a potential resource for capturing high-valued groupers, snappers, breams, etc. Similarly, cuttlefish and squids beyond the shelf area are also underutilized. Deepwater lobster is fished only by India; none of the other nations have ventured yet to utilize this resource or other finfish in the >200 m depth range of the EEZ. Dr. R.V. Fridtjof Nansen surveys in this subregion have shown that large quantities of deepwater demersal finfish are available to be taken. But first, fish technology must be put in place to prepare the fish or products from it so that they are marketable. Research in this area is progressing too slowly for the needs in the subregion. With some catch of highly-valued exportable products such as deepsea lobsters, shrimp, cuttlefish and squid, the economic viability of exploiting the unutilized deepsea finfish will be strengthened. If successful, this should contribute to at least another 150-200 thousand mt, with India having access to no less than 50 percent of it. **This is the second most important resource component on the continental slope, with potential for development in this subregion in the near future.**

The amount of squids in the Indian Ocean is estimated to be around 2 million mt, and even if only 5 percent of this becomes exploitable by countries in the subregion, it will provide 100,000 mt (Garcia & Majowski, 1990).

In offshore/oceanic fisheries of this subregion, the provisions for access to export markets are tied to access to the resources. When joint ventures are engaged in, bargaining power lies in requiring that the flag State is obliged to purchase fish from the coastal State. At the same time, the coastal States must take market access into account when determining the quantity of fish to be allocated to the foreign flag State. Provisions under which the flag State is requested to provide the coastal State with information relating to access to the flag State's domestic market and for both States to cooperate in the expansion of the market for products originating from the coastal State are also very important.

c) Diadramous species

The total production of this variety of fish was around 300,000 mt in 1993. Among the diadramous species fished by Bangladesh, India and Pakistan, hilsa shad (*H. ilisha*) stands out as the dominant species (75.0 percent), followed by kelee shad (17 percent), giant perch (5.0 percent) and toli shad (*Hilsa toli*) (3.0 percent) (FAO, Year Book 1994). Unlike the trends of diadramous species on the western side, toli and gizzard shad show a sharp increase in annual production, while the other two exhibit this to a lesser degree. Bangladesh relies heavily on hilsa shad as the single species that contributes most significantly to fish production. These species are not always identified and classified separately in all the countries of the subregion, and separation of their production from marine and freshwater sub-sectors is also not available. **Management of these stocks and the fisheries is very urgent because any damage to the stocks of hilsa shad could cause a major disaster to overall fish production in a country like Bangladesh.**

The shad resources are also very important to the achievement of food security in a country like Bangladesh which therefore should establish joint management measures with India, and perhaps with Myanmar also, for the sustainable development of the fisheries of this most important fish resource in Bangladesh. A similar situation exists between Pakistan and India on the Arabian Sea side. There may not be a significant increase from this sub-sector, but regulation is essential for sustained exploitation of this important resource.

<u>Inland capture fisheries</u>

Inland fisheries production in the subregion increased significantly from 1,250,558 mt in 1984 to 1,216,000 mt in 1994, a decline from the 2,729,327 mt in 1993. According to the 1993 figures, India produced 67.3 percent of the total, Bangladesh 26.8 percent, Pakistan 4.5 percent, Nepal and Sri Lanka 0.6 percent each, and Bhutan had negligible production of about 350 mt while Maldives has no inland water bodies (Table 7). Almost all the countries showed an increase, with India's contribution having the largest impact. However, in Sri Lanka, production declined from 30,575 mt to 18,000 mt, because of the government's new policy to stop supporting inland fisheries development for cultural reasons. The cyprinids, mainly the carps such as the common carp, rohu, mrigal, bighead, catla, grass carp, silver carp, trouts and climbing perch, were the main contributors in India, Bangladesh and Pakistan, but in Sri Lanka the dominant species were tilapia (FAO Year Book, 1994).

Inland fisheries production has been exhibiting a slow rate of growth, due to heavy fishing pressure, environmental degradation and unbalanced utilization of the resources on land and in water. India is a major contributor to inland fish production, but its inland fishery catch rate is showing a decline. It is believed that any further increase in production has to come from reservoir fisheries.

Bangladesh's rate of increase of human population is greater than the increase in fish production and hence the per-caput consumption tends to decline. It has also contributed to overfishing and increase in competition for access to fish resources. Only proper management and application of sound technology to increase the yield can help to improve the exploitation potential. In almost all the countries except Maldives, greater yield from reservoirs could be obtained. An integrated fish farming system also should be encouraged in all the countries, for improved fish production from the freshwater bodies.

In Pakistan, the Water and Power Development Authority (WPDA) is in charge of fisheries development in major irrigation and hydroelectric power reservoirs on the Indus and other rivers. It is reported that production of fish can be increased through stocking of hatchery-raised seeds (rohu, silver carp, grass carp, catla, mrigal carp and common carp). About 23,000 mt of fish, valued at Rs.118 million, are being caught by 5,000 fisherfolk for their living, and 13,000 anglers as game fishermen. The yield is around 15.5 kg/ha but it is thought that this can be increased to 100 kg/ha. It is also reported that presently only about 35 percent of the 8.6 million ha of freshwater bodies (rivers, reservoirs, lakes and flood-plains) are being utilized. There are 5,000 fish farms covering an area of 1,500 ha, and six hatcheries and 22 nurseries provide 16 million fingerlings. While the growth rate of total fish production is expected to decrease from 3.4 to 2.7 percent, the inland fish production rate is expected to increase from 2.4 to 3.0 percent (IPFC, 1994). Similarly, in India, Sugunan (1995) has reported that the small, medium and large reservoirs can be made to realize a moderate increase in their average yields from 49.9, 12.3, and 11.4 kg/ha, to 100, 75 and 50 kg/ha, respectively. This will take their present yield from 93,650 mt to 245,134 mt. Stocking fast-growing extraneous species should be considered. However, stocking programmes in the region have not followed any scientific basis. Consequently, the effect of stocking has been different in different reservoirs. Characteristics of populations of endemic species should be studied and their feeding habits understood before any attempt is made to identify the species to be introduced and the quantities of fingerlings to be stocked.

Ul-Ameen (1987) has quoted figures of 888 mt of freshwater mussels collected and about 13,850 (160 kg.) pink pearls produced annually in Bangladesh. The meat of the mussels is utilized as duck-feed and the shell used in making buttons, toys and decorative items. He has also reported that in 1978 and 1979, molluscs worth Tk 677,000 and Tk 360,000, respectively, were exported.

Around 2,000 mt of frog-legs, valued at Tk 2 million, were being exported annually from Bangladesh, until the late 1980s. In 1984, Bangladesh exported 2,511 mt of frog-legs and India 2,834 mt. This industry was discouraged in both countries and in 1993, the record shows that Bangladesh had exported only 700 mt of frog-legs. There are no records of exports of any products from crocodiles, turtles or aquatic mammals.

The Indian Ocean region has many major rivers, with a total mean discharge of 78,000 m^3/second and drainage area of over 920,000 km^2, besides numerous small rivers and riverlets. In addition, there are numerous reservoirs, perennial and seasonal irrigation tanks, ponds, rainwater stagnating in depressions in the low-lying areas (*villus* in Sri Lanka and *bheels* in Bangladesh and India). Bangladesh has over 103 million ha of rivers, canals and estuaries, 114,161 ha of *bheels* and *baors*, 166,943 ha of ponds and tanks, 5,488 ha of ox-bows, 68,800 ha of reservoirs and 2.8 million ha of flood plains inundated seasonally (Ataur Rahman, 1989). Ancient irrigation tanks are being renovated and new reservoirs added, with the development of irrigation and hydroelectric power by diverting rivers, as recently was done in Sri Lanka.

Potential. This is one sub-sector that could provide considerable expansion and employment opportunities and also provide cheap fish for the poor people of this subregion. Application of the benefits of research work carried out over the last 5 or 10 years should result in better yields from natural water bodies through appropriate stocking programmes, poly-culture and integrated farming systems. It is anticipated that the yield from the subregion might be increased by 10-20 percent over the next 10 years. In Sri Lanka, where production declined due to policy changes, it can recover by at least 100 percent. Better management schemes, including the replacement of leasing and auctioning systems with straightforward licensing to fisherfolk, may have significant benefits in terms of exploitation and income to fisherfolk, particularly in Bangladesh, India and Pakistan.

Capital investments and operational costs in the freshwater sector are relatively small compared to small-scale fisheries in the marine sector. With the large extent of freshwater bodies available, the potential for development and expansion of capture fisheries, culture fisheries and culture-based capture fisheries in freshwater is greater than from any other sub-sector in this subregion.

<u>Seaweeds and aquatic plants</u>

Common commercially valuable seaweeds are *Caulerpa spp. Hypnea spp., Gracilaria spp., Euchema spp., Codium spp., Sargassum spp., Gelidiella spp., Enteromorpha spp.*

Countries like India and Sri Lanka have a long history of harvesting and exporting seaweed (*Gracilaria vericosa*) and in the recent past, have attempted to cultivate this species. Harvesting consisted largely of collecting seaweed that gets detached or broken and washed ashore during monsoon seasons. As the material was not processed into clean products, the market for such products declined in favour of cultivated products, such as those from the Philippines. This affected the export of naturally grown seaweed from most developing countries on the Indian Ocean. Later, cultivation of seaweeds was commenced in India, Sri Lanka and Malaysia. However, various constraints such as finding suitable markets, obtaining a good export price, grazing of cultured weed by rabbitfish, have retarded progress in cultivation.

Potential. Perhaps local demand for seaweed will increase and economically justify active collection and utilization of the otherwise underutilized natural resource of seaweeds for domestic markets. Cultivation may have to be considered after identifying export markets and improving the quality of the product to compete with established exporters.

There are numerous species of freshwater plants of economic value, but no identifiable records are available on the commercial collection of plants from freshwater. Collection of such plants takes place in most of the countries for consumption, ornamental, religious, medicinal, cattle feed and manuring purposes. A supporting industry for collecting/importing/cultivating freshwater plants is developing along with the freshwater ornamental fish industry. With increasing popularity and domestic and export demand for ornamental fish in the region and elsewhere, demand for the supply of ornamental plants for aquaria may have also been increasing in recent years.

Utilization of this resource in the subregion appears to have declined in the last decade or two, one reason being the increased production and competition in export from other countries like the Philippines. This industry can be revived and production increased by making a serious effort to identify markets for export. Secondly, the domestic consumption of species like gracilaria as a food item and for industrial purposes can be increased by suitable and economical processing and marketing. Culture techniques also have been developed for gracilaria but again, successful application will depend on establishing markets. There is under-utilization of other kinds of water-plants and sea weeds as vegetable food items from the aquatic environment. Utilization may be increased by starting extension and popularization programmes.

Marine fisheries versus inland fisheries

The ratio of marine production to that from freshwater among the countries in the subregion ranged from 0.0 (Bhutan & Nepal) to 100.0 (Maldives). Bangladesh (0.4), India (1.0), Pakistan (3.5) and Sri Lanka (23.4) fall in between. India, with the highest production, has almost equal production from the marine and freshwater sub-sectors. **Even landlocked States can consider entry into marine fisheries and exercise their right to claim a share, through the Indian Ocean Fisheries Commission and the Indian Ocean Tuna Commission, of the Total Allowance Catch. It may be useful for them to examine the practicability and feasibility of such ventures. Sri Lanka's situation is abnormal in that inland fisheries declined due to the government's policy decision not to encourage fisheries in that sub-sector. Since the position has changed recently, inland production should be able to reach the previous maximum level of 30,000 mt or even more.**

Aquaculture

Aquaculture production has increased from about 0.64 million mt in 1984 to 1.9 million mt in 1994 (Table 7). Freshwater aquaculture production increased at a high growth rate, while brackish water and mariculture production achieved an even higher growth rate because of the high demand and high export value for the species.

India's contribution was close to 50 percent of the Indian Ocean total. India and Bangladesh alone produced more than 100,000 mt, each. Contribution by freshwater aquaculture was more than 90 percent of the total aquaculture production in India and Bangladesh, while it was around 35 percent in Indonesia and Thailand and only 11. 9 percent in Malaysia. Cyprinids and Cichlids are the predominant freshwater species groups cultured.

a) Freshwater culture

Freshwater aquaculture of various traditional forms has been practiced for many decades in countries like India that have very large land-mass. Some of these cheap, backyard techniques have also helped to keep freshwater fish within the reach of poor people in China. The traditional system of trapping shrimps and finfish in intertidal waters and culturing them, practiced in countries like Bangladesh, results in the production of many species of penaeid shrimp and finfish. Other developing nations have taken smaller steps in this direction by breeding hardy varieties of fish (endemic and exotic) and periodically stocking natural and man-made water bodies, both seasonal and perennial, for the benefit of poor people living inland.

Sewage-fed fish ponds in Calcutta are one outstanding example of a well-organized system of combining sewage disposal with fish culture in a large city.

Production of freshwater species by capture fisheries on natural stocks and the contribution by culture-based capture fisheries on stocked species have not been quantified to assess the economic benefits of the stocking programme.

Jhingran and Ahmad (1991) indicate that the average yield from a reservoir in India is around 14.5 kg/ha/yr, though a yield of 50-100 kg/ha/yr can be realised. Fish ponds stocked with carnivorous species and artificially fertilized are reported to yield 225-560 kg/ha/yr in the USA. German fish ponds yield 1,120-1,681 kg/ha/yr, while in the eastern, western and central regions of India, the yields were 2,582-2,927, 5,527-5,621, and 3,457-3,754 kg/ha/yr, respectively. Well-managed ponds should yield 6,000 kg/ha/yr, as against 10 kg/ha/yr in natural freshwater bodies.

Freshwater species cultured are: prawn (*Macrobrachium rosenbergii*) and numerous species of the cyprinids and cichlids as food fish and ornamental fish. Exotic freshwater species such as grass carp (*Ctenopharyngodon idellus*), silver carp (*Hypothalmichthys molitrix*), freshwater siluroids (*Siluroides spp*.), snake heads (*Channa spp.*), giant gouramy (*O. goramy*), etc., have also become very popular in this subregion. Many of these species are also being stocked in natural water bodies for the development of culture-based capture fisheries. Species such as tilapia (*Oreochromis mossambicus*, *O. niloticus* and *Tilapia rendalli*) have also been introduced into many water bodies in Sri Lanka.

Extensive or semi-intensive poly-culture systems through stocking of natural water bodies and intensive monoculture of freshwater species are reported to have exhibited a manyfold increase in production in most countries over the last couple of decades. Composite carp culture involving 3-6 species is popularly practiced in countries like India, with yields ranging from 400-10,000 kg/ha/yr (Sinha & Srivastava, 1991 & Jhingran & Ahmad, 1991).

b) Integrated aquaculture

Aquaculture integrated with agriculture and animal husbandry has been practiced traditionally in some countries. Paddy cultivation and shrimp culture in seasonal rotation is an old system, but popular use of fertilizers and pesticides for agriculture impedes aquaculture activities. A more modern approach to this system is in use in India. Integration of raising poultry, ducks, cattle, sheep or pigs and growing of vegetation such as mulberry, banana and other fruit trees on the fish pond embankment or adjacent to the ponds is also a favourably accepted system.

Growing freshwater plants as a system integrated with utilization of the nutrients in the waste water from fish culture ponds is also gaining popularity. There are more than 40 species of aquatic plants (Macrophytes) that are considered edible. Some of the popular ones are:

water lettuce	- *Pistia stratioles*	water chestnut	- *Eleocharis dulcis*
water spinach	- *Ipomea aquatica*	water hyacinth	- *Eichorniacrassipes*
duckweed	- *Wolffia arrhiza*	water lily seeds	- *Nymphaea stellata/lotus*.

c) Brackishwater culture/mariculture

Brackishwater culture and mariculture were relatively less significant in the subregion until the 1970s, but there was a significant increase in production from these between 1984 and 1993. This was because of the heavy demand for high-valued crustaceans, molluscs and finfish in foreign markets. In the recent past, there has been a decline in production due to serious environmental and disease problems, and countries like India and Sri Lanka are now in the process of getting out of both kinds of culture.

Traditional culture of fish and shrimps was practiced in tidal ponds and mud flats, as in Bangladesh and India. Modern extensive, semi-intensive and intensive culture systems have been popular in the subregion since the 1980s. The choice from among these systems depended on pond facilities, stocking densities, food supply, water management and supervision. Feeding and maintenance of the quality of water are two factors that became constraints in many ways. The high cost of good quality feed and excessive use of feed because of high density of cultured animals in intensive culture resulted in reduction of water quality in ponds, increase in costs and reduction in production and revenue. Insufficient arrangement for the continuous supply of good quality water required in aquaculture and improper systems of discharging waste water from ponds contributed to the pollution of sources supplying water to ponds and local people, and caused damage to the environment. Organic/chemical pollution caused many kinds of diseases in cultured animals and people inhabiting the surrounding area and loss of income to the culturists. Generally, diseases are less common in semi-intensive and extensive culture practices, compared to intensive culture systems. Excessive tapping of ground water results in temporary or permanent damage to the water-table, and seepage of polluted waste water affects the quality of the ground-water used by the people. Environments damaged by such actions have recovered with the suspension of culture activities but become more vulnerable to the effects of future pollution.

Some of the noteworthy marine/brackishwater species being cultured or ready for culture in the subregion are: penaeid shrimp, freshwater prawn, mullet (*Mugil cephalus* and *Liza spp.*) and diadramous species such as sea bass (*Lates calcarifer*) and milkfish (*Chanos chanos*), pearl oysters (*Pinctada spp*. and others), sea cucumber and seaweeds (*Gracilaria vericosa* and others).

Potential. Freshwater aquaculture has the potential for significant expansion and providing cheap fish for domestic consumption in the subregion. Carps form the major category, followed by tilapias. There is scope for small-scale fisherfolk to be engaged in this activity.

Brackishwater culture and mariculture also have potential for expansion but not to the level of freshwater culture. More constraints have to be overcome and investments are greater. These two kinds of culture perhaps will cater mainly to the export market for many more years. There is less scope for small-scale fisherfolk in this activity.

Bycatch and discards

Bycatch generally consists of non-targeted species or targeted species which are too small in size to fetch a good price. Bycatches of pelagic sharks on large-scale tuna longliners in the Indian Ocean are generally discarded at sea after the fins are removed. Some quantities of the shark meat of selected species are being kept if there is unutilized storage space on board, for specific usage such as the base material for making fish cake, etc. Small-scale tuna longliners and gillnetters, such as those of Sri Lanka, consider sharks as targeted species, but in countries such as Bangladesh and India sharks are considered a bycatch. Some of them export the dried fins to the Far East and the dried shark meat to countries like Sri Lanka. Others discard them at their landing sites. **There is already a small export of dried shark to Sri Lanka from India, Maldives and Bangladesh, but this could be developed into something more beneficial to the exporting and importing countries, if the trade could be placed on a stronger footing within the South Asian countries. Further, a means of importing the unutilized/discarded sharks from the Gulf, and any other region, to countries that have a good demand for shark meat, may also be beneficial in reducing the wastage of resources and providing additional food supplies - a system of exchanging certain varieties of fish for others, within and between regions.**

In this subregion, the trammelnet fishery for shrimp generally has a very small component of large-sized fish as bycatch which are being marketed without any difficulty. On the other hand, the shrimp-trawl fishery has the largest proportion of bycatch which consists of medium and small-sized fish and other organisms. In such a fishery the bycatch is sometimes retained and sold at a very low price if the catch of target species is poor and the crew has spare time and space to sort and preserve the bycatch on board. However, the bycatch will be discarded if handling and preservation of the catch of target species requires the full-time attention of the crew and there is no time to handle the bycatch. Bycatch landed are not always in good condition and in some countries like India, the bycatch landed are generally converted into dry-fish. In many of the developing countries, poor people buy the bycatch for their consumption because they can afford only such low-priced fish. A large quantity of the landed bycatch is commonly used in the preparation of fish-meal for poultry and other livestock and also as fertilizer. **Therefore, there are opportunities in this region for better utilization of bycatch that are now being discarded. Suppression of industrial trawling for small and scattered stocks of shrimp may reduce the capture of juveniles, help to improve the recruitment of many stocks of such fish and contribute to higher yield to appropriate fisheries targeting them. This will also prevent the high efficiency of bottom trawls from causing intensive exploitation of the numerous small stocks of all kinds in tropical waters. Alternative processing methods to extract the nutrient components of these fish are also an option that may be taken up seriously.**

In India, traditional fisheries such as *kattumaram* and *teppa* with different sizes of small mesh gillnet, small quantities of various kinds of unmarketable fish and also fish damaged by crabs, are landed seasonally along the shores. Although the amount discarded by each unit is small, considering the number of such craft in the country, the total quantity being discarded in this manner is very large. A scheme to utilize these discards to create useful products at a cottage industry level has been recommended (Sivasubramaniam, 1991).

Estuarine set bagnet and pushnet fisheries generally do not classify their catches into target species and bycatch, even though their catches include most species and sizes that are considered bycatch in shrimp trawl fishery. These fishermen attempt to market almost everything they catch except trashfish. The pushnets, dragnets and set bagnets used in the collection of shrimp seeds for culture catch an enormous proportion of numerous species of larvae and very small juveniles as bycatch. **It has been estimated that during shrimp larval collection for culture purposes, billions of other larvae and juveniles are caught and discarded on the banks of the estuaries in Bangladesh and India. Appropriate**

management steps should result in considerable improvement to the yields from these populations.

In Pakistan, the people are generally not fish-eaters. It is reported that small fish caught are mostly unutilized. Considering that the trawlers are contributing to 30,000 mt of shrimp catches and that the shrimp resources are being subjected to over-fishing, the ratio of shrimp to finfish by catch may be not less than 1:3 or 4.

Trashfish consists of species not suitable for consumption because of the taste and odour in their muscle, the appearance of the fish and poison or allergy-causing chemicals in the tissues. These include fish such as puffers, tripod fish, jellyfish and scorpionfish. Even some species which are marketable in one country are classified as trash in another, because of traditions, culture or taboos.

Discards include bycatch that are not marketed in any form and trash fish thrown overboard at sea or discarded ashore. No proper record of discarding is maintained in any country in the Indian Ocean, though some rough guesstimates are made whenever necessary. Discards at a global level may be around 27 million mt (estimates vary between 17.9-39.5 million mt), not including freshwater and marine molluscs. Based on observation, it may be said that not less than 200-300 thousand mt of fish are discarded annually in the South Asian subregion. The largest contributors are the fleet of 3-4 thousand trawlers operating in the subregion, mainly from India and Pakistan.

Based on information from some areas of the Indian Ocean, the discards of bycatch by shrimp trawlers is estimated to be about 12 kg for every kg of targeted catch. In the finfish trawl fishery and tuna longline fishery, the corresponding values are 1.72 kg and 1.13 kg, for every kg of targeted catch of those fisheries (Alverson, Freeberg, Murawski & Pope, 1994).

Fish trade in the subregion.

In Maldives, fish export is rather small in value but contributes 25 percent of the GDP. There is rapid expansion in the export of fish and fishery products from this region. Imports of such items by the countries in the subregion are small or negligible, except in the case of Sri Lanka, where fish imports have a major role in meeting the demand for fish. Export earnings may be no more than 2 percent of the GDP. Exports and imports of fish and fish products were 448,414 mt ($1.22 billion at an average price of $2,728/mt) and 42,028 mt ($39 million, at an average price of $935/mt), respectively. Both exports and imports are lower in quantity and average prices, compared to the ASEAN region. However, it may be noted that **export items fetched a higher average price per mt than imported items**. Sri Lanka receives almost 90 percent of the fish and fish products imported into the subregion, mainly to compensate for the shortfall in the domestic supply, and there has been an additional increase in fish import to compensate for the decline in production from the northern and eastern provinces, due to the ethnic problem. Among the exporters of fish and fish products, India is responsible for nearly 57 percent, Pakistan, Bangladesh and Maldives for 20 percent, 17 percent and 5 percent, respectively. Sri Lanka exported approximately one percent of the total from the subregion. The major types of products imported were dried fish (74.6 percent) and canned fish (8.8 percent) and the major types of products exported were crustaceans (shrimp & crabs), molluscs (squid & cuttlefish) (45 percent), frozen fish (44 percent) and dried fish (9 percent). In terms of revenue, 77 percent was from the export of crustaceans and molluscs. Sri Lanka imported dried fish at the price of $867/mt, but the export price of dried fish from this subregion was $1,218/mt in 1993. India, Sri Lanka and Pakistan imported 5,983 mt of fish-meal at $773/mt but India and Maldives exported 3,854 mt of this item at $1,568/mt (FAO, 1984-1994).

Intra-regional trade among the SAARC countries has the opportunity of growing in the future. In the past, the main trade was the import of Maldives fish from the Maldives and dried small sardines and anchovies by Sri Lanka from India and Pakistan and also frozen fish from Pakistan. All these declined to almost zero by the late 1960s or early 1970s. During the last decade, with the opening up of the free market economy, Sri Lanka recommenced import of Maldives fish, dried reef fish and shark from Maldives and dried shark from India and Bangladesh. Sri Lanka also imported marine ornamental fish from Maldives. The export of chank from Sri Lanka to Bangladesh appears to have declined in recent years, but the fate of the flourishing export of this item from India to Bangladesh is not clear. Similarly, the extent of the trade between India and Nepal is not evident. It is also unrecorded and unofficial knowledge that there is an exchange of hilsa for shrimp seed between Bangladesh and West Bengal State of India, across the border.

Inter-regional trade in fish between South Asian and South-East Asian nations is also growing: tuna from Maldives to canneries in Thailand; ornamental fish from Sri Lanka and Maldives to Singapore; shrimp from any of the South Asian countries to Singapore and Malaysia; dried anchovy from Thailand to Sri Lanka; ‘icing glass’ (dried gas bladder of croakers) from Bangladesh to Hong Kong SAR; beche de mer (dried sea-cucumber), from India and Sri Lanka to Singapore and Hong Kong SAR; mud-crab from India, Bangladesh and Sri Lanka to Singapore, Malaysia and Thailand, are some of the trade known to exist. Export of shrimp seeds from hatcheries in ASEAN countries to shrimp culturists in SAARC countries and export of grouper larvae from SAARC countries to ASEAN countries also developed in the recent past. Besides these, high-value finfish and shellfish species are also exported by South Asian countries to Japan, USA and the EEC, and, particularly by India, to Middle-East countries and other areas where Indians are resident.

Intra-regional trade agreements and increased trading in fish and fish products would be in the interest of the economy and food security in the subregion.

Imports of fish and fish products by most of the South Asian countries are negligible, compared to their exports. Indians are predominantly vegetarians and there is no heavy demand for fish at present. The high price of imported fish and other economic factors may prevent an increase in the per-caput consumption of fish by the large populations of lower income groups in Bangladesh and Pakistan. It would be beneficial for South Asian countries to realize that exports by Thailand, Singapore and Malaysia include catches that come not only out of their EEZs but also large quantities imported from other countries, including those in South Asia. Consequently, Thailand, which has the highest revenue from exports of fish/fish products, also has the largest expenditure for importing fish/fish products. Its exports include a very large amount of tuna imported from other countries, including Maldives, for canning and export to USA and other countries. Singapore is not a major fishing nation. Hence it has to import most fish for domestic consumption, but like Thailand, it is also a trading nation that imports fish (both live and dead) from South Asia for export to more affluent nations. **South Asian nations also may be able to organize a similar system as an intra-regional approach to collectively increase their supplies for export and strengthen their markets.**

The seven categories of fish and fish products imported and exported are: fish (fresh/frozen/iced), fish (dried), crustaceans and molluscs (fresh/frozen/iced), fish (canned), crustaceans (canned), fish-oil and fish-meal. The relative percentages of the quantities and values involved in imports and exports by South Asian countries are summarized in Table 8b.

Export of crustaceans and molluscs. Export of crustaceans alone by South and South-East Asian countries on the Indian Ocean is estimated to be 680,000 mt valued at $128 million (average price of $5,900/mt).

Since the slump in the shrimp markets of distant nations in 1989, the thinking in South Asia has been to move towards reliance on exports to non-traditional importers in the region itself. This has been facilitated by the high economic development in Southeast Asia, increased disposable income of the growing middle class, abolition of import restriction by Taiwan Province of China and Korea, introduction of market-oriented economies in China and Vietnam, duty-free imports by Singapore, Hong Kong SAR and Malaysia, increased supply of shrimp due to expansion of shrimp culture, and higher per-caput consumption of seafood in these countries.

Dried fish preparation and consumption are common in Asian countries. In the South Asian subregion, preparation of dried fish evolved traditionally as a cheap way of preserving fish. Dried fish is prepared when large catches during the peak season cannot be handled and marketed in fresh form to the interior of the State for storage without spoiling. Consequently, very large quantities of the catches in these developing countries were converted into dried fish. With the introduction of modern preservation methods such as freezing and canning, the proportion of the catch converted into dried fish has declined. However, the tradition of including dried fish in regular meals continues and therefore production of dried fish also continues. Now, however, considerable attention is being paid to improvement of the quality of dried fish. Countries that have an excess of any fish species or have no domestic demand for those species find it easier to export it as dried fish to others who are willing to pay a good price. In South Asia, there are more countries exporting dried fish than importing it. The average price of imported products is cheaper than that of exported products, but the unit prices received or paid by the countries in the region are significantly different.

Live ornamental fish capture, culture and export/import records are extremely weak in the South Asian subregion, though it is a fast-growing industry in many of the countries and management problems already exist. Capture fisheries are for both marine and freshwater varieties but more for the freshwater species. Culture fisheries are also mainly for freshwater species, rather than for marine species. Some marine ornamental fish from Maldives are routed through Sri Lanka to other markets. The markets in the developed countries offer a very good price, but a fair amount of the fish from this subregion is routed through intermediate marketing nations like Singapore. When dealing through intermediate or middle-men markets, the producers do not always receive the benefit of the consumer markets. Again, considering the volume presently available, a collective approach to the production of a wide range of varieties, improved quality and export may be advantageous.

Fish-meal production in the region is insufficient to meet the demand. Yet some countries export higher-valued fish-meal and import cheaper fish-meal for their domestic use. **Available information indicates that in 1993 local production was around 648,543 mt, exported quantity was 41,741 mt at $505/mt and imported quantity around one million mt, at $519/mt.**

Production of **fish-oils and fats** was also recorded as very small in 1993. However, it is known that Maldives exports ambergris, which should fetch a high price. The local production is highly variable from year to year because of the uncertainty of dead marine mammals being washed ashore or found inshore.

FAO Statistical Year Book for 1993 records the production of 55 mt of **corals** by India only. There is more but it remains unrecorded. The relative proportions of the various categories of imports and exports and the average prices are presented in Table 8b.

5. Contribution of Fisheries to Food Security

5.1 As Food

It has been said repeatedly that the root cause of food insecurity is poverty. The people most vulnerable to food insecurity are those living in rural areas, including fishing communities. In South Asia, the majority of fisherfolk are in the small-scale fisheries sector and are the primary producers of fish by capture fisheries. South Asian countries differ widely in the size of human population and levels of development. India's huge population of 900.5 million makes the collective population of the region an extremely large 1.18 billion**.** A very significant percentage live close to or below subsistence level. The economies are vulnerable and in the coastal States of the subregion, fisheries is one of the main components of the economy, except in Bhutan and perhaps in Nepal also. They all have policies to expand fisheries and increase its role in improving their economy and their food security. Fisheries, then, definitely has a significant role to play in the establishment of food security in the subregion. To achieve food security at a national or regional level the countries in this subregion must strive towards a stronger and more stable economic condition, through political stability and responsible development and management of natural resources, especially food resources.

Fish consumption may be much higher in Lower Income Food Deficit Countries (LIFDCs), even if it contributes about the same share or less to animal protein in the economically better off countries in Asia. In the South Asian group of LIFDCs, fish may contribute less animal protein in most countries, but in Maldives, Sri Lanka and Bangladesh it is very important (Table 9a).

Per-caput food supply for direct consumption in South Asia has been increasing slowly from 2,030 to 2,060 and 2,070 calories/caput/day, from 1960 to 1970 and 1980, respectively. The World Food Summit (FAO,1996f) projected that by 2010, the supply will be around 2,520. These values are considered to be higher only than the Sub-Sahara subregion. All others have exceeded 3,000 calories, which is the boundary between low income and middle income categories. Some of the developed countries also have been reported to have only about 300 to 400 calories/caput/day higher than 3,000.

Over the last decade, agriculture has shown steady growth as a contributor to food security, and India's experience has been described as a success story. Capture fisheries of the world may not be entitled to similar recognition. However, the South Asian coastal States have established a good record by achieving an average growth rate of around five percent in their total fish production. Sri Lanka's negative results were attributed to the significant decline of about 40 percent in marine fish production from the north and east coasts affected by ethnic troubles, and by the 40 percent decline in production from inland fisheries due to a political decision that suspended State support to that sub-sector for a few years. Production from the latter sub-sector is slowly recovering and should be accelerated during the next few years, but the former and larger sub-sector will realize its full production capacity only when the entire coastal area of the country is once again actively contributing to fishing.

South Asia's reliance on vegetables for energy is very high compared to developed and developing countries in general (Table 9a). Developed countries have a higher energy demand from animal products than developing countries have. Southeast Asian countries consume more meat, fish and eggs than South Asians, but less milk. However, in recent years, there has been an increasing trend in the relative supply of animal protein in South Asia also (Table 9b).

The World Food Survey (FAO, 1996e) indicates that there were about 255 million or about 22 percent undernourished individuals in South Asia in 1990/92. Though the percentage of undernourished shows a decline from the 33 percent in 1969/71, the actual number of individuals has increased from the earlier 238 million. The average per-caput energy consumption by the undernourished in Southeast Asia was less than that of South Asia in 1969/71, but the former had overtaken the latter by 1979/81. Undernourished children under five years old in South Asia totalled around 156 million in 1990/92, and 30 percent of the population of under five years in developing countries are in South Asia. Over the last two decades, the population of undernourished has been increasing in all the South Asian countries (FAO 1996e).

Approximately 40 percent of total animal protein is contributed by fish in South Asian countries. It is around 80 percent in Bangladesh and perhaps more than 90 percent in the case of Maldives. Consumption of water is also an important item that is linked with food. In South Asia, 50-80 percent of the rural and 80-85 percent of the urban population are supposed to have access to safe water. Average per-caput consumption of fish in this subregion is 9.9 kg/yr, which is about 40 percent less than the world average of 16 kg/yr. As already mentioned, high dependency on fish as a food item and as a source of protein is also evident. Poor quality of legumes, due to poor environmental quality, has also been reported for the subregion (Table 9c).

Maldives depends on fish not only as its most important natural resource but also as its main source of animal protein and as one of its main foreign exchange earners, besides tourism. In the case of Sri Lanka and Bangladesh, fish is significant for its high contribution to protein supply for the people and also as a foreign exchange earner from fish export. India is the largest fish producer in the Indian Ocean, but due to cultural reasons, the majority of Indians are vegetarians; most fish eaters are among the coastal and urban populations. It is also the largest exporter in this region, exporting a very large quantity of shrimp, other shellfish and finfish. Pakistan, although a coastal State, depends less on fish for animal protein. The two land-locked States of Bhutan and Nepal are forced to rely less on fisheries but have been attempting to improve their inland capture and culture fisheries to provide fish to their people.

The fishery resources available to the countries in the subregion contribute to the protein content of their food, to obtaining foreign exchange earnings through export and to providing employment opportunities to a section of the population, thus enhancing the economies of the countries. On the other hand, at the individual or household level, opportunity is created for some to have fish as food and also to earn some money to buy other provisions or to barter excess fish for other things. For other subsistence level fishermen, fish serves as the major source of food for survival. Fisherfolk households in South Asia generally attempt to engage in additional income-generating activities to supplement their income from fishing. Common activities are: cultivating other crops in the backyard, working as labourers in agriculture and on construction sites and salterns, shrimp seed collecting and livestock rearing.

5.2 As Employment/Income

Fisheries also contributes to the economic and social betterment of the countries in question. Generally, the contribution is around 1-2 percent of the GDP, except perhaps in the case of Maldives where fisheries and tourism are the two most important sectors for the economy of that country. More than four million people are engaged in the primary economic activity, capture or culture fisheries, either on a full-time or a part-time basis, in both small-scale and commercial capture fisheries and in fish farming. The estimated number of persons employed in fisheries-related industries such as processing, distribution and trade amounts to some 20 million. Employment opportunity for such a large number, in the subregion which has a very high unemployment rate, is an indication of the contribution that fisheries makes to the countries, particularly in Maldives. A land-locked country like Nepal also has a fair number of its population dependent on fisheries for employment and livelihood. The policy of the States is also to achieve even higher employment in the fisheries sector.

Besides its contribution to employment and small income to the fisherfolk, fisheries also provides benefits to the economic wealth of the regional countries. Trade in fisheries commodities has developed rapidly during the past two decades, and they have become one of the most important commodities in international trade. Among the SAARC countries, Sri Lanka is the only nation that has been importing a large quantity of dried fish - more than exports. However, the imported items are of lower value than the exported items. Fisheries is an important foreign exchange earner through export for almost all the SAARC countries, though its contribution to the GDP may not be very significant in most countries, except Maldives. Traditional and modern small-scale fisherfolk in the region, such as the small-scale tuna producers in Maldives and Sri Lanka and those engaged in the capture of exportable quality shrimp and finfish, have been steadily and significantly improving their income from fishing in recent years. Those engaged in the export-oriented industrial fisheries and the export trade fall into a much higher income class.

With the potential resources available for increasing fish production in the subregion, there is room to increase employment opportunities in the fisheries sector. However, the development choices that are available will need labour-intensive systems for capture and culture fisheries in freshwater bodies which now provide low income to fisherfolk. The major marine resource potentials in the offshore/oceanic ranges may tend to encourage capital-intensive technological systems that will increase efficiency and produce more of the species that are not utilized at present and may therefore require specialized catching, handling, processing and marketing. There will be manpower requirements and employment opportunities, but they may be less than those in the former sub-sectors. It is also expected that with improved infrastructure facilities, improved handling and processing and avoidance of loss and wastage in the catches from the coastal fisheries, there will be more employment opportunities in shore-based fishery-related activities. Some of these opportunities may have to be reserved for those who may be edged out of coastal fisheries by more effective management of the coastal resources and fisheries.

5.3 Demand and Supply

The fish is an animal that is most readily acceptable for consumption by the people of South Asia. It is consumed in all the States in this region. Traditionally, access to fish was available through marine fisheries for those living in the coastal areas and through inland fisheries for those living close to inland water bodies. With improvement of roadways, transport, and electric power facilities, and understanding of nutritional requirements, the distribution, storage and consumption of fish has increased. In India, although the majority are vegetarian, an increasing number of people are consuming fish, at least in the urban areas.

The present level of production and imports, non-food usage and exports and the supply available for human consumption are found in Table 8c. Average per-caput consumption of fish in South and Southeast Asian countries is 8.7 kg, which is consistently lower than the world average of 13.4 kg. The value is a little higher in Southeast Asia than in South Asia, but the value has a very wide range in South Asia, with an average of 126 kg/caput in Maldives and a low of 0.2 and 0.8 kg/caput in Bhutan and Nepal.

Consumption of small and large cured-fish in the form of salt-dried and pickled fish is characteristic of the subregion. However, traditionally caught varieties continue to be in high demand. With time, other varieties are also being included in the marketable species list. Tuna and large shark in India and Bangladesh, varieties other than tuna and tuna-like species among the Maldivians and small varieties and tuna in Pakistan have still to gain strong demand in those countries. Because of the habit of eating selected fish and shellfish, many forms of invertebrates and seaweeds available in the sea are not consumed. In this South Asians differ significantly from people of ASEAN and other Far Eastern nations which consume practically every form of edible aquatic animals and plants. In fact, most items that have been traditionally exported from this subregion, such as sea-weed, beche de mer, sharkfin, etc., are those that are relished in other regions but not in this region. With increasing demand and price of fish for domestic and export markets, demand for low-valued varieties like the small pelagics and demersal species, and freshwater species like tilapia, is increasing rapidly in Sri Lanka. There are species in special demand in many of the countries, like hilsa in Bangladesh and the West Bengal State of India, barramundi and giant sea-perch in northern India and Pakistan and Spanish mackerel in Sri Lanka. Sri Lanka and Maldives are two nations that have a high demand for tuna, and the former is the only country in the region with very high demand for shark meat.

The demand for fish is growing continuously in the subregion because the population is growing. Per-caput consumption of fish is increasing and there is also a demand to export fish to get higher value and to earn foreign exchange. However, that demand is not being met because of insufficient production due to limited fishery resources, depletion of resources through over-exploitation and/or insufficient production of certain preferred species. The situation in Nepal and Bhutan is difficult to quantify but there is definite interest in increasing fish production and demand is not being met there at present, due to various economic and technical constraints.

Kee-Chai & Donna (1996), analyzing the situation in 1992, indicated that in spite of its low per-caput consumption compared to the world average, the South Asian subregion was a fish deficit region and was unable to meet the needs of the population. Pakistan was considered to be the only country with a fish surplus. Countries in the subregion export 2-52 percent of their productions. Sri Lanka had the lowest percentage exported (2 percent) and Maldives had the highest (52 percent), with Pakistan (16 percent), Bangladesh (7 percent), and India (5.6 percent), in between. It appears that the quantities produced and the percentages exported in 1993/94 have shown significant increase, compared to the preceding year. There were small imports of edible fish by Bangladesh and India and relatively more fish-meal and fish-oil were imported by India, Sri Lanka and Pakistan. Sri Lanka imported mainly dried fish and canned fish which was about 30 percent of its production in wet weight.

5.4 Outlook for the Future

Table 10 presents the approximate scenario for the year 2010, in terms of projected human population, fish production, exports, imports and shortfalls. The population growth rates show slight changes for the better in recent years, except in Maldives, Nepal and Pakistan, and future growth has been based on these values as the average. However, it is anticipated that the population growth rates are likely to decrease at different rates in these countries. In fact, Maldives is facing a general labour shortage, particularly in the fisheries sector. Their desire to increase the population is understandable in some ways. The production levels required to maintain the present level of per-caput consumption, even into 2010, have been estimated for the estimated population size in that period. However, it has to be borne in mind that with per-caput consumption very poor in the landlocked countries, it is also poor in Pakistan, even though a lot of fish is going waste in that country. The probable export and import levels in 2010 have been estimated by increasing the 1993 levels in proportion to the estimated increase in production required to meet increased consumption. This has been done to enable their relative percentages to the total production to be kept constant until 2010. Overall, the annual total production will have to increase from around 6.5 million, to 7.8 million mt, or a 20 percent increase, to maintain the contribution that fish makes to the food supply and the same percentage of export. In at least five of these countries, the consumption rate is far below the average for the world, and the estimated production required to attain 13 kg/caput by 2010 in the five countries other than Maldives and Sri Lanka, will be in the region of 20 million mt! This value may be unattainable without a miracle. It is anticipated that the per-caput consumption rate in Maldives is very high and may decline to a more reasonable value if the rate of increase in fish production does not keep up with the population growth rate. The demand in 2010 thus may be realized at a lower level of production than that in Table 10. This does not mean that Maldives cannot attain that level of production but the fact is it relies almost entirely on tuna stocks which are shared with too many countries in the Indian Ocean region and outside it. Efficient functioning of the Tuna Commission, allocation of catches and sustaining the exploitation of tuna resources will determine the degree of increase in production. India’s fish consumption rate has been diluted by the large population value but in realistic value may be double, or even greater, if it is based only on the non-vegetarian population in India. However, the percentage of non-vegetarians is steadily increasing in urban areas, and a significant increase in demand and price of fish is already evident.

Loss from discards of bycatch of trawlers and gillnetters, damaged catches due to predation and unmarketable species in traditional fisheries, spoilage and wastage in shrimp and finfish seed collection processes and non-consumable small fish in Pakistan, is estimated to be around 400-500 thousand mt. Offshore/oceanic ranges may contribute a minimum of another 150-200 thousand mt of large pelagics to the coastal States. Large demersals on the slopes of the subregion and offshore cephalopods can contribute at least 50-70,000 mt and deepsea lobster and shrimps will safely provide 20,000 mt. Underutilized pelagic resources of the shelf may provide not less than 30-50,000 mt and the unutilized deepsea fish can yield over 300-500,000 mt of fish from the EEZs, which may have to be made marketable or converted into value-added products. Freshwater bodies can be stocked and made to yield an additional 1 or 2 kg/ha and this should bring in not less than 100,000 mt from the subregion. In Sri Lanka, freshwater fisheries should achieve another 15,000 mt to reach its previous level of production, and marine production will gain another 50-60,000 mt when the problems of the north and east are sorted out. Freshwater aquaculture, utilizing all available water bodies and introducing poly-culture and integrated fish-farming, should bring in an additional 250-300,000 mt, including Nepal and Bhutan. Brackishwater culture and mariculture should become well established in the region in another couple of years, and production of shrimp, prawn and finfish should increase considerably to supplement exports. These figures add up to 1,415,000 mt-1,865,000 mt., arbitrary but modest estimates and therefore, the targeted catch for 2010 may not be an unattainable figure. It is also likely that South Asia will be in a position to increase production from brackishwater culture and mariculture and export more than the anticipated amount of higher-valued fish items and earn more foreign exchange. They also have some chance of reducing import of fish-meal and organizing means of producing their own fish-meal, using offal or non-consumable portions of fish and meat, residual components of vegetable oil production, vegetable wastes, domestic food wastes, etc. Even if this does not work out, the discarded bycatch, trash and damaged fish may easily be used for this purpose and the money saved by the suspension of fish-meal import may be used to import some other kinds of edible fish or food items.

Considering the general political and economic conditions prevailing in this subregion, it would be far too optimistic to assume that these countries can achieve the optimum utilization of all available discards, wastage, etc., and the exploitable potentials to increase production by the year 2000, i.e., within the next 3 years, as anticipated by Kee-Chai and Donna (1996). It is more likely that the developments may be closer to the goal by between 2005 and 2010. Even to attain that target and sustain it, more effort than in the past must go into it, because it involves not only developmental processes but also the more difficult ones of implementing and enforcing various management measures that could not be carried out in the past. It calls for serious reorganization, unification, collaboration and strengthening of the various fisheries and fishery-related units, creation of new units, engaging in specific development and management-oriented research, planning of development programmes in their entirety (not piece-meal) and establishing/revising legislation, for it to be amenable to new approaches to rational development of aquaculture, protection of environments, integrated coastal management and community-based management/co-management.

Meeting demand and overcoming problems in supplying fish depend on successful changes in the traditionally established fish-eating habits and the attitude towards specific species-wise demand, creating demand for new species and new fish products for which resources may be available. The low degree of preference for freshwater species should be changed to equal that for marine species, to dilute the prevailing greater demand for marine varieties. This would also involve popularization of recipes for freshwater species, to be on a par with the countries in ASEAN and the Far East.

6. Role of Public and Private Sectors

6.1 Public Sector

In this subregion, the public sector has been primarily responsible for the development of agriculture and fishing industries. The predominance of agriculture as the sector with the largest population participation is the backbone of the economy of the countries, except in Maldives. The political consciousness, support, assistance, etc., have always been there. In fact, assistance in the form of seeds, fertilizers, drought relief, subsidies and loans provided to the agricultural sector has been so enormous that the contribution to the fisheries sector appears to be negligible. Further, because agriculture and fisheries have been under the umbrella of the same ministry in all these countries, the approach to fisheries development, management and extension service has been biased by the practices in the agriculture sector. This philosophy has been suggested as the reason for the failings in the fisheries sector. Even today, fisheries is linked with agriculture or livestock, except in Maldives and Sri Lanka, where the Ministry for Fisheries has, in the last decade, annexed agriculture and other aquatic resources. In India, the situation is more complex because offshore/oceanic fisheries is under the Ministry of Food Processing, while coastal fisheries remains with the Ministry of Agriculture. In Bangladesh, too, fisheries statistics are under the Central Statistics Department and the information available is insufficient for research or management purposes. There, decisions on licensing of foreign and industrial fishing vessels rest with the Ministry of Industries and not with the Department of Fisheries or the Ministry of Fisheries and Livestock.

It must be accepted that whatever infrastructure facilities exist, such as harbours/anchorages, fish-markets, roads, housing and research, in addition to flood relief, subsidies, loan schemes, insurance and pension schemes, have been provided by most of the coastal nations. However, with the present economic standings of these countries and with such collective responsibilities, fisheries has not been able to get the attention it deserves. The major failure has been in non-implementation of management regulations and in reduction of the over-exploitation of the coastal resources. Sufficient far-sighted thinking has not gone into long-term fisheries development goals. For example, where regulatory measures were not enforced, in order to help poor traditional fishermen to carry on whatever fishery they liked, and with subsidies and credit facilities, the government concerned has, in fact, contributed to the destruction of the resources that are necessary for fishers' survival.

With recent developments in high-value shellfish and finfish exports and the potential for foreign exchange earning by the industry, the public sector has shown significant improvement in their interest and attention to fisheries development. At the same time, private-sector entrepreneurship also entered the fisheries sector. These developments happened too fast for public sector institutions to gear themselves to deal with the legal aspects, technical guidance and management mechanisms for the protection of aquatic and coastal environments, resources, quality control, etc. This resulted in severe damage to environment and financial loss to the industry and the aquaculture sub-sector of the private sector. Similarly, delay or failure of policy decisions and implementation of offshore/oceanic fisheries among the coastal States contributed to the expansion of the fishing effort by distant nations. Unfortunately, the public-sector decision to licence foreign vessels to operate from bases in some of the countries in this subregion was made when the private sectors in those countries had just begun to operate in the same fishery.

The public sector is awakening to these realities, and their thinking is improving fast. Strong, far-sighted and integrated policy decisions are essential for this subregion, in addition to streamlining the government organizations for efficient and integrated functioning of all components of this sector. With more and more private sector participation, the future role of the public sector will be more in terms of far-sighted policy decisions, effective management systems and collecting rents for proper maintenance of services rendered by the State to the industry.

6.2 Private Sector

The private sector is becoming more actively involved in the development of offshore/oceanic fisheries, in brackishwater aquaculture, mariculture and in processing and marketing of fish and fish products, including exports and imports. Their enthusiasm is curtailed to some extent by administrative machinery and regulatory mechanisms which were not geared to the needs of the time. This led to some loss to the industry and slowed the development process. Recent experiences, both positive and negative, have provided lessons to the private sector and the governments to amend or introduce legislation and facilities and tax concessions to encourage and accelerate private sector investments, particularly those with the potential for export or foreign exchange earning.

A government's regulation of private sector investments, while facilitating them, should be stringent enough to prevent wrong-doings such as damaging the environment, disregard of foreign exchange regulations and, most importantly, not maintaining the expected quality standards and being discredited by the importing nations. All the coastal nations in this subregion, except Maldives, have been listed for exporting bad-quality fish products to the United States.

The private sector will have to be the main group to contribute to the development of capital-intensive sub-sectors in fisheries. With the need for better shore facilities for multiday fishing boats and for maintaining the quality of exported fish items, infrastructure facilities have to be improved and increased. Since the States cannot afford to provide funds for more of these facilities or for their continued maintenance, the private sector owners of offshore fishing craft must pay rental for the use of existing harbours and other facilities provided by the State.

6.3 Inter-country Cooperation

Inter-country cooperation in South Asia has a major role for the successful development and management of fisheries for food security. The most essential role is in bilateral and multi-lateral management of straddling stocks and highly migratory stocks that are numerous in this subregion. Secondly, with differences in eating habits, in preference for different varieties of fish and in the relative abundance of the fish available, there are many opportunities for trading by exchange of fish that one country prefers and another does not. Some fish may also be bartered in exchange for other kinds of food items. Improved sharing of technical knowledge in agriculture and fisheries that is already available will improve the overall output, not only from fisheries but also from agriculture, in all the member countries. Perhaps an organized collective-trading plan for the export of fish to countries outside the subregion would help to reduce competition within the subregion and strengthen bargaining capacity with larger quantities for each shipment, a more steady supply of more varieties of fish and fish products, e.g. seaweeds, sharkfin, beche de mer, tuna and ornamental fish. The present inability to do this is a weakness that some of the countries in this subregion are suffering from.

Liberalization of trade and deregulations among the SAARC members is an actively discussed subject, and if it materializes, it will facilitate trade within the region and with other subregions, including those dealing with fish and other food items.

6.4 Others

Among others who are involved with fisheries and fisherfolk are the international and bilateral donors and executing agencies. The United Nations Development Programme (UNDP), World Bank (WB), Asian Development Bank (ADB), International Monetary Fund (IMF), Food and Agriculture Organization (FAO), Swedish International Development Agency (SIDA), Danish International Development Agency (DANIDA), Norwegian Agency for Development (NORAD), Canadian International Development Agency (CIDA), and German Technical Cooperation Programme (GTZ) are some of the major agencies funding and executing developmental projects in the agriculture and fisheries sectors in the subregion. There has been considerable input in the last four decades or so and they still continue their assistance.

In recent years, it appears that there are a few issues which may be of relevance to food security in the fisheries sector. One is that there are too many agencies involved in fisheries developmental activities in each country at the same time, and they are increasingly directing their inputs through other institutions and organizations, besides the relevant departments of the ministry concerned, such as universities and other institutions including non-governmental organizations and consultancy groups. There is a need to prepare collectively-planned lists of projects, which should be shared among all the agencies interested in funding and/or executing them, in the various countries. This is necessary to avoid misplaced priorities in selecting projects, duplication of projects, and to reduce waste of time, money and effort by limited skilled personnel available in most countries. The other important issue is the failure to evaluate follow-up activities of the projects, to identify whether the results of the projects have been incorporated into the system. **Repetition of projects on the same or a similar subject has not been meaningful because the reason for the failure the first time was not evaluated. There is less time for such trials, as far as the future of fishing industry in this subregion is concerned, and both the governments and the agencies have to pay attention to this. The political atmosphere in the countries also will have to become more sympathetic to such an outlook.**

Fisheries cooperatives are playing a useful role in the fisheries sector, particularly for the small-scale sector in coastal fisheries. Besides all that they are doing at present, it is also possible that they could be involved in the community-based management of fisheries. The NGOs in this region have been very active in carrying out extension work to educate the fisherfolk about various fisheries matters and by speaking on their behalf. They can educate fisherfolk about the environment and perform the function of environmental protectionists. They continue to enlighten fisherwomen on their responsibility for their family's welfare, health, savings and even on finding additional income-generating activities.

Adult education centres in the coastal areas provide an opportunity to improve the literacy level among fisherfolk in this subregion. They also help to provide some understanding of fisheries, fishing methods and resources.

7. Policy Framework for Sustainable Contribution to Food Security

7.1 Fisheries Policy Issues

<u>Marine sub-sector</u>

The objectives for developing fisheries generally listed by the countries of this subregion are :

a) Increase fish production to the maximum
b) Provide cheap fish for domestic consumption
c) Increase export of fish to earn foreign exchange
d) Increase employment opportunities
e) Improve the living standard of the fisherfolk
f) Manage the fishery resources for sustainable development

It is evident that these objectives have a tendency to be counterproductive to one another. Maximum production and increased employment may not be acceptable for sustainable development. Increasing export of quality fish would mean that costs will go up, and it will not be in line with increased production of cheap fish required for domestic consumption. Increased employment could also mean less income for individual fisherman and this will not be favourable to improving their standard of living. Implementation of these may mean pushing and pulling developmental activities in different directions which may not favour any one of the objectives or may make development unmanageable. In this context, objectives with strong and positive indications of good return on investment, such as the development of capture and culture fisheries for export, will succeed. Thus, very highly capital-intensive industrial fleet operation and culture activities which employ relatively few fisherfolk have been established in the midst of predominantly low-cost and labour-intensive small scale fisheries which employ only fisherfolk. This is the common scenario in almost all the coastal states in the subregion.

Providing subsidies to poor fishermen has contributed to the survival of some inefficient or destructive traditional fisheries that do not provide a reasonable income and are not favourable to the sustenance of the resources. Because of the subsidies provided to certain categories of fishermen, their fishery also gets protection under management regulations. These protective management regulations generally have not been favourable to more efficient fishing systems that compete with the inefficient subsidized fishery. Subsidy schemes also encourage an increase in fishing effort beyond the level of sustainability, as in the case of the Sri Lanka coastal fisheries. Subsidies given to industrial trawl fishery for shrimp created competitive and interactive fishing between traditional shrimp fisheries, and between modern small-scale fisheries for shrimp and industrial shrimping vessels. The traditional fishermen found themselves in a disadvantageous position. When this happened in India, the subsidy was shifted from the industrial fishery to the small-scale fisheries and this resulted in a significant increase in the fishing effort of the latter sub-sector, which has turned out to be too intensive for coastal resources. In the sub region, this policy has permitted traditional, modern small-scale and industrial fisheries to grow simultaneously, increasing conflicts within and among these categories of fisheries.

a) Encouraging small-scale fisheries development

The general tendency for the governments of developing coastal States is to allow their coastal fisheries to grow beyond the maximum economic or sustainable levels until it stabilizes at the equilibrium point. This is to provide an opportunity for maximum employment. Subsistence fisheries and subsidies help to increase the fishery even beyond the equilibrium point. Management decisions to correct this exist, but action has not been evident.

i) Because of the economic status of the coastal States with medium (Sri Lanka) or large (India, Bangladesh and Pakistan) populations of fishermen and fishing craft, the introduction of modern small-scale craft cannot be undertaken by the State on a sufficiently large scale. Hence a very large population of the traditional fleet has also been assisted to survive alongside the modern fleet.

ii) Too many kinds of craft and gear combinations have made management a very difficult process. At the same time, there are too many conflicts among these fishermen.

iii) The introduction of industrial-scale fisheries, like trawling for finfish and shrimp or purse seining for small pelagics on the continental shelf, has worsened not only the conflicts arising as a result of competitive and interactive fisheries on the same stocks and of allowing an even smaller share to the traditional fisheries, but has also contributed to the discarding of large quantities of bycatch.

b) Disproportionate development of the resources available

i) A review of fishery resources surveys conducted, and facilities for research available, in a number of developing countries (Sivasubramaniam, 1988) brought out that demersal resources surveys have been done repeatedly in many countries but surveys of pelagics have been relatively poor in quality and frequency. Correspondingly, development of demersal fisheries also has been proportionately greater than that for pelagics. Early introduction of efficient trawl fisheries and traditional fisheries like beach seine and other gear have resulted in damaging resources, like burning the candle at both ends. In fact the demersal resources in this region are in a critical condition.

ii) Extensive large-scale trawling for shrimps resulted in over-exploitation of shrimp stocks and production of bycatch of finfish and shellfish in excess of 150,000 mt annually, most of which was discarded.

iii) The rise in demand and value of exported fisheries products, particularly shrimps, lobsters and cephalopods, resulted in rapid development and expansion of modern, high-technology and high-investment fisheries, both in capture as well as culture fishing. This is perhaps the most significant development in most third world countries. Sri Lanka is an exception in that it operates traditional non-motorized and modern small-scale fishing craft with inboard engine for shrimp trawling, while the others use imported commercial-scale shrimp trawlers. The ratio of shrimp to bycatch, is very small (1:3 or 4) and valuable in the former, while it is much more (1:15 to 20) and largely discarded, in the case of the latter.

c) Insufficient participation in management by fisher community

Management measures affecting traditional fisherfolk will certainly require identification of alternative income-generating activities and financial assistance to encourage them to quit that kind of fishery. It would be preferable to consider modern small-scale types of fisheries as an alternative to any fishery being discouraged, because large-scale fisheries are likely to create new conflicts with small-scale fisheries. With the prevailing heterogeneity in income among small-scale fisherfolk, socio-political issues do not favour traditional management approaches.

d) Absence of fisheries policy for long-term development plan

i) Each political party has its own general policy on economic and developmental approach and with changes in the party governing the country after a general election, there is also a tendency for the policy and development plan to change about once in five years. This time span may be insufficient to successfully implement policy decisions and development plans.

ii) Often, it is not good projects but good policies which are required for development of fisheries. There has been insufficient assessment of long-term policy measures, in the interest of achieving success with some short-term plans. Baseline work, such as registration of fishing units for licensing, regulating the number of fishing units entering each fishery and *ad hoc* management actions on many of the fisheries on intensively fished stocks, is needed as an interim measure, but is still awaited in many cases.

iii) There needs to be linkage with national planning, to ensure necessary opportunities, support services and the political will for successful implementation.

iv) There is a lack of comprehensive sectoral planning, taking under each sub-sector, division and sub-division all development components: resource status, surplus resources, fishing technology, marketing, processing, export, infrastructure facilities, fishing population, socio-economic issues, joint-ventures with foreign collaboration, management measures and issues, etc.

v) Every progressive step, including the introduction of new technology or a new system, requires rules and legislation that not only facilitate their implementation but also have provisions to control and regulate the developmental process, to protect the environment and protect the welfare of the State and its people. In the past, such actions have not been timely enough to prevent damage to resources or environment and loss to the fisherfolk, investors or the State.

e) Offshore and oceanic fisheries policy and development

Offshore fisheries development planning is relatively weak among countries of the subregion, for a number of reasons:

i) unpopularity of the species concerned in the country and the need to identify new markets;

ii) lack of sufficient knowledge of the resources and the implications of entering fisheries involving highly migratory stocks in international waters;

iii) lack of experience in specialized fisheries for such stocks and in the offshore/oceanic area;

iv) need for higher capital investment; and

v) disproportionate concern of governments and politicians for the coastal fisheries which have the majority of the fisher population.

These reasons have distracted the attention of fisheries planners from timely planning and preparation for offshore fisheries development and/or to determine the pros and cons of entering into joint ventures with foreign collaboration. This has affected countries in the subregion in which the fishermen traditionally have been engaged in fishing for oceanic tuna and shark that extend their distribution into the outer fringes of the coastal waters. These fishermen, with their knowledge of pole and line (live-bait fishery), large-mesh drift-gillnetting, trolling and/or longlining for tuna and shark at the edge of the continental shelf, have been desperately trying to shift into the offshore range over the last two decades or more. Sri Lanka is an outstanding example of a country with such fishermen. However, they find themselves competing with foreign tuna fishing vessels licensed to operate from bases in Sri Lanka, the justification and terms and conditions of which are discouraging to the local fishermen and do not seem to be favourable to local offshore fisheries development.

f) Operational interaction between small cetaceans, pelagic sharks, turtles, etc.

i) Complete protection of some accidental bycatch

The demands from some developed countries for protection of some aquatic animals, such as dolphins, small whales and turtles, are issues in the development of tuna fisheries in developing countries. Restrictions have been imposed on the import of tuna from countries that are not using "dolphin friendly" fishing gear. The very long gillnet has been declared a "wall of death" for many marine animals and birds, and there is a UN moratorium on its length if used in international waters. Gillnet is the predominant gear used in almost all types of small-scale fisheries by most countries in this subregion, as it does not require a specialized fishing craft. There is pressure to restrict this gear even within the EEZs. That would involve almost a complete change in the overall structure of the fishing gear, characteristics of fishing craft and fishing techniques, which would require an enormous amount of funds. Based on some arbitrary figure produced without proper scientific study, Sri Lanka was internationally named as a nation killing about 60,000 dolphins annually and the country was harassed by various groups of environmentalists, locally and internationally. A special FAO/BOBP project set up to study this problem made a reliable estimate of the number of dolphins and small whales caught of around 5,000 (Dayaratne & Joseph, 1992). However, the protesters still continue to reject this figure. Recently, there has been an objection to the import of fish and shellfish from countries in this subregion, such as India, unless they use a turtle excluder device (TED) in their trawlnets to reduce the killing of turtles. There are reports based on trials in tropical waters that targeted fish also escape through the TED. These restrictions are of serious consequence at this juncture, when the trend is that the per-caput consumption of fish will decrease significantly in this subregion, even if all the fish caught at present are landed and used.

ii) Competitors and predators

It is also well known that marine mammals and pelagic sharks are competitors for the food fish that poor people in these coastal States are also attempting to catch, and their per-caput consumption per day may be very much higher than that of the people in the subregion. These apex-predators are causing the loss of catches, through predation of a very significant percentage of the tuna and other large pelagic fish species caught with drift gillnet and tuna longline. In fact, the loss is greater in the Equatorial region, including the EEZs of Sri Lanka and Maldives, than in other latitudes of the Indian Ocean (Sivasubramaniam,1964). The loss through predation on longline catches is greater than that on gillnet catches. At the same time, countries are being discouraged from using gillnetting and encouraged to use longline. Complete protection of dolphins and small whales is likely to increase the population of marine mammals and their consumption of fish in the sea.

Lagoons, estuaries and coral reefs

a) Intensive exploitation and environmental damage, in estuaries, and lagoons

The potential for increased production from this sub-sector is minimal or nil in the countries of this subregion because the intensity of exploitation has been high from the beginning of fisheries. Some of the methods introduced then are turning out to be very destructive to resources but because they are some of the most traditional systems, there are many difficulties in banning or significantly reducing exploitation by such gear. Due to larval collection for culture, reduction of a number of very small stocks of various penaeid shrimps and larvae and juveniles of valuable finfish such as groupers and basses being exported from South Asian countries for aquaculture in countries with exhausted stocks, are a considerable risk to the wild stocks.

This subregion has a large extent of very rich and highly productive mangrove areas, but these are being destroyed rapidly for various purposes, including expansion for human inhabitation, aquaculture, fire-wood, etc.

Desalination programmes and direct and indirect discharge of industrial and domestic wastes, fertilizers and pesticides through rivers opening into lagoons, anchoring of motorized craft, construction of causeways and bridges across lagoons and channels, all obstruct the free flow of water in and out of the lagoon and are a few of the common sources of destruction to this environment.

Clearly spelt-out policy decisions and regulatory measures are required to retard these destructive processes.

b) Destructive fisheries in coral reef areas

Dynamiting and use of poison such as sodium cyanide to collect fish in the vicinity of coral reefs is another method which is not only causing the death and destruction of the targeted species but also all other organisms in the area, including coral reefs. Dynamiting for domestic consumption is an old tradition, but the use of poison for the export of live snappers, groupers, breams, etc., is a new and flourishing business. In South Asia, Maldives appears to have entered this business already. An extremely cautious approach to the development of this kind of export item is essential because sodium cyanide poisoning has already become a very serious problem.

Ornamental fish and shell collection, operation of trammel and other types of nets for lobsters and finfish on the reefs, also cause damage to reefs and the ecosystem.

Policy decisions are necessary to control such destructive practices on fishery resources that are becoming scarce.

Freshwater sub-sector

a) Protection of freshwater resources and environment

Pollution, misuse and insufficient management for efficient sharing of this aquatic environment by various types of users is increasing in this subregion. Besides these, the ecology for the maintenance of biological diversity is also threatened. Relatively small compared to the marine environment, it is very sensitive and vulnerable to changes and impacts. Damage to freshwater habitats has been more severe than to the marine environment in this region. Unregulated use of fertilizers, pesticides and insecticides in agriculture, of water for various activities, loss of groundwater resources and consequent intrusion of saline water, are some of the very serious problems.

b) Systematic approach to increase yields and improve management

Due to desire for rapid increase in production from this sub-sector in some countries and insufficient or uncertain policy considerations in some others, freshwater fisheries development has not followed a systematic and well-planned approach in this subregion. Though considerable research and trials have been conducted and very beneficial techniques have been developed, their applications have not been sufficient to achieve a yield in keeping with expectations. This includes improvements to the environment, increasing the productivity of water bodies, improving fishing technology, production, marketing and utilization and, most importantly, catch statistics.

c) Traditional systems of providing fishing rights to fisherfolk

In countries like Sri Lanka, fishermen in the freshwater sub-sector generally have a subsistence fishery, are poorer than their marine counterparts and their income is more seasonal in nature. They engage in all kinds of labour for survival during the off season. Some of the poorest among fisherfolk are engaged in freshwater fisheries in the flood plains (*bheel/villus*) of countries like Bangladesh, India and Sri Lanka.

In Bangladesh, and perhaps in some parts of India also, there are traditional systems of leasing, auctioning and other forms of water-tenuring of freshwater bodies to middle-men or money-lenders, who in turn provide access to the water bodies and the fish resources to a large number of fishermen for a rental fee. Having too many fishermen in a specified area provides a very poor income to each fisherman. Their poverty drives them to borrow money from lenders to whom they eventually give their user rights because they are unable to repay the loans. Management regulations are ineffective in preventing poor fishermen from thus losing their only means of survival.

d) Giving higher priority to the development of freshwater fisheries

In view of the fact that freshwater fisheries has the potential for providing significant increase in production, and at relatively less cost per unit increase than in the case of marine fisheries, the price of freshwater fish may not be as high as the marine varieties. Development of freshwater fisheries should get the priority, funds and other inputs it deserves. The benefits of the research already done have not been realized and the costs incurred have not yet been recovered.

Aquaculture

a) Unplanned and unregulated/uncontrolled development

Anxious to capitalize on the opportunity to make good returns on investments in aquaculture culture, particularly shrimp culture, entrepreneurs made investments without sufficient planning, investigation and preparation. Consequently, a number of issues are retarding progress in shrimp and other forms of brackishwater culture and mariculture in the South Asian subregion. It is also unfortunate that the experiences of other subregions that started such aquaculture programmes much earlier than South Asia were overlooked by many. Consequently, problems relating to environmental conditions, pollution, disposal of effluents, shortage of clean water supply, availability of sufficient and healthy seeds for culture and diseases in cultured organisms suddenly became very critical issues. This resulted in heavy/mass mortality in culture ponds, poor export demand for unhealthy shrimp and loss of millions of dollars to the industry and the countries. Following are some of the short-comings:

- lack of skilled manpower in various specialized aspects of aquaculture;
- lack of effective land-use policy for aquaculture;
- need for pilot projects at selected projected centres for trials and demonstrations of technical and economic viability of the methods;
- not prepared for the feed requirements of the planned aquaculture development;
- insufficient market surveys for consumer potential and demands for the culture of new species and for the expansion of existing culture activities, particularly of freshwater species;
- need for efficient system of assessing proposals and sufficient credit facilities for aquaculture development;
- need for a strong environment protection programme and approved techniques as well as designs to guarantee this;
- dependence on wild seed/fry of intensively raised fish stocks in the marine sub-sector for domestic culture programme and also for export for culture activities in other countries;
- need for research into diseases for preventive and curative measures; and
- utilization of lagoons and mangrove areas for culture activities and lack of appropriate legislation for land-leasing policy for these areas.

Today’s aquaculture practices demand **specialized requirements in aquaculture:** engineering, pond engineering, genetic engineering, nutrition, treatment of diseases, brood-stock and hatchery management, etc.

b) Better utilization of the research findings

In the freshwater sub-sector, considerable outstanding research work has been carried out in both India and Bangladesh in this subregion, besides the progress made by institutions in the ASEAN region. Cloning, selective breeding, induced breeding, improvements in culture biology for seasonal water bodies, species combinations for yields of 1,850 to 2,125 kg/ha from polyculture, integrated fish farming with agriculture, freshwater prawn hatchery with brine in tubs, etc., have been reported during the last few years. Full application of these results should contribute to the continuation of the significant increase in the freshwater fish culture programme in India and Bangladesh and through TCDC or other means of transferring these technologies to other States in the Subregion.

c) Other constraints

Overcoming damage to culture activities in the coastal areas of States which are prone to frequent **floods and cyclones**, as experienced by Bangladesh and the east coast of India, is an issue that requires attention.

General Issues

a) Insufficient development of infrastructure and other facilities

Infrastructure and other facilities for the efficient operation and maintenance of the fishing fleet and ensuring the quality of the catches deserve considerable improvement and expansion in most of the countries in the subregion. Traditional craft are generally scattered along the coast-line, without proper **anchorage or harbours**. Recently, motorized boats have begun to increase in numbers, but they do not have access to safe anchorage in every developing country. Lack of anchorage/harbours results in lack of facilities for supplying ice for preservation of catch on-board and for handling and preservation/processing of the catches when unloaded. Such facilities are hardly available for traditional fleets and available for only about 40-60 percent of their motorized fishing fleet, depending on the State. Lack of such facilities demands extensive transportation facilities for the immediate removal of the catches from the landing places. Indian shrimp trawlers on the east coast have to sail for days from the fishing port in Andhra Pradesh to the fishing ground off the coast of West Bengal State because there are no suitable facilities in Andhra Pradesh, for landing and processing the shrimp catch for export.

Fishing-boat building and routine maintenance and repair facilities are of various standards. There are numerous traditional craft construction yards but few for the construction of modern motorized craft. Even these may not always have qualified naval architects and marine engineers to design economical and sea-worthy craft in line with the traditions of familiarity and acceptability of the small-scale fisherfolk and to supervise construction and maintenance.

b) Need for significant improvements in the quality of fish and fishery products

Special emphasis has to be placed on development of post-harvest technology to improve the handling, processing and quality of fish and fish products in most South Asian countries, to reduce loss due to spoilage and discard, to increase the value of the products and to improve earnings from exports. The importing countries complain constantly about the quality of fish and fish products exported from developing countries. Even when these products are accepted, the unit price received for shrimp and other products is low for some of the South Asian countries. US sea-food detention from South and Southeast Asian countries, in January-March 1996 covered practically every product exported. Reasons included salmonella, decomposition, insects, rodent and bird wastes, parasites, labeling error, sulphites, harmful colouring material, histamine, clostridium, short weight, mercury and cadmium. Countries listed included India, Bangladesh, Pakistan and Sri Lanka.

Implementation of inspection according to the HACCP regulations of the US Food and Drug Administration becomes mandatory with effect from December 1997. US importers will be required to obtain fish products only from countries with an active memorandum of understanding or similar agreement with the FDA documenting the equivalency of the country's inspection system with the FDA system, that ensures products offered for import were processed according to HACCP regulations. The quality of fish available in the domestic markets of developing countries is also not of satisfactory health standards in this subregion.

c) Trade

There is pressure on sea-food exporters in South Asia to respond to a rapidly changing market situation influenced by quality, demand and other concerns. Recession in some countries like Japan hit Indian exports, which dropped in 1995/96. Dependency on few markets has been found to be a risk. The need to establish new and additional markets for each product and ensuring fairly large shipments on a steady basis has become evident.

d) Balancing the usage of land and freshwater for food production

Limitations of arable land and irrigation facilities, deforestation and increase in human populations place greater dependency and pressure on the marine and freshwater environments to make more contribution to food supply. Balancing land and freshwater usage for agriculture and for fisheries is becoming a complex exercise, particularly with the need to protect and maintain the quality of the aquatic environment, to be able to cope with demands from both sectors. Inputs favouring one may be counterproductive to the other. An example of such a situation concerns one of the largest and most productive seawater lagoons in Sri Lanka - Batticaloa Lagoon. Excess irrigation water from the Gal-Oya scheme is diverted into this lagoon, and rice cultivators would also like a major part of the lagoon to be converted into freshwater. Fishermen's protests have not had any effect. The southern part of the lagoon has changed; water lilies are growing and shrimp and other valuable fish species have disappeared from that part of the lagoon. Agricultural activities have affected Pakistan's freshwater capture and culture fisheries: loss of water resources through seepage in water canals and in fields, soil erosion, salinity intrusions, pollution from fertilizers and pesticides and obstruction to movement of fish populations in the rivers by the construction of barrages for agriculture and dams for hydro-electric power generation. Perhaps all the countries in this subregion have the last type of problem, except Maldives.

e) Stability of fish supply

The most significant factor that controls the steady supply of fish in this subregion is the monsoonal weather which influences sea conditions as well as flood and drought on land. The size and characteristics of fishing craft, which reduce their sea-worthiness in rough conditions in the seas around the subregion, prevent them from operating during many months of the NEM and SWM. In the past, most traditional fishing families virtually starved at those times, while some managed to save something for the 'rainy days'. In later years, fishermen's societies, associations, groups and even the church helped to organize relief funds for the fisherfolk during the lean seasons, but the supply of fish to the public was almost nil. With the introduction of modern small-scale and industrial fishing fleets, this situation improved by degrees, depending on the level of modernization of the fishing fleet in each country. The degree of modernization also has proportionately increased the diversity of the exploited fish resources and the sea areas accessible to these craft, and has reduced seasonality in the supply of fish. With this, the peak seasons in the supply of some species changed from the inter-monsoons to monsoons, while others became available throughout the year. Better stability in the supply of fish requires the modernization of traditional fleets, which form the larger component in countries like India and Bangladesh.

Similarly, in the inland fisheries, seasonal drought and flood affect fish production and the livelihood of poor fishermen, and the most affected country is Bangladesh. One of the factors contributing to this problem in Bangladesh is the Farraka barrage on the Indian side of the river Ganges. Very recently, India and Bangladesh appear to have come to an understanding, and India has agreed to release water on a continuous basis. This should reduce flooding during the monsoon and drying up of the river bed during the inter-monsoon periods and also enhance fish production in Bangladesh to some degree. Flooding and drought affect not only capture fisheries but also culture fisheries. The loss of production from the former is much greater in value because it includes loss of brackishwater cultured animals such as shrimp from the ponds that get washed away by the cyclones/floods, as in Bangladesh and the east coast of India. The loss from the latter is also great because the spawners concentrated in the deep ditches during drought are easily fished out, as reported by Bangladesh. Stocking programmes in the inland freshwater bodies are also affected by the reduction in the surface area of the water during drought. Management of freshwater bodies is generally lacking.

f) Buffer stock

Unlike in the case of grains and cereals, it is difficult to stock fish without appropriate facilities. Presently fish production is generally consumed in fresh form. A smaller component is converted into salt-dried, smoked, smoked and dried or pickled fish. This is more because of the storage problem, consumer preference and to facilitate distribution into the interior areas that are without electricity, rather than for preservation as buffer stock. Some specific fish stocks in the subregion have provided unusually large catches in particular seasons in some years, and most of these perished due to lack of storage and distribution and not due to lack of demand, but such situations are becoming relatively rare.

The present organizational arrangement for fish production, for domestic consumption as food, fish-meal, baitfish, and for export as high-valued luxury-food items, ornamental fish, game fish, etc., does provide for buffer-stocks of fish, except the large stocks of dried fish imported by the Cooperative Wholesale Establishment and the private sector in Sri Lanka.

7.2 Policy Measures

Objectives for developing fisheries

First and foremost, "**political will**" must prevail if major changes in fisheries policy matters, changes in fisheries development priorities and implementation of drastic but essential management measures are to be achieved. Secondly, placing all fisheries development and management matters under **one ministry** will help coordination, regulation and execution of all aspects of the industry to be carried out efficiently and expeditiously.

General objectives for developing the fishing industry mentioned earlier may be kept, if each of them is related to specific fisheries, fishery resources, areas or situations, to reduce conflict and counterproductive tendencies. This is possible, but very difficult to implement, unless appropriate management mechanisms exist or can be introduced. Enforcement also will not be very effective.

In light of the threatening food security situation, the following primary objectives are being discussed at conferences for inclusion under fisheries policy and are valid for the countries in South Asia:

- sustaining fishery resources;
- raising fish productivity;
- arresting and recovering environmental degradation;
- improving preparedness for food shortages;
- increasing per-caput consumption in countries with very low fish consumption; and
- minimizing the risks.

Incorporating international conventions

The following should form the basic skeleton for any future policy framework for the sustainable development and management of fisheries and for a meaningful food security programme in any subregion.

a) Convention on the Law of the Sea [The United Nations Convention on the Law of the Sea (UN, 1983) and the Convention on Fishing and Conservation of Living Resources on the High Seas (UN, 1958)]

The UN Convention on the Law of the Sea gives the responsibility of managing the resources in the EEZ to the coastal States. For developing countries, this responsibility is a serious one, as they have not been concerned about it until recently. Article 63 considers shared and straddling stocks together.

b) Responsible fishing

The International Conference on Responsible Fishing, held in Cancun, Mexico; 1992, requested the FAO to prepare an international code of conduct to address their concern. The declaration of the Cancun conference was an important contribution to UNCED (1992). The code of conduct sets out principles and international standards of behaviour for responsible practices with a view to ensuring the effective conservation, management and development of living aquatic resources, with due respect for the ecosystem and biodiversity. The code recognizes the nutritional, economic, social, environmental and cultural importance of fishers and all concerned with the fisheries sector. It takes into account biological characteristics of the resources and the environment and the interests of consumers and other users. States and all those involved in fisheries are encouraged to apply the code and give effect to it (FAO, 1995).

c) Highly migratory stocks and straddling stocks

Establishment of the EEZ and expansion of marine fisheries of developing countries have increased the kinds and numbers of fisheries conflicts and issues connected to the exploitation of stocks of highly migratory species and stocks of numerous species straddling across EEZs of coastal States with common EEZ boundaries and contiguous EEZs.

The UN Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks was convened subsequent to the Cancun Conference on Responsible Fishing. Six sessions were held between 1993 and 1995 and an Agreement, dated September 1995, is available for implementation of the provisions of the UN Convention on the Law of the Sea, relating to the conservation and management of straddling fish stocks and highly migratory fish stocks.

<u>Establishment of new fisheries act and introduction of new management regulations</u>

The Fisheries Acts of most countries in the subregion have evolved from their very long-standing Fisheries Ordinances of the colonial era over a period of one hundred years or more. The evolution has mainly been in the form of amendments to the Act made from time to time to incorporate new aspects that were the result of the fisheries development process. There have been too many drastic changes in the fisheries sector; the accumulation of amendments, therefore, does not seem to give sufficient clarity, coverage and flexibility to the Act to serve satisfactorily present and future demands in fisheries management. The major areas of difficulty will be in the incorporation of a **co-management or community-based management** approach, as well as in the introduction and implementation of an **Integrated Coastal Zone/Resources Management Programme**. These require careful framing of the legal reforms to make suitable provisions in the Fisheries Act and to frame fisheries management regulations that are practicable, sound in law and effective in enforcement. Therefore, it may be better if the Fisheries Act is drafted afresh and independently of the framework of the existing Act (Sivasubramaniam 1997). Earlier acts and regulations based on past experiences in the subregion may not mean very much, because the government administrative system has undergone radical changes from the colonial system. No management measures of any great significance to fisheries have been successfully implemented since the colonial era. Even the basic step of registering and licensing of fishermen and fishing units/craft after the colonial era is still to be implemented to obtain a realistic estimate of the number of fishermen and fishing craft in the respective countries, except perhaps in Maldives. Maldives has a very small population and one major fishery, and it is the main responsibility of each island-chief and atoll-chief to collect information on every fishing operation every day - a total enumeration system.

<u>Marine fisheries</u>

Coastal. To reduce conflicts among fisherfolk and competitive and interactive marine fisheries, including finfish and shrimp trawling, purse seine/ring net fishery for small pelagics and offshore/oceanic tuna and shark fisheries, an attempt should be made to keep the fishing industry primarily within the structure of small-scale fisheries, as is the present situation in Sri Lanka. Further, the existing traditional fisheries should be replaced by equivalent and modernized small scale fisheries, as is being done in Maldives, and not by adding a modern fleet to the already existing traditional fleet, as in India and Bangladesh and partially in Sri Lanka.

The shortage of labour in Maldives requires capital intensive systems or a third generation *dhoni* with devices to reduce labour requirements and crew only to operate fishing devices and other machinery.

Subsidies should be restricted to unexpected situations that contribute to difficulties in maintaining viable operation of a fishery in a particular area or areas, or to encourage the entry into an uncertain fishery of an unutilized resource.

Since **industrial shrimp trawling** in tropical waters is too efficient for the small stocks of shrimps and numerous finfish and other shellfish species taken as bycatch, it has been responsible for the sharp decline in shrimp and finfish resources in many coastal States. **Small-scale shrimp trawling and/or trammelnetting as an alternative to shrimp trawling**, as in Sri Lanka, may be considered. Trammelnet fishery in South Asia catches primarily white shrimp (*P. indicus*) and some banana shrimp (*P. merguiensis*), with very small amounts of other penaeid shrimps. Modified versions of this gear with different mesh sizes, operated in a wider range of depth, may prove suitable for other penaeid species as well. With trammelnetting, bycatch will be small and of marketable size and quality. Bangladesh mentioned such a consideration in their policy paper prepared in 1993.

Substantial **lowering of the cost of production** could be obtained with small-scale fisheries, improved efficiency of fishing methods, reducing the importation of fishing vessels from developed countries, increased utilization of bycatch and discards by creating value-added products from them and by introducing a wide range of management measures covering practically all aspects of marine fisheries.

a) Offshore/oceanic fisheries

For the development and management of offshore/oceanic fisheries, the ministry concerned with these fisheries needs to have very firm policies, development plans and appropriate regulations for local and foreign fishing vessels. Some of the islands in the southwest of the Indian Ocean set up this programme over a decade ago, because of the limitation to the development and expansion of offshore fisheries with only a local fleet; a policy decision was therefore taken to encourage foreign collaboration. Many others have fisheries acts which touch on the conditions relevant to offshore fisheries in a general way. But they are not comprehensive enough to ensure that the terms and conditions are fair and favourable to the fishers and the governments of the coastal States, and that foreign collaborations or joint ventures are not detrimental to the resources, local fisheries and owners of the resources in their EEZs. Joint ventures established on the basis of such weak terms and conditions have led to many problems: uncontrolled expansion in the number of joint ventures; issue of licenses without limitations to the quantity of fish to be taken from specified offshore stocks by local and foreign fleets; conflicts between local and foreign fleets; fees/taxes not being levied on any established system; uncertainty about the technical status of the catch made by a foreign fleet (recorded as landings of the coastal state or foreign partners, etc.); and failure to declare information to the coastal state government on the catches made, effort applied and areas fished by foreign vessels.

b) Need for developing a bait fishing industry

In view of the pressure to discontinue gillnetting, there is a need to provide a steady supply of bait-fish for increased hook and line fishery in the coastal, offshore and oceanic fisheries. This would require establishment of a bait fishery for various species suitable for different target species. The need for hook and line fishery in inland fisheries also may be considered here.

c) Catching of dolphins and turtles

The list of species protected by law has grown longer during the last two or three decades. However, both the law and enforcement continue to be weak in developing countries and, consequently, there are numerous threats of banning import of marine products from countries that are not "friendly" to animals such as dolphins, dugong and turtles. The responsibility for preparing the acts on protected aquatic species has been with the departments concerned with wildlife, forestry and/or fisheries in most countries, but coordination between them has been insufficient, the listings based on weak justifications and the acts are not comprehensive enough to ensure punishment of those who are guilty. The Fauna and Flora Protection Acts have to be updated and amended with well-defined conditions and stringent punishment to overcome all the existing limitations from the point of view of fisheries development and management.

Implementation of management regulations for lagoons/mangroves/game-fish reserves/marine reserves

This policy measure is listed separately because it involves government departments like wildlife, fisheries, forestry, coast conservation, irrigation, railway, highway, etc., and in the countries of this subregion these may be placed under different ministries. Though there are legal enactments covering such responsibilities of these departments and their ministries, experience shows that the combined implementation of management regulations tends to run into administrative bottle-necks. Policy decisions are required that would facilitate combined effort and successful implementation of these important aquatic ecosystems, for example:

- establishment of marine reserves to preserve stocks, to maintain biodiversity and to enhance recruitment in the neighbouring areas, etc;
- regulatory measures to protect and preserve the environment and animals in the reserve; and
- strengthening the mechanism of implementation and effective enforcement of regulations to control fisheries and activities that may be destructive to coral reefs, particularly to prevent the use of explosives and poison as a means of collecting fish, dead or alive.

Freshwater fisheries

a) Policies for protection of freshwater environment

- In-stream improvement structures such as impounding or modified flow, to maintain flow of water into seasonal water bodies and to reserve water during drought.

- Systems for regulating the usage or supply of water for industry, aquaculture, washing/bathing purposes, etc. to reduce loss of water and ensure that polluted water does not return to the stream without adequate treatment.

- Dams and reservoirs constructed for irrigation and hydro-electric power generation must not cause complete obstruction to the migration of fish in the rivers. Protection and improvement of access for fish to spawning areas, fish passes and protection of spawning fish are needed.

- Periodic monitoring of fertilizers and pesticides drained into these water bodies and regulatory measures to keep this at safe levels for the fish and the people consuming the fish.

b) Systematic approach to increase yields and to improve management

- Categorization and classification of water bodies according to their productivity and other physical and chemical characteristics is urgently needed, to enable better estimates of potential yields and even sampling for catch and effort statistics.

- Fishing technology in freshwater bodies in this subregion has received much less attention than has been provided for marine fisheries. Technological improvements to increase efficiency for selective fishing, to capture species that are not being targeted presently and to operate in areas that are not suitable for using gillnets because of the presence of dead tree-trunks.

- Freshwater fish catch and effort statistics in the subregion are extremely weak and unreliable for stock assessment purposes and to understand the reasons for the declining production of freshwater fish in some countries.

- Stocking for artificial recruitment and transplantation for culture-based capture fisheries. Scientific determination of optimum stocking densities, ecological niches available and fish species ideal for stocking, to improve the yield from vast natural areas of water bodies such as ponds, tanks, flood-plains and reservoirs, which are available in the countries of this subregion, except Maldives. An *ad hoc* basis of stocking and selecting species for it has led to rash decisions on the effectiveness and benefits of the stocking programmes. Reconsideration has become necessary.

- Reservoir fishery management to improve productivity, particularly in small reservoirs. There is evidence for increasing their yield capacity by 20 percent or more.

- Assessment and exploitation of unconventional resources, such as small cyprinids which are considered to have high productivity. This also includes ornamental species which are being harvested without regard to availability. Management regulations are urgently required, to prevent damage to rare species stocks.

- Indiscriminate capture of *jatka* (hilsa fry) in Bangladesh may be specifically mentioned as an issue, in view of the importance of that single species to total fish production in that country.

- Discourage traditional systems of leasing and auctioning water areas or water bodies and encourage a suitable licensing system.

- Regulate the catching capacity of fishermen and/or introduce a closed season, ban destructive gear and control mesh and fish size regulations.

- Flood plains and channels should have areas demarcated for “reserved waters”, to compensate for dry season losses.

- Management of freshwater bodies may contribute not only to better and steady production from agriculture and fisheries sectors but also lead to better utilization of water for other purposes such as transport, industries, domestic usage and entertainment. Excess irrigation water may be diverted into storage, even at high cost, to create additional areas of water resources for fish culture and perhaps for irrigation in other dry areas.

- Urgent attention should be given to identifying ways and means of increasing the utilization of potentials of freshwater bodies to increase freshwater fish yield levels and total fish production, particularly in Nepal and Bhutan, but also in Pakistan.

<u>Aquaculture</u>

a) Mapping suitable areas and general layout plans before allocation of land

- Advance planning by preparing maps of areas available for each type of aquaculture and determining sources for the quantities of water supply required for the ponds, the amount to be drained out as waste water, requirements for the purification of a specified quantity of polluted water and reuse of the water, etc. The land area to be allocated for culture ponds and proportionate areas to be allocated for sedimentation, filtering, biological purification, discharge canals, etc. The layout plan for these, in each locality.

b) Rigid regulation of environmental protection

- The central environment authority in each State must be empowered to act firmly and impartially and in the best interest of environmental protection, without succumbing to pressures from politicians and industrialists.

- Rigid regulations concerning protection of the environment used in aquaculture, pollution control, disease control, disposal of waste/polluted water, etc. are essential for the effective management of aquaculture activities. Shellfish from the bottom are most vulnerable to environmental deterioration and controlling the environmental conditions in which they are cultured is essential.

- Environmental impact assessment must be executed by bodies that have recognized competence and are approved for making such assessments. Initial impact assessment must be carried by the national institutions identifying areas to be allocated for aquaculture. This will not permit investors to overlook the basic environmental requirements at a macro level. Individual investors will be responsible for specific, in-depth assessment at a micro level for the specific plot allocated to them. Even in the freshwater fisheries sector, there are concerns about the reduction in genetic diversity of species, as a result of various impounding and engineering works utilizing freshwater for purposes other than fishing.

c) State priority for expansion of freshwater aquaculture

- Though the contribution by aquaculture to the development of the freshwater fisheries sector is higher than that to the marine/brackishwater sector, it is felt that freshwater aquaculture can be developed to produce much cheaper fish, even with less than 50 percent of the effort that has gone into the development of aquaculture in the marine sector. Therefore, in view of the food security situation in these developing countries, priority may be given by the States to freshwater aquaculture development. The private sector will take care of the export-oriented brackishwater culture and mariculture.

- As far as possible, small-scale fisherfolk should be encouraged to participate in the development of freshwater aquaculture.

- The potential exists for significantly increasing freshwater aquaculture activities in Nepal, Bhutan, Pakistan and Sri Lanka, and the necessary steps are urgently required. Similarly, the potential for brackishwater culture and mariculture in Pakistan remains unutilized, particularly the great opportunity for shrimp culture. In fact, by activating a shrimp culture programme, shrimp exports from Pakistan can be stepped up without the heavy pressure that is put on the shrimp stocks of the Indus river delta, and TCDC within the subregion can easily provide cheap and appropriate technology, training and experience for this.

- The problems of availability of economical and appropriate feed and of marketing of cultured diadramous species should receive timely attention for the expansion of the culture programme for this category of fish.

- Integrated farming approaches, including rice-fish farming, are practiced at different levels in different African and Asian countries like Senegal, Philippines, Indonesia and India. This is an area for considerable expansion in many other countries in the subregion. Popularization of this system should be encouraged by the respective States.

Mariculture programmes for marine shrimp, freshwater prawns, marine and freshwater finfish, crabs, edible oysters, seaweed, aquatic plants, ornamental fish, giant clams, sea cucumber and pearl-oysters, are becoming very popular in many developing countries. Penaeid shrimp culture is the most popular activity, and the private sector must be provided guidance and encouragement to expand and include other varieties mentioned above, for both export and domestic markets.

Following the success of aquaculture in some countries in the world, many developing countries have planned for increased aquaculture production without learning enough about the techniques, conducting trials under conditions prevailing in their countries, establishing economic feasibility and demonstrating appropriate techniques to the fisherfolk. A heavy burden of success is being placed on such hurried approaches. Viability should be demonstrated before recommendations are made for investment in such ventures and before extension to fish-farmers.

Fisheries research needs

The rate of return on investment in agricultural research has been reported to be 65 percent for rice in India and 58 percent for wheat in Pakistan. Though quantified estimates are not available, the return on the investment in freshwater fisheries research may be quite significant, considering the increase in production from capture fisheries achieved by India and

Bangladesh in the last decade. If the results of all the research done are applied, there is strong reason to believe that the rate of return on investment will be even more. In freshwater fish culture activities, too, similar or better returns are indicated. Both input and output in other countries in the subregion have been relatively poor but the results from India and Bangladesh are quite easily adaptable to the needs of Sri Lanka, Pakistan, Nepal and Bhutan through TCDC or other means.

The situation in the marine sub-sector does not indicate a parallel result in the subregion. Management-oriented research using a prioritized programme has to be stepped up under the "Essential Food Security Situation", and the Fisheries Act must be made stronger and more effective for implementation of the management measures. It is unfortunate that the need for streamlining the research institutions in the subregion, appropriate training of scientific staff and guidance by competent scientists continues to be re-emphasized but not heeded (Sivasubramaniam, 1993, 1996).

A determined effort has to be made by the governments in most countries of the subregion to prepare a prioritized fisheries development and management-oriented research programme at the national level and strengthen the capability of fisheries research institutions, universities and their staff to coordinate execution at the national level and to provide appropriate direction, guidance and suitable facilities (Sivasubramaniam, 1996).

Research into utilization of (a) unexploited deep sea finfish resources; (b) bycatch in shrimp-trawl fishery; (c) unmarketable and damaged fish discarded by small-scale fisheries, for direct human consumption, for converting into value added products and/or fish and live-stock feed, should receive the highest priority. Success in this area would make the biggest contribution to maintain the per-caput consumption level until 2010.

Research into environmental stresses, fish diseases, production of disease-resistant and fast-growing strains of fish is of importance to the successful development of aquaculture - a major hope for ensuring food security in this subregion.

<u>Infrastructure facilities and quality of fish as food</u>

a) Infrastructure facilities

Improvements to existing infrastructure facilities will improve the efficient operational management of the fishing fleet, fish processing and preservation and preparation of value-added products of quality. These are essential support services for the efficient management of marine fisheries in these countries.

Additional infrastructure and anchorage facilities will help to reduce the scattered distribution of very large numbers of traditional and modern fishing units. Poor handling, collection, transportation and marketing of fish, due to scattered landings, contribute to reduction in quality of the catch. They also reduce the opportunity of getting the best value for the catch and a better price to the fishermen. In Maldives, further increase in production demands increase in infrastructure facilities. Difficulties in providing sufficient infrastructure facilities to cater to the needs of fishers and fishing fleets, due to the financial burden on each State government to establish and maintain such facilities, may be considerably reduced by **introducing a system of**

collecting rent for the usage of the infrastructures and facilities. The rent would be based on the type of fishing unit, its average production capacity and cost and earnings analysis.

Increase in cold-storage facilities along the coastline and along the mid-line of the inland area will minimize transportation and distribution time and cost from the coastal and inland waters and will reduce spoilage and wastage. Further, such an arrangement of storage facilities may also be used for other perishable food items such as meat, fruits and vegetables.

b) Quality control, fish processing and utilization as food

Lack of rigid quality control standards for handling and cleaning of fish, storage of fish on board, fish processing plants, preservatives used and fish export licenses, are contributing to poor quality of fish and lower prices for products exported from this subregion. The quality control standards in the ISO 9000 series (based in Geneva), published in 1987, aim at providing international acknowledgment of quality efforts. Countries must insist that fish producing, marketing, processing and exporting individuals and organizations adopt these standards and abide by them.

Lack of proper quarantine for checking import and export of live and dead fish and reducing/preventing the problems of pathogenic organisms in fish and fish products.

Lack of fish diseases control/treatment and sufficient number of trained personnel to maintain quality of environment and products, particularly in aquaculture, to improve price and demand for exportable fish and fish products.

Many States need to develop infrastructure facilities which can maintain expected standards of quality for fish and processed fish products, with minimum spoilage due to bacterial/viral infections, insect/rodent infestations, etc., sufficient to meet the requirements of the quantities of the product in appropriate geographical locations.

Improvements in the quality of transport for fish, both for domestic consumption and for high-valued export markets. Similarly, specialized systems such as sedation by lowering the body-temperature, anaesthetizing by bubbling carbon dioxide, etc., to preserve live fish exported for consumption and aquarium and depuration for cleaning of live oysters, cockles and mussels have to be popularized to achieve the required quality standards for such products.

Direct utilization of fish reduces wastage and cost, and is suitable for poor people. Processing and converting fish into value-added fish products may be suitable for export markets. Producing surimi, utilizing palatable species like threadfin breams and small pelagics, as in India, may not be the best way to utilize the yield without loss. In terms of ensuring food security, developing and marketing these fish locally or exporting them to other countries in the subregion may be more beneficial than converting them into products with a significant loss of yield.

Discarding bycatch fish damaged by predators, fish-offal and other wastes in fish processing, etc., should receive the attention of fisheries planners and developers, to identify ways and means of utilizing them as food for humans, or at least as fish and animal feed. The latter may help to reduce the import of fish-meal to the region for savings which can be utilized to import food fish. **Alternatively, there is the possibility of selling such categories of fish in forms acceptable to other countries in the region such as Nepal and Bhutan that may require fish-meal because they do not have any discards that could be utilized for such purposes. In this way, the differences between estimated fish-catch, landed-catch and fish-utilized will be reduced, and the last category will increase considerably without additional fishing effort.**

<u>Other related matters</u>

a) Stability of supply

In-depth analysis, far-sighted policy decisions and timely planning are required today to sort out such major national issues. Controlling nature is not possible, but mechanisms to reduce the risks from weather and sea conditions may be possible through improvements to sea-worthiness of fishing units, safety of fishermen at sea, etc., particularly in the large traditional sub-sector. The increase in costs and the consequent reduction in economic returns become a constraint. Can the countries of this subregion bear the costs or should the State let fisherfolk risk their lives and let fish supply be unsteady? Though the policy measures for this issue may rest with the respective countries which would tend to be in favour of introducing mechanisms, their economic condition may not permit that.

b) Buffer stock

The basic idea of maintaining a buffer stock may be encouraged, initially, to establish **a buffer-stock of baitfish collected during seasons of abundance and low price to supply hook and line fisheries, particularly for the tuna longline fishery which has to grow in Sri Lanka, India and Pakistan and is likely to start in Maldives and Bangladesh in the future. In Maldives, when the next generation of pole and line boats is introduced, it is expected that they may not be able to spend time collecting live-bait. Therefore, a live-bait fishery and stocking-pens for them may have to be established to provide sufficient live-bait for multiday voyages.** This would then be an encouragement to maintaining a buffer stock of food fish - unusually large productions from a glut-season in the rainy season when fish-drying is difficult; highly seasonal fishery for varieties with low demand, e.g., Coramandel flyingfish for which production is curtailed by fishermen; and oil sardine which cannot be preserved by drying and hence is used as manure; non-preferred and cheap fish bartered with other countries in the subregion, to be marketed during periods when national fish production is low and fish price soars.

c) Subregional and regional cooperation

This subject has been mentioned in section 6.3. This is an area in which facilities may be available for liberalization of trade, and tariffs and deregulation under the existing regional body, SAARC. Discussions along such lines are ongoing among some countries, and perhaps fisheries is one area in which there are numerous possibilities and benefits to all the members. Examples of possible cooperation are:

- Combined trade agreements on collective export of fish and fish products to other regions to strengthen their bargaining power through a larger quantity of many varieties of captured and cultured food fish and ornamental fish available in this subregion.

- Fisheries management agreements on straddling stocks can be made easy with subregional cooperation, and even the management of highly migratory species can be enhanced by subregional cooperation to strengthen cooperation with the rest of the Indian Ocean region.

- Adjacent developing subregions like ASEAN, which are becoming economically better developed, are potential markets for the export of high-value fish food items from the Indian Ocean region. This has many advantages, including diversification of export markets.

- Another very significant benefit could be in the form of a collective agreement among the SAARC countries to execute the expensive programme of surveillance and monitoring of the seas surrounding the subregion for the implementation of the Law of the Sea and preventing illegal fishing and damage to the environment. This would be beyond the capability of the nations in this region on an individual basis, except, perhaps, for one or two.

- Within the SAARC membership there is a great deal of technical knowledge and skill in the areas of freshwater capture fisheries and culture fisheries, offshore fisheries, food technology, etc. Exchanging know-how through TCDC or other mechanisms would be of immense value to the development of fisheries in all the countries in the subregion, particularly in Nepal and Bhutan.

The governments should endeavour to achieve these benefits, though subregional and inter-regional cooperation.

d) Support from international fisheries bodies in the subregion

Section 6.4 dealt with the assistance provided by international and national funding and executing agencies that have made contributions and continue to assist the countries in the subregion with aid and technical support to increase food production and supply. Their assistance should be continued, but better coordination and collaboration by identifying fisheries projects from a national or subregional priority list, as already mentioned, may yield greater benefit and reduce losses by avoiding duplication of effort and taking up projects that give priority to food security issues.

It has been an advantage that the Indo-Pacific Tuna Programme (IPTP), the fore-runner of the Indian Ocean Tuna Commission (IOTC) and the Bay of Bengal Programme (BOBP) of the FAO are based in two of the States in this subregion. The former will be closed down at the end of this year, when the Indian Ocean Tuna Commission Secretariat in the Seychelles is ready. The fate of the BOBP is uncertain. The governments in the subregion, through SAARC, should endeavour to establish similar bodies to facilitate and strengthen activities mentioned under subregional cooperation, as well as for easy access to a centralized subregional technical information and support services unit during this critical period for food security.

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Table 1. Population indices in the South Asian countries

Items	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka	Period
Land area	144 000 km^2	47 000 $miles^2$	3 287 263 km^2	90 000 km^2	147 181 km^2	796 095 km^2	65 610 km^2	4 467 149 km^2
Population (Mn)	114.8	1.7	900.5	0.25	19.6	126.6	17.9	1 181.35 (1994)
Population growth rate (%)	1.9	2.3	1.8	3.3	2.6	2.5	1.4	1980-1995
Population density (per km^2)	882	36	303	826	143	164	287	1994
Urban population (%)	17	6	26	26	12	33	22	1992
Life expectancy								
- Male	55	48	61	61	54	59	76	
- Female	56	49	62	64	53	59	74	
Human development index**	0.364	0.305	0.439	0.554	0.343	0.483	0.704	1992
Literacy								
- Male	47	51	62	91	38	47	92	1992
- Female	22	25	34	92	13	21	85	

** A composite Index of Life Expectancy, Education and Income, given equal weight.

SOURCE: Statistics - Central Bank of Sri Lanka, 1996.

Table 2. Temperature and rainfall in the South Asian countries

Country	Temperature Range (C)	Rainfall	Cyclone
Bangladesh	9.8-13 C NE. Monsoon; 25 C SW. M.	1 300- 3 500 mm heavy during NEM	V. Vul.
Bhutan	South -15-30 C; Central - <15 C; High North - Alpine temp.	South - 2 500-5 000 mm; Central - 1 000mm; High North - 400 mm	Not Vul.
India	9.5-49.5 C Mean variation 6.6 C	127-11 000 mm	Vul.
Maldives	22-33 C	Av.1 967 mm	Not Vul.
Nepal	20-35 C	East - >4 000 mm; West + North <3 000 mm	No
Pakistan	15-30 C	280-4 000 mm	Not Vul.
Sri Lanka	Av. 27 C low lying; 16.1 C in the hills	850-4 115mm	Occ. Vul.

Source: Sixth SAARC Summit; Colombo; 1991. Special Issue.

Table 3. Economic indices of South Asian countries

ITEMS	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka	Period
Econ. active pop. (%)	47	46	38	27	40	28	49	1990-93
GNP $ (Mn.)	26 715	234*	287 024	217*	3 564*	51 683	11 647	1994 1993*
GNP per caput ($)	233	137*	319	908*	185*	408	652	1994 1993*
Growth rate of GDP (%)	3.6	5.2*	5.3	6.6	7.0	4.0	5.6	1994 1993*
Sectoral comp. GDP(%)								
- Agriculture	35.9	42.2	30.3	20.6	42.2	24.1	20.9	1994
- Mining	-	0.8	2.0	1.8	0.6	0.5	2.4	1994
- Manufacture	10.5**	9.1	20.0	6.1	8.9	18.3	19.1	1994
- Services	53.6	47.9	47.5	71.5	48.3	57.1	57.6	1994

** Mining and manufacture combined

Source: Central Bank of Sri Lanka, 1996.

Table 4. Productive capacity of agricultural land

Item	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka	Period
Arable land/total Land (%)	69.5	2.9	57.1	10.0	17.2	27.4	29.5	1992
Forest + woodland/ total land	14.5	54.5	23.0	3.3	39.1	5.3	32.5	1992
Irrigated land/arable land	34.3	25.4	27.0	-	36.1	81.0	28.9	1992
Cropped land/caput (ha)	0.08	0.08	0.19	0.01	0.11	0.17	0.11	1992
Share of agriculture in GDP (%)	35.9	42.2	30.3	20.6	42.2	24.1	20.9	1993
Per caput paddy prodn.	41.6???	179.3	131.4	25.2	239.8	41.6	150.2	1994

Source: Statistics; Central Bank of Sri Lanka, 1996.

Table 5a. Exports and imports and balance of trade, in South Asia, 1994

Item	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka
Exports ($ million)	2 661	66	25 022	35	363	7 367	3 209
Export/ caput	20	39	24	146	20	54	162
Imports ($ million)	4 702	87	26 843	222	1 176	8 890	4 767
Balance of Trade	-204	-21	-1 821	-176	-813	-1 523	-1 558

Source: Central Bank Statistics, Sri Lanka (1996).

Table 5b. Intra-regional trade forecast under non-cooperation scenario ($ million)

Year	Exports (1)	Imports (2)	(1) + (2)	Trade Balance
1990	853.5	969.1	1 822.6	- 115.6
2000	1 591.2	1 791.7	3 382.9	- 200.5
2010	3 057.2	3 445.9	6 503.1	- 388.7
2015	4 184.5	4 738.5	8 923.3	- 554.3

Source: Ashfaque & Annice, 1994.

Table 6. Food aid deliveries to South Asian countries, 1995

Countries	Cereal food imports (t)	Local purchases	Total	Non-cereal imports	Local food purchases	Sub total	Grand total
Bangladesh	614 684	5 757	620 441	4 775	151	4 926	625 367
Bhutan	0	5 790	5 790	0	638	638	6 428
India	252 023	113 145	36 568	47 773	2 753	50 527	415 695
Maldives	2 598	0	2 598	0	0	0	2 598
Nepal	15 010	20 365	35 375	172	4 784	4 956	40 331
Pakistan	53 494	0	53 494	8 404	0	8 404	61 898
Sri Lanka	147 781	6 000	153 781	1 654	0	1 654	155 434

Source: World Food Programme, 1995

Table 7. Marine and inland waters, fisher population and production trends (1993)

ITEMS	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka	Total
Coast line (km)	480	0	8 085	na	0	1 120	1 700	>11 385
C. Shelf area (km^2)	40 000	0	182 000	na	0	na	24 372	>246 000
EEZ (km^2)	124 000	0	2 020 000	1 000 000	0	na	256 000	3 400 000
Inland waters (ha)	1 473 101	0	1.09 (billion)	0	6 500	35 000	382 000	1.2 billion
Fishermen (number)	1 057 951	na	3 837 387	22 268	27 104	499 938	120 000	5 564 648
% of the total	0.9	na	0.6	9.0	0.2	0.4	0.6	0.4
Marine production (t)	157 000	0	1 770 000	55 000	-	302 000	139 000	2 423 000 (1984)
Marine production (t)	232 000	0	1 797 000	71 000	-	341 000	165 000	2 606 000 (1989)
Marine production (t)	251 000	0	2 420 000	104 000	-	418 000	211 000	3 404 000 (1994)
Inland production (t)	482 000	na	584 000	0	3 000	61 000	27 000	1 157 000 (1984)
Inland production (t)	448 000	na	838 000	0	6 000	95 000	34 000	1 421 000 (1989)
Inland production (t)	570 000	400*	511 000	0	7 000	119 000	9 000	1 216 400 (1994)
Aquaculture production (t)	117 000	0	510 000	0	2 000	9 000	3 000	641 000 (1984)
Aquaculture production (t)	163 000	0	1 005 000	0	7 000	10 000	6 000	1 191 000 (1989)
Aquaculture production (t)	270 000	0	1 609 000	0	10 000	15 000	4 000	1 908 000 (1994)
Total (t)	756 000	0	2 865 000	55 000	5 000	372 000	169 000	4 306 000 (1984)
Total (t)	843 000	0	3 640 000	71 000	13 000	446 000	205 000	5 218 000 (1989)
Total (t)	1 091 000	400*	4 540 000	104 000	17 000	552 000	224 000	6 528 400 (1994)

* Guesstimate

Sources: FAO Year Book on Fish Production 1984-1994; Hotta, 1996.

Table 8a. Quantities and values of export and import of fish and fish products by the South Asian States, in 1993

State	Export (t)	($) x 1 000	Import (t)	($) x 1 000	E/I ($)
Maldives	54 000	64 541	0	0	28 685
Bangladesh	76 511	168 290	186	160	1 051.8
Pakistan	88 673	184 591	224	185	997.7
India	254 860	810 645	3 428	4 497	180.2
Sri Lanka	4 447	31 378	38 190	34 463	0.91
Total	478 491	1 259 445	42 028	39 305	

Source: FAO Year Book on Fisheries Commodities (1993)

Table 8b. Relative percentages of the quantities and values of the seven categories of fish and fish products imported and exported by the countries in South Asia

Country	Fish (Frozen)	Fish (Dried)	Crustacean + Mollusc	Fish (canned)	Crustacean (canned)	Fish (Oil)	Fish (Meal)	Total
Import								
Bangladesh - Q	151	-	-	35	-	-	-	186
- V	60	-	-	100				160
India								
- Q	171	-	14	0	-	174	3 069	3 428
- V	1 305	-	35	2	-	264	2 891	4 497
Pakistan								
- Q	6	-	-	12	-	185	21	224
- V	33	-	-	4	-	143	14	185
Sri Lanka								
- Q	85	31 348	174	3 688	0	2	2 893	38 190
- V	177	27 177	400	4 979	3	5	1 722	34 463
Total								
- Q	413	31 348	188	3 735	0	361	5 983	42 028
- V	1 575	27 177	435	5 085	3	403	4 627	39 305
Average price ($/t)	3 813	867	2 314	1 361	3 000	1 116	773	935
Percent of Q	0.9	74.6	0.4	8.8	0.0	0.8	14.2	100
Export								
Bangladesh								
- Q	49 301	2 000	25 000	210	-	-	-	76 511
- V	12 610	10 800	144 300	580	-	-	-	168 290
India								
- Q	96 579	2 237	154 888	7	164	81	1 404	254 860
- V	102 928	1 967	702 885	25	2 346	144	400	810 645
Maldives								
- Q	9 887	6 633	72	4 877	-	4	2 450	23 923
- V	7 846	9 821	594	9 238	-	18	1 168	28 685
Pakistan								
- Q	38 096	28 247	22 259	16	53	2	-	88 673
- V	85 866	23 223	75 229	49	153	1	-	184 591
Sri Lanka								
- Q	2 512	95	1 715	85	-	40	-	4 447
- V	11 992	2 016	16 883	162	-	325	-	31 378
Total								
- Q	196 375	39 212	209 212	5 195	206	85	3 854	448 414
- V	221 242	47 777	939 891	10 054	26 722	162	1 568	1 223 589
Average price ($/t)	1 126	1 218	4 608	1 935	12 970	1 906	407	2 728
Percent of Q	43.7	8.7	45.5	1.7	0.0	0.0	0.8	100

Q = Quantity (t) and V = Value ($)

Source: FAO Year Book on Fish Commodities (1993).

Table 8c. Domestic consumption, export and import of fish in South Asia (1993)

Country	Population (millions)	Catch (x 1 000 t)	Non-food Use (x 1 000 t)	Import (x 1 000 t) foodfish	Non food	Export (x 1 000 t)	Total supply (x1000 t)	Approximate Consumption (kg/caput)
Bangladesh	112.7	968. 9	5.2	0.186	0	76.5	887.2	7.9
Bhutan	1.5	0.4	-	0	0	-	0.4	0.26
India	8 884.5	4 200.0	391.3	0.428	3.0	254.8	3 553.8	4.0
Maldives	0.23	84.3	13.0	0	0	54.0	29.0	126.0
Nepal	20.3	16.3	-	0	0	-	16.3	0.8
Pakistan	129.3	563.4	183. 8	0	2.2	88.6	290. 9	2.2
Sri Lanka	17.7	208.4	-	35.3	2.8	4.5	242.1	16.2

Source: Based on FAO Fish Commodities Statistics, 1993 and Hotta, 1996.

Table 9a. Economically active populations, protein and energy supply and relative role of fish in South Asian countries

Items	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka	Period
Economically active population (%)	47	46	38	27	40	28	49	1990-93
Daily per caput protein supply (gm)	43	na	58	113	50	56	47	1992
Daily per caput calories supply (calories)	2 019	na	2 395	2 580	1 957	2 316	2 274	
Fish/animal protein	47.4	na	12.4	96.2	2.8	3.5	54.0	
Fish/total protein	4.8	na	2.0	49.5	0.3	0.9	10.2	

Source: FAO, 1995b+c.

Table 9b. Dietary energy supply (DES) share of major food groups in developed countries, developing countries and South Asia

Item	World	World	Developed	Developed	Developing	Developing	South Asia	South Asia
Year	1969/71	1990/92	1969/71	1990/92	1969/71	1990/92	1969/71	1990/92
Meat + offal	6.4	7.4	11.1	12.8	3.5	5.2	0.9	1.1
Milk	4.8	4.3	8.9	8.6	2.2	2.6	3.2	4.5
Animal oil/fat	2.7	2.0	5.4	4.4	1.0	1.1	1.0	1.4
Eggs	0.8	0.9	1.5	1.8	0.3	0.7	0.1	0.2
Fish	0.9	1.0	1.4	1.3	0.6	0.7	0.3	0.3
Animal production total	15.6	15.7	28.3	29.1	7.7	10.3	5.6	7.4
Vegetables production	84.4	84.3	71.7	70.9	92.3	89.7	94.4	92.6

Source: FAO, 1996e.

Table 9c. Food supplies and shares of major food groups in total protein for direct consumption in South Asia

Item	1969/71	1979/81	1990/92
Per caput food supplies (Cal./caput/day)	2 060	2 070	2 270
Total protein supplies	51	50	55
Animal protein supplies (g/caput/day)	7	7	7
Total fat supplies (g/caput/day)	29	32	42
Animal fat supplies (g/caput/day)	8	8	11
Shares of major food groups in total protein			
Cereal	63.1		62.3
Pulses + nuts	17.1		13.2
Vegetables/fruits	3.9		4.3
Roots + tubers	0.8		1.1
Other vegetable products	1.9		1.7
Meat + offal	3.4		4.0
Milk	7.4		10.4
Fish	2.1		2.3
Eggs	0.3		0.7
Oils + fats	0		0
Vegetable total (%)	86.7		82.6
Animal total (%)	13.3		17.4
Fat from vegetables (%)	73.6		72.2
Fat from fish (%)	(0.8)		(0.6)

Source: FAO, 1996e.

Table 9d. Fish consumption pattern in South Asian countries

Country	Fishing population	% in total population	People in rural area (%)	Poverty in urban area (%)	Fish % in animal total
Bangladesh	1 057 951	0.9	51	56	80
Bhutan	na		na	na	na
India	3 837 387	0.4	49	38	13
Maldives	22 268	8.9	na	na	>80
Nepal	27 104	0.1	na	na	na
Pakistan	499 938	0.4	31	20	4
Sri Lanka	120 000	0.6	36	15	65

Sources: FAO 1996e and Hotta, 1996.

Table 10. Estimated populations and fish production for consumption and export by the year 2010

Item	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka	Total
Estimated population (million)	150	2.32	1 160.5	0.382	27.75	177.24	21.66	1 539
Production for consumption (x 1 000 t)	968.9	0.05	4 642.0	48.132	22.2	389. 9	350.89	6 422.07
Estimate export	99.923	0	328.259	54.00	0	124.053	5.425	611.660
Non-food usage (x 1 000 t)	6.700	0	503.990	6.86	0	257.130	0	774.680
Estimate import of edible fish (x 1 000 t)	0.248	0	0.564	0	0	0	46.591	47.403
Total production (x 1 000 t)	1 075.248	0.05	5 474.813	570.68	22.20	771.080	402.906	7 803.81
Per caput availability/supply	6.5	0.024	4.4	123.0	0.8	3.6	16.19	
Per caput demand/supply	1.4	0.176	0.4	3.6	0.0	-1.4	-0.01	

THE SUSTAINABLE CONTRIBUTION OF FISHERIES TO FOOD SECURITY IN THE OCEANIA

by

Gillett, Preston and Associates Inc.

1 Introduction

1.1 Background

The Food and Agriculture Organization of the United Nations is undertaking a review of food security issues and challenges in the Asia and Pacific Region. The review aims to identify and analyse the most critical common issues and constraints affecting food security in the region, and draw up recommendations to aid in the establishment of appropriate regional and national policy frameworks.

The present document has been prepared as part of the first stage of this study. It aims to analyse the contribution of the fisheries sector to food security in the Oceania (Pacific Islands, Australia and New Zealand) subregion of the Asia-Pacific region. The report addresses food security issues in terms of both food production and the generation of income, and also recommends possible mechanisms and policies to strengthen the ways in which the contribution of fisheries to these areas might be maintained or increased.

It is anticipated that the present contribution will be combined with both similar studies of the other subregions of Asia and the Pacific and with studies of other food-producing sectors. The output is expected to be a coherent food security strategy for the region.

1.2 The Subregion

For the purposes of the present study Oceania is considered to be a distinct geographical subregion of the broader Asia-Pacific region. It includes the developed nations of Australia and New Zealand as well as the 22 smaller island states of the central and western Pacific. Table 1 indicates the political status of its constituent countries.

Table 1. Names and political affiliations of states of Oceania

Country or state	Political status/affiliation
American Samoa	US territory
Australia	Independent developed country
Cook Islands	New Zealand-affiliated developing country
Federated States of Micronesia (FSM)	US-affiliated developing country
Fiji	Independent developing country
French Polynesia	French territory
Guam	US territory
Kiribati	Independent developing country
Marshall Islands	US-affiliated developing country
Nauru	Independent developing country
New Caledonia	French territory
New Zealand	Independent developed country
Niue	New Zealand-affiliated developing country
Northern Mariana Islands	US territory
Palau	US-affiliated developing country
Papua New Guinea (PNG)	Independent developing country
Pitcairn Islands	UK territory
Solomon Islands	Independent developing country
Tokelau	New Zealand territory
Tonga	Independent developing country
Tuvalu	Independent developing country
Vanuatu	Independent developing country
Wallis and Futuna	French territory
Western Samoa	Independent developing country

Ethnically, the subregion is usually broken into four major components: **Micronesia**, comprising the northwestern countries of Palau, Federated States of Micronesia (FSM), Guam, Northern Mariana Islands, Marshall Islands and Kiribati; **Polynesia**, which includes the southeastern countries of Tuvalu, Tokelau, American Samoa and Western Samoa, Niue, Cook Islands, French Polynesia and New Zealand; and **Melanesia**, which comprises Papua New Guinea, Solomon Islands, Vanuatu, New Caledonia and Fiji (which is a transition point between Melanesia and Polynesia). **Australia** is the fourth component of the subregion.

Historically, extensive migration has taken place throughout the region, and this continues today in the form of labour movement and economic migration. All but one of the countries of the subregion (Tonga) were colonised by European nations during the 18th century. Some have since become independent states, while others continue to be formally associated in some way with the original colonising nations, or with other nations.

The subregion's ethnic origins, combined with modern-day political affiliations, and the various indigenous and introduced languages now shared among some groups of states, influence the composition of the various political and economic groupings that exist in the subregion. Principal among these is the South Pacific Forum, a political alliance which brings together the independent countries and self-determining states (the latter being the US-and NZ-affiliated developing countries in Table 1) of the subregion, including Australia and New Zealand. Outside the Forum, the various US, French and NZ-affiliated states and territories also have formal political and economic links with their respective 'mother' countries.

In regard to the role of fisheries in food security, Australia and New Zealand are quite distinct from the other countries of the subregion, and from each other. Papua New Guinea is also somewhat distinct in that it has more extensive land resources and a greater population than the rest of the developing Pacific combined. Major differences exist within the subregion with respect to degree of development, affluence, ethnic composition, resource endowment, climate, oceanography, the quality of fisheries and economic information available, and the role that fisheries play in the national economies. In some cases, disparities between the countries referred to above and the rest of the subregion are great, and as a result, combining data or making generalisations on a subregional basis may be misleading. This is particularly true in regard to statistics or projections that are made on a per-caput basis, since trends or characteristics prevalent in the larger countries tend to mask important differences in the smaller ones.

In order to compensate for this problem, some effort has been made in the present paper to disaggregate information wherever there appear to be significant differences between countries or areas of the subregion. In some sections of the document information on individual countries, particularly Australia and New Zealand, is highlighted to draw attention to differences between the situations in these countries and the small island states that make up the rest of the subregion.

1.3 Physical Features

General

The Oceania subregion contains 8.5 million km^2 of land, but its exclusive economic zones (EEZs) cover an estimated ocean area of 41.7 million km^2, equivalent to about 40 percent of the world EEZ area. EEZs collectively cover less than 10 percent of the ocean's surface but contain most of the world's prime fishing grounds (Weber, 1994). The areas of land and sea of each country of the subregion are shown in Table 2, along with estimated 1995 population data.

Table 2: Land, EEZ and fisheries management areas in the Oceania

subregion (in km^2)

State/territory	Land area (km^2)	EEZ area[1] (km^2)	Estimated population (1995)[2]
Pacific Islands area			
American Samoa	197	390 000	57 000
Cook Islands	180	1 830 000	18 100
Federated States of Micronesia	702	2 978 000	125 100
Fiji	18 376	1 290 000	768 700
French Polynesia	3 521	5 030 000	221 300
Guam	549	218 000	150 000
Kiribati	726	3 550 000	80 400
Marshall Islands	720	2 131 000	56 500
Nauru	21	320 000	10 400
New Caledonia	19 103	1 740 000	186 800
Niue	258	390 000	2 200
Northern Marianas Islands	475	1 823 000	71 800
Palau	500	629 000	16 900
Papua New Guinea (PNG)	461 690	3 120 000	4 173 200
Pitcairn Islands	5	800 000	100
Solomon Islands	29 785	1 340 000	375 000
Tokelau	12	290 000	1 600
Tonga	696	700 000	98 900
Tuvalu	26	900 000	9 900
Vanuatu	12 189	680 000	168 300
Wallis and Futuna	124	300 000	14 700
Western Samoa	2 934	120 000	163 900
Sub-total	**552 789**	**30 569 000**	**6 770 800**
Australia/ New Zealand area			
Australia	7 682 300	8 900 000	17 100 000
New Zealand	270 534	2 222 400	3 400 000
Sub-total	**7 952 834**	**11 122 400**	**20 500 000**
Total	**8 505 623**	**41 691 400**	**27 270 800**

The disposition of land in Oceania varies greatly from country to country, with over 90 percent being situated in Australia, and over 83 percent of the Pacific Islands area's land being situated in Papua New Guinea. Population data shows a similar distribution, with 63 percent of the region's population resident in Australia, and 62 percent of the population of the Pacific Islands area resident in Papua New Guinea.

The distribution of EEZ and ocean area follows a somewhat different pattern, however. Although both Australia and New Zealand have very large EEZs, so also do many

1 Where states have not declared EEZs, or where the Fisheries Management Zone does not correspond exactly to the EEZ, data has been modified or estimated, as appropriate.

2 Australia/ New Zealand population data is from 1990.

Pacific Island countries, despite their tiny land areas and populations. In most Pacific Island countries the area of maritime jurisdiction is thousands of times greater than the available land area. Given their isolation and the limited alternative resources available, the fishery resources contained in these vast ocean areas represent not only a means of achieving food security but also the principal hope for economic development and self-reliance in many of these nations.

Pacific Islands area

The 22 countries of the Pacific Island area contain about 200 high islands and 2,500 low islands and atolls. Apart from the Pitcairn group and the southern part of French Polynesia, in the east of the area, all the islands of the area lie in the tropical zone.

In general, the islands increase in size from east to west, with Papua New Guinea at the western-most edge comprising most of the area's land area. In general, the islands rise steeply from the deep ocean floor and have very little underwater shelf area. Coral reefs characteristically surround the islands, either close to the shore (fringing reef) or further offshore (barrier reef), in which case a coastal lagoon is enclosed. The area includes many atolls, which are the remnant barrier reefs of islands that have subsided. Some of the more recent islands in the area lack coral reefs. Mangrove forests often border the inshore waters, especially of the larger islands, and provide habitat for the juveniles of many important food fish.

Because of the relatively small size of most islands, major bodies of fresh water are not widespread in the subregion, with substantial rivers and lakes only being found in some of the larger islands of Melanesia. The small land areas of most islands create limited freshwater and nutrient runoff, resulting in low enrichment of the nearby sea. The ocean waters of the area are usually clear and low in productivity. Upwellings occur in the boundaries between currents and in other localised areas, and have important implications for the harvesting of marine resources.

Annual rainfall generally varies between 2,000 and 3,500 mm, although considerable variation is experienced across the area. Rain is frequently seasonal, but not consistently so across the area: Palau in the west has two periods of heavy rainfall (July/August and December/January) while most of the rain in French Polynesia in the east occurs in November and March. Considerable inter-annual variation in rainfall also occurs and droughts are common, especially on the smaller islands. The windward sides of the larger islands are characteristically much wetter than their leeward sides due to the existence of rain shadows.

In general the larger islands have more fertile soil, resulting in the greater availability of food plants. Conversely, on the small islands, especially the atolls, the poor soil results in limited plant food production. As an extreme example, in Tokelau there were only two species of edible land plants at the time of first European contact. The amount of arable land per person in the Pacific Islands area is relatively small. Kofe (1990) gives estimates of this statistic in Fiji (2.1 ha per person), Solomon Islands (1.4), Tonga (1.8), Vanuatu (1.4), and Western Samoa (3.5).

There are differences in the wind patterns of the area. Those islands in the west are more strongly affected by the Asian land mass (seasonal reversals of the wind pattern), while in the east the southeasterly trade winds dominate for most of the year. Equatorial winds tend to be lighter and more variable, while those of the higher latitudes are stronger and more constant.

Tropical (cyclonic or, in the northern hemisphere, anticyclonic) storms represent the most prevalent natural disaster of the Pacific Islands area, and occur in all but a few of the equatorial countries (notably Kiribati). On average, the northwestern portion of the area (FSM, Palau, Guam) experiences about four times the number of destructive tropical storms as the areas south of the equator. Tropical storms tend to occur at the time of the year when oceanic warmth is at a maximum.

The thermocline, or horizontal layer in the water column within which there is a rapid temperature change from the warm surface to the cool underlying water, tends to be relatively deep in the Pacific Islands area. This has important implications for fishing as a shallow thermocline tends to restrict the vertical movement of tuna schools, making them more vulnerable to capture.

The periodic oceanographic phenomenon known as El Nino can produce major climatic aberrations in the Pacific Islands. At roughly three to seven-year intervals a warm south-flowing current off the west coast of South America changes course and alters the patterns of ocean water temperature across the Pacific Ocean. This can result in major changes in rainfall patterns and other aspects of the weather, including the frequency, intensity and distribution of tropical storms. Another important effect, the raising of the thermocline in the western Pacific, may shift the pattern of distribution of surface tuna schools and result in their becoming more vulnerable to purse seine fishing gear.

Biodiversity tends to be at a maximum in the equatorial region in the west of the Pacific Islands area, and decreases markedly towards the east. For example, the number of naturally occurring species of animals and plants is much greater in the Solomon Islands than in Tahiti. This is also true of the marine environment, where fish and invertebrate species, including corals, are far more numerous in the west of the subregion than in the east. Some commercially valuable fishery species, such as trochus and green snail, have a natural range which is restricted to the western Pacific, and this has resulted in repeated introductions of these species to more easterly islands in order to extend their natural ranges. So far there have been at least 70 recorded international introductions of trochus in the area.

Similarly, the freshwater fauna of the subregion, including even the larger islands in the west, is also characterised by having relatively few species, mainly due to the isolation of these freshwater systems. To increase fishery productivity, intentional introductions of freshwater fishes have been carried out throughout the region. Tilapia has received the most attention in this regard, and has been introduced to every Pacific Island country except Pitcairn. Papua New Guinea has also introduced a wide range of other freshwater species into its river and coastal swamp systems.

The prevalence of ciguatera fish poisoning appears to be greatest where fish species diversity is least; it is increasingly common in the northeast and east of the area and therefore more common in Micronesia and Polynesia. This poisoning, which produces a severe reaction in those that consume the affected fish, has a major implication for the use of fish as food in some of the Pacific Island areas and results in the non-acceptability of many coastal species of finfish.

Australia/New Zealand area

The two large continental land masses of Australia and New Zealand are bordered by the Indian Ocean to the west, the Timor, Arafura and Coral Seas to the north, the Pacific Ocean to the east, and the Southern Ocean to the south, as well as the Tasman Sea which separates Australia from New Zealand.

Despite their relative proximity to each other, the geography and climate of the two countries are quite different. Australia's large continental land mass spans tropical and sub-tropical zones, while New Zealand's much smaller land area, located further south, is entirely sub-tropical to cool-temperate.

Australia generally has a hot, dry climate, with average summer temperatures in excess of 32°C in some areas, and above 10°C throughout most of the country. Areas of substantial rainfall (more than 1,000 mm/year) are restricted to a narrow zone running around the coast, particularly in the eastern half of the country.

Whereas Australia's climate is essentially continental, New Zealand's is mostly maritime. Although subject to complex weather patterns, westerly winds prevail, with local modifications. Mean annual rainfall varies from less than 400 mm in inland basins to over 6,000 mm in the western mountains. Average summer temperatures rarely exceed 20°C, and snowfall is widespread in alpine areas during winter.

Australia is generally flat and low in relief. It's average altitude is 210 m and the highest summit, Mount Kosciusko, only 2,228 m in elevation, with some extensive inland areas as much as 11 m below sea level. Due to the general dryness of the climate much of Australia is desert, with 64 percent of the land area being devoid of surface water. Immense regions of the central and western parts of the country are drained only by seasonal creeks which run episodically and for short distances. Many areas therefore have sparse natural vegetation. Areas receiving higher levels of rainfall that have not been converted to agriculture still have extensive eucalypt forests or, in the north, tropical rain forests.

New Zealand is more rugged, with hills and mountains occupying three quarters of the land. Although there are no major waterways, many small rivers flow from the mountains, usually discharging towards the east, and much of the plains and lowlands is composed of alluvium washed down from the uplands. A wide range of climate, rocks, slope and vegetation have contributed to a diverse range of New Zealand soils, some of which are naturally quite fertile. The native vegetation includes conifer and broadleaf forests, fernland, scrub, tussock, and sub-alpine and alpine plants.

The distribution of Australia's human population essentially follows the same pattern as that of rainfall, with most of the populace concentrated on the east and southeast coasts. Inland parts of the country are sparsely populated, frequently with less than one inhabitant per km^2 New Zealand's population distribution is less constrained by climate and agricultural potential and is more evenly dispersed, although densities are higher in the North Island. As in Australia, many areas of the country have a population density of less than one person per km^2.

Because of its long geographical isolation from other countries, the great length of its coastline (over 36,000 km.) and the wide range of habitat types represented, one of the world's most diverse marine faunas has evolved in Australian waters. This includes more than 3,600 species of fish in 303 families, and tens of thousands of species of aquatic molluscs. The Decapoda, which is the most important crustacean order for commercial fisheries, is represented by more than 2,000 species. However, whereas Australian waters have representatives of most marine animal families, by world standards they have few freshwater animal species (Kailola et al, 1993).

New Zealand has a much more restricted marine fauna, with quite different characteristics. Although some 150 fish families are represented, many of these include only two or three members and the total number of marine fish species is estimated at around 700, less than 20 percent of Australia's count. New Zealand is a meeting point for families, genera or species that have their main centres of distribution elsewhere. Being sub-tropical to cool-temperate, the country is too far south to have an extensive tropical fauna, and too far north to support a true sub-polar fauna characterised by very large concentrations of a small number of species. Instead it has something of a mixture, with mostly small resources of numerous sub-tropical species in the north, moderate resources of many warm temperate species on the shelves around the main islands, and large resources of a few cool water species on the extensive plateaux to the southeast and east (Anon, 1981).

1.4 Socio-economic Conditions

General

The 27.3 million people in the 24 countries and territories of the Oceania subregion are at various stages of development. The two large developed countries of Australia and New Zealand, which together are home to 75 percent of the subregion's inhabitants, have relatively affluent populations and comparatively high standards of living. GNP per caput in 1990 was US$ 12,386, and in New Zealand US$ 9,500 (Coates, 1996b).

In the other 22 island states, socio-economic conditions vary widely. In general, those people living in territories of metropolitan countries (e.g. Guam [USA], New Caledonia and French Polynesia [France]) have better access to goods and services than inhabitants of the independent states or those in free association with metropolitan powers. Throughout the region, urban residents live a more consumerist lifestyle than those in small isolated islands, remote coastal areas, and the interior of large islands, who live a subsistence lifestyle and have a relatively low standard of living.

The socio-economic conditions of the independent Pacific Island countries have recently been summarised in the Pacific Human Development Report (UNDP 1994). With respect to relative development the report concludes that, based on the Human Development Index (HDI), the Pacific Island countries with the exception of Papua New Guinea (PNG), Solomon Islands, and Vanuatu would fall into the category of "medium human development". Globally, of the 173 countries listed in the report, 65 fall into this category. PNG, Solomon Islands, and Vanuatu are placed in the "low human development" category, amongst 55 countries in this category. Unlike Australia and New Zealand, none of the 13 Pacific Island countries covered by the report is amongst the 53 countries categorised as "high human development".

Information from SPC (1995), UNDP (1994), and Booth and Muthiah (1993) was used to compile the socio-economic data given in Table 3.

Table 3. Socio-economic data for Pacific Island countries

Country	Per-caput GDP (US$)	Aid per caput (US$, 1990)	Agriculture production (% of GDP)	Per-caput government expenditure (US$, 1992)	Population (1995 estimate)	Population density (1994)	Population growth rate (%)
American Samoa	5 328	1 693	-	-	57 000	273	3.7
Cook Islands	4 156	729	18	2 286	18 100	81	1.1
FSM	2 720	-	25	-	125 100	151	3.0
Fiji	2 172	51	18	580	768 700	43	2.0
French Polynesia	15 697		-	4 116	221 300	62	2.5
Guam	9 884	702	-	-	150 000	271	2.3
Kiribati	480	336	8	554	80 400	97	2.3
Marshall Islands	1 596	1 108	14	-	56 500	299	4.0
Nauru	17 934	22	-	-	10 400	505	2.9
New Caledonia	14 346		-	3 741	186 800	10	2.0
Niue	3 156	3 227	16	-	2 200	8	-2.4
N. Mariana Islands	10 352	-	-	3 002	71 800	120	9.5
Palau	3 330	725	-	-	16 900	34	2.2
PNG	1 505	102	28	384	3 951 500	9	2.3
Pitcairn Islands	-	-	-	-	100	-	-
Solomon Islands	757	139	27	-	375 000	13	3.4
Tokelau	382	3 000	-	-	1 600	150	-1.3
Tonga	1 452	311	34	287	98 900	132	0.5
Tuvalu	1 004	555	24	-	9 900	365	1.7
Vanuatu	1 342	269	20	403	168 300	13	2.8
Wallis and Futuna	-	75	-	-	14 700	56	1.3
Western Samoa	1 044	106	34	587	163 900	56	0.5

For the Pacific Islands area as a whole, economic growth during the past decade was almost nil (World Bank 1995). When this is combined with the population, the resulting outlook is gloomy. Between 1970 and 1990 the population of the Pacific Islands area grew by 2,222,000 people, which is equal to an annual growth rate of 2.3 percent, high relative to the world average of 1.8 percent (NCDS 1994). The resulting situation is arguably the Pacific Islands' greatest long-term problem. UNDP (1994) states that "the combination of low economic growth and high population growth poses a serious threat to the future performance in human development of many Pacific Island countries".

Population growth in Australia and New Zealand is slow relative to other regions of the world (1.4 percent p.a. between 1970 and 1990, with a slight decline in recent years) and is expected to decline to 1.1 percent between 1990 and 2010 (FAO, 1995c). Based on these expected growth rates, the combined population of these two countries is expected to rise from 20.5 million in 1990 to 25.4 million in 1995, of which over 80 percent are resident in Australia.

The economies of most Pacific Island countries are largely based on agriculture, which for statistical purposes often includes fishing. Fiji, FSM, Tonga, American and Western Samoa, Kiribati, Vanuatu, and the Solomon Islands all have agricultural sectors which employ more than 40 percent of the labour force (Booth and Muthiah, 1993). There is a tendency, however, for increasing diversification into the industry and services sectors, especially in the smaller countries.

Despite their differences, both Australia and New Zealand have developed as agricultural countries. Until recent times 75 percent of Australia's exports were agricultural and livestock products, despite the fact that only 7.5 percent of the country receives enough rainfall to be considered cultivable. Much livestock production in Australia is from herds of sheep and cattle which are raised extensively on dry inland areas where forage is sparsely scattered and where drought has frequently resulted in massive livestock mortality. Other main industries in Australia include mining, manufacturing, tourism and service industries.

New Zealand similarly places great reliance on land resources. Economic activity is based mainly on pastoral activities. Production of crops and horticulture is significant and improved grassland covers 34 percent of New Zealand's land area, with sheep farming being spread through both of the main islands. About 25 percent of the labour force is involved in manufacturing and tourist-based, forest-based and extractive industries such as those for coal, natural gas and ironsands are also important.

Tourism is the most important sector in some Pacific Island economies, while in others it is non-existent. SPC (1995) shows that the Northern Mariana Islands, Fiji, and French Polynesia received 536,263, 287,462, and 147,847 overseas visitors respectively in 1994. No data was available for Guam, an important tourist destination. The Cook Islands, Kiribati, the Marshall Islands, Niue, and Tuvalu recorded fewer than 10,000 visitors each.

A characteristic of Pacific Island countries is the large number of people who derive most of their basic needs from non-monetary subsistence production. The Forum Secretariat (1992) estimated the proportion of the subsistence economy in the Solomon Islands (80 percent of the population), Tuvalu (80 percent), Kiribati (80 percent), Western Samoa (60 percent) and FSM (at least 50 percent).

The term "subsistence affluence" is sometimes used to describe the relatively high quality of life on some of the Pacific Islands. The term refers to a condition of well-being outside the cash economy. Factors contributing to this situation include low population densities, fertile soil, a benevolent climate, effective traditional resource management, and social systems which provide a safety net for disadvantaged members of society. Recently however, high birth rates, unsustainable commercial practices in regard to natural resource use, increasing dependency on the cash economy, labour migration, and the deterioration of traditional authority and social systems, are having a negative impact on the quality of subsistence life on many islands. Nevertheless, the fact that widespread poverty has not emerged in response to the gradually deteriorating economic conditions in most Pacific Island countries gives some indication as to the effectiveness of the traditional social support systems.

Population movement from outer islands or rural areas into towns and cities is a prominent characteristic of most Pacific Island countries. According to the World Bank (1995), the average urbanisation rate across the region was 17 percent in 1970 but had increased to 24 percent in 1990. Crowding in the major cities of each independent island country was studied by Booth and Muthiah (1993) and the results are summarised in table 4.

Table 4. Urbanisation in selected Pacific Island countries

Country	Urban population as % of total	Urban annual growth rate (%)	City with highest density	Population density of city (people/km^2)
Cook Islands	59	2.1	Rarotonga	154
Palau	60	3.8	Koror	571
Niue	n/a	n/a	-	-
Tonga	23	1.6	Nuku'alofa	3 308
Tuvalu	43	4.8	Funafuti	1 376
Fiji	39	2.4	Suva	3 418
Marshall Islands	67	5.7	Majuro	1 510
PNG	15	3.8	Port Moresby	817
W. Samoa	21	-0.1	Apia	548
FSM	26	n/a	-	-
Kiribati	35	3.2	South Tarawa	1 610
Vanuatu	18	2.7	Port Vila	762
Solomon Islands	13	6.4	Honiara	1 394

The problem of low per-caput GDP becomes much more acute as populations become more urbanised. Urban migrants are usually unable to find employment and have no access to land or fishing rights, both of which are usually governed by strict traditional systems. Urban migration generates urban poverty which contrasts starkly with the "subsistence affluence" categorisation, and which is the source of many other social problems, including rising urban crime rates.

The high amount of development assistance received by the region, and remittance income, are two external factors which will tend to mitigate, at least in the short term, the appearance of poverty. Overall the region receives a relatively large US$ 204 of aid per caput (Fairbairn 1994) which is quite unevenly distributed among the countries (Table 3).

In many countries, particularly Tonga, Western Samoa, and the Cook Islands, cash remittances by relatives living overseas are substantial and may in fact exceed the value of all exports. Remittances from overseas employment are also very important to Kiribati and Tuvalu (a large number of whose citizens work as crew on merchant and fishing vessels and in the Nauru phosphate mining industry), as well as to Vanuatu (fishing vessels), and to a lesser extent Fiji and W. Samoa (various types of vessels).

Both aid and remittances face an uncertain future as the countries which provide aid and the countries which accept Pacific Island immigrants show signs of changing their policies. In addition, although increasing employment of Pacific Islanders aboard foreign fishing vessels is anticipated, the future prospects of employment in Nauru are poor due to the exhaustion of phosphate reserves.

Natural disasters are common in the Pacific Islands. In the period 1960 to 1989 the Cook Islands, Fiji, Solomon Islands, Tonga, Vanuatu, Western Samoa, and Papua New Guinea suffered 15, 34, 14, 15, 32, 10 and 2 tropical cyclones respectively (Chung 1991). Other types of common disasters are coastal floods, river floods, drought, earthquakes, tsunami, and volcanic eruptions. Table 5 gives information on the vulnerability of the independent Pacific Island countries to these events. Although there is no evidence that the incidence of disasters is increasing, for various reasons the amount of damage from each event and the subsequent disaster relief is growing.

Table 5. Vulnerability of Pacific Island countries to natural disasters (Chung, 1996)

Country	Cyclone	Coastal flood	River flood	Drought	Earth-quake	Land-slide	Tsunami	Volcanic eruption
Cook Islands	Med	Med	Med	High	Low	Low	Med	-
FSM	Med	High	Low	High	Low	Low	High	-
Fiji	High	High	High	Med	Med	Med	High	-
Kiribati	Low	High	-	High	Low	Low	Low	-
Marshall Islands	Med	Low	-	Med	Low	Low	Low	-
Niue	Med	Low	-	High	Med	Low	Low	-
Palau	Med	Med	-	Med	Low	Low	High	-
PNG	Low	High	High	Med	High	High	High	High
Solomon Islands	High	High	High	Low	High	High	High	High
Tokelau	Med	High	-	High	Low	Low	Low	-
Tonga	High	Med	Med	Med	High	Low	High	High
Tuvalu	Low	High	-	Med	Low	Low	-	-
Vanuatu	High	High	High	Low	High	High	High	High
Western Samoa	Med	High	High	Low	Med	High	High	Low

Natural disasters in Australia and New Zealand are somewhat less frequent and, due to the larger size of these two countries, have less national significance or impact on food security. The main threat to food production is drought in Australia, which may cause severe disruption to agriculture production. The northern states of Australia are also prone to cyclones which have in the past caused destruction of fishing fleets and shore-based infrastructure. However, natural disasters have a far less significant impact on the national economies of these two countries than they do in Pacific Island countries.

Fishing and fish farming communities

The socio-economic conditions of fishing communities depend largely on the character of the fishing with which they are involved. One means of examining the situation is to categorise the fishing by scale. Although there is some uncertainty and inconsistency in the use of the terms, three broad categories are generally recognised in the region:

- Subsistence fishing, frequently equivalent to traditional fishing
- Artisanal, or small-scale commercial fishing
- Industrial, or large-scale commercial fishing

It should be noted, however, that the distinction between the categories is increasingly blurred; fishing in which none of the catch is ever sold is becoming uncommon. The difference between subsistence fishing and recreational fishing is often not readily identifiable. Similarly, the recent rise in the use of relatively small vessels for longlining for tuna may represent an intermediate category between small- and large-scale commercial fishing.

Subsistence fishing communities

Virtually every coastal village in the Pacific Islands is involved with subsistence fishing activities. Especially on the smaller islands, the socio-economic conditions of subsistence fishing communities are equivalent to the conditions found in most rural villages. Conditions relevant to a study of food security are characterised by:

- great differences between the countries of the region;
- transportation difficulties between villages and locations of marketing opportunities;
- demand for social services (health, education, communication) resulting in the presence in villages of individuals whose primary source of income is from formal employment, resulting in the beginnings of a local cash economy;
- loss of individuals to urban centers for educational and employment purposes;
- the presence of traditional resource management together with factors reducing its effectiveness;
- the large degree of importance attached to religious activities, social functions, and recreational events;
- traditional social safety nets reducing the presence of absolute poverty;
- affinity of those who have departed to return someday to the island and to remit income;
- social controls on the activities of individuals resulting in behaviour different from that sometimes found in urban areas;
- despite the local food potential, a large degree of dependence on imported food.

The fishing activities of the Pacific Islands subsistence communities have been the subject of numerous studies, many of which are listed in Gillett *et al*. (1993). General characteristics are: specialised knowledge often passed down through generations, labour intensive operations sometimes involving the entire community, sharing of the catch amongst the community, the use of conservation mechanisms which often involve restricted entry into the fishery, social restrictions/prohibitions, and specialisation of activity by gender.

This latter topic deserves special attention. Typically women are involved in inshore fishing activities, such as reef gleaning and invertebrate collection, and the preparation of food from the products of fishing activities. Men are usually involved in the more strenuous work of fishing further offshore for large species of fish, and in diving activities. There are, however, important exceptions to this generalisation. Several observers of the Pacific Island subsistence fisheries situation estimate that fishing activity by women actually results in a greater amount of family food than that which is produced by men.

Although there have been several development projects attempting to commercialise aspects of fishing in subsistence communities, they have usually met with limited success. On the basis of studying the fish marketing situation in many Pacific Island countries Carleton (1983) concluded: "the basic structure of the subsistence sector is not conducive to the regular supply of fish to urban communities in sufficient quantities to satisfy demand".

Small-scale commercial fishing communities

Communities in which small-scale commercial fishing is a dominant activity are not typical of the Pacific Islands area. Although found in some locations (e.g. South Tarawa in Kiribati), the more normal situation is for a small segment of an urban or semi-urban area population to supply fish to local markets in towns and cities, and some for export. Examples of this are in Papeete in French Polynesia (tuna), Tongatapu in Tonga (snapper), Pohnpei in FSM (tuna), Suva in Fiji (inshore reef fish), Apia in Western Samoa (snapper, tuna), and Rarotonga in the Cook Islands (flying fish).

These commercial operators can be very small-scale (e.g. women in many countries who glean reefs for a few hours and then sell the majority of what they have obtained) or much larger (e.g., Tonga bottom-fish fishermen who are out for week-long trips). In general, the larger the scale, the more likely that the fishers are employees of non-fishermen who own the vessels. Most of the typically small vessels fishing for flying fish in the Cook Islands are operated by their owner, some of the catamarans fishing in Western Samoa are owned by non-fishing businessmen, while most of the active snapper boats in Tonga are not owned by the people that crew them.

Although there have been few economic studies on small-scale commercial fishermen in the Pacific Islands, it appears as though these fishermen in general are not greatly different in socio-economic status from the general community. Their main difficulties in business are typical of other small businesses in the Pacific: insufficient planning, social obligations frequently overriding business concerns, inadequate savings, and poor record keeping. Although Pacific Island governments have dedicated substantial resources to economic work on the industrial fisheries, there are currently no regional efforts to study the economics of small-scale fisheries in the region.

Industrial fishing communities

In several Pacific Island countries there is industrial fishing and communities are supported by these operations, either through the fishing itself or the subsequent processing of the catch. About half of the countries have either bases or transshipment points for industrial tuna fishing vessels which are mainly foreign-owned. Three of the countries have tuna canneries.

The economic activity generated by industrial fishing can be substantial. For example, in 1995 Fiji's relatively small tuna cannery exported 920,000 cartons of canned tuna worth about US$ 25 million (Anon 1996c). On the other hand, these industrial operations can have negative impacts. Several studies including Doumenge (1966) point out that social problems, increased incidence of communicable diseases, increased urbanisation, and pollution are unwanted side-effects.

The large tuna canneries in American Samoa employ nearly 5,000 workers (Gillett 1994), which is quite substantial considering that the entire population of American Samoa is only about 57,000 people. This staff, however, is predominantly from Western Samoa and to a lesser extent, Tonga. The cannery in Fiji is located away from the urban area, providing much formal employment in an area which otherwise would have few jobs. Similarly, the cannery facilities in the Solomon Islands are situated away from the major urban area. Tuna canneries therefore appear to exert a large influence on the socio-economic situation of the countries in which they are located.

In all the tuna canneries of the region, most of the workers are women. FFA (1995) states: “The region’s canneries bring cash incomes to women who would otherwise not have had the opportunity to enter the money economy, and therefore they have had a favourable, if fairly small, effect on the gender distribution of both employment and income.” An alternative view on the employment of women in the Fiji cannery has been put forward by Alexander (1995): “Women leave home early in the morning and put in long, tiring days. They have less time and more cash and so tend to buy processed fish rather than catching and processing it themselves. This not only makes women dependent on the market and the fishing industry for a product for which they could presumably be self-sufficient, but will in the long run have deleterious effects on the health of those concerned.”

<u>Fish farming communities</u>

Unlike in Southeast Asia, there is no strong heritage of fish farming in the Pacific Islands. Fish farming communities do not exist in the region, with the possible exception of the outer islands of French Polynesia and the northern Cook Islands where pearl oysters (a non-food item) are cultured. Those communities tend to be economically dominated by aquaculture and the residents are relatively affluent.

2. Fisheries and Food Security

2.1 Concepts

Food security means that food is available at all times, that all persons have the means to access it, that it is nutritionally adequate in terms of quantity, quality and variety, and that it is acceptable within a given culture. When all these conditions are in place a population can be considered “food secure”. It is not enough for a nation as a whole to be regarded as food secure whilst certain groups within it are chronically insecure.

To achieve food security, the development of a nation or state must be founded on the principles of economic viability, equity, broad participation and sustainable use of natural resources. Food security relies on the production of adequate quantities and types of food, equitable access to food, stability of food supplies and environmental action to preserve the resources from which food is derived.

The two components of the subregion have different perspectives on food security.

- In the Pacific Islands the definition has been modified to some degree to reflect the concern with household as opposed to national food security: "household food security is defined as a situation in which all individuals and households possess the resources to assure access to enough nutritious food at all times, either through self-production or purchase, for an active and healthy life (SPC undated).

- Australia and New Zealand are developed, affluent major agricultural and fisheries producer nations and exporters. As such their perspectives on food security are somewhat different than those of the Pacific Island countries, although not inconsistent with them. The attitude of both governments is that food security should not necessarily be equated with food self-sufficiency. There should not be a simplistic approach to the problem which concentrates only on each country increasing its food production without regard to its competitive advantage. Since the world already produces enough food to meet its requirements, they consider that the main problem is one of access, and its solution requires more efficient markets and distribution. Both countries are vocal in their support of international trade reform in agriculture and fishery products, and the elimination of barriers to free international trade, as a major factor in improving food security world-wide (Falloon, 1996: Brownhill, 1996).

Food security issues in the Asia-Pacific Region are often caused by resource constraints, poverty and unfavourable terms of trade for food commodities. The basic causes of under-nutrition and household food insecurity include low production and productivity from primary resources (aggravated by high year-to-year variability), scarcity of employment opportunities, and inadequate and uncertain incomes in both rural and urban areas. These causes are closely inter-related: low productivity from primary resources means insufficient food and income for subsistence use, and inadequate surplus of food to meet the needs of rapidly growing urban populations, both of which may contribute to chronic and deepening food insecurity.

2.2 Issues

With respect to general food security in the Pacific Islands area, the major issues are:

- There is a high dependence on imported food.
- The region is subject to a high incidence of natural disasters which often have large negative effects on the supply of locally-produced food.
- Cash remittance by Pacific Islanders residing overseas forms an important source of national income and hence ability to purchase food.
- Chronic food security problems are most common in urban areas while acute food security problems are greatest in isolated locations.
- Starvation is virtually unknown in the region, but malnutrition occurs and diseases related to poor nutrition are widespread, usually from lack of a balanced diet.

Anon (1996d) gives the NGO perspective on the food security situation in the Pacific Islands: "The food security situation in the South Pacific Island countries is characterised by dependence on overseas food supplies and food aid, especially in times of natural disasters. Simultaneously, local production of food crops has declined due to the changing focus of our agriculture systems as dictated by respective government policies. Any increases in local food crop production are usually associated with the export market, reflecting the policy of export led growth."

It has been stated that the situation in the Pacific Islands with respect to food security is remarkably different from that in Asia, a geographic area that the Pacific Islands are sometimes linked to for administrative purposes. In *Food security situation and issues in Asia and the Pacific* (FAO, 1996b) it is stated that "food security for the vast majority of people in the region largely depends on the performance of the cereals sector". This is not true of the Pacific Islands area, where root crops have a much greater importance than cereals. Another major difference is the relatively large importance of fisheries for food security in the Pacific Islands.

In contrast, both Australia and New Zealand are relatively affluent countries which produce large food surpluses and which are well-supplied by a wide range of domestically-produced and imported agricultural products. Per-caput protein consumption is very high and malnutrition or other problems caused by inadequate supply of food, or of certain types of food, are essentially non-existent. Where dietary health problems occur they tend to be related to incorrectly balanced diets or over-consumption of certain types of foodstuffs and associated obesity, diabetes, coronary problems, etc.

Seafood, while currently increasing in importance in the diet of Australians and New Zealanders, still comprises a relatively small part of overall protein supply (7.2 percent in 1992). Cheaper forms of animal protein (such as poultry) are readily available in large quantities in the event that resource-related or economic circumstances result in a reduction in seafood supply.

3 The Fisheries Sector

3.1 Overall Situation and Relationship to Other Sectors

General

Fisheries play an important role in many aspects of food security in the Pacific Islands area. The high per-caput consumption of fish (on some islands as high as 250 kg per year) attests to the importance of fish as a source of animal protein. In many cases the most likely alternative is imported food, which would further increase the already large foreign food dependence and hence vulnerability to factors beyond the control of countries in the region. Fisheries contribute in three ways to the food security of the area:

- Fisheries themselves contribute a substantial amount of food to the people of the South Pacific. For example, a recent study of the dietary habits of three villages in Fiji (Rawlinson *et al*. undated) showed that fresh fish was eaten at 58 percent of the meals.

- Fisheries contributes to employment, thereby allowing the purchase of food. It has been estimated (FAO, 1996e) that fisheries provide income to almost 100,000 Pacific Islanders.

- The licensing of foreign fishing vessels to fish in the waters of Pacific Island countries forms an important source of revenue for these countries. This revenue has implications for the purchasing of food as well as a range of programmes which could enhance the food security situation. The World Bank (1995) estimates that in 1993 total access fees for the Pacific Islands region were about US$ 56 million.

It has been estimated (McCoy 1991) that there are about 25,000 non-motorised and 17,000 motorised fishing vessels operating in the Pacific Islands. Australia has about 10,000 fishing vessels, which is about the same number as in 1965. However the fishing power of the Australian fleet has grown significantly during that period due to an increase in average vessel size: 14 percent of the Australian fishing fleet now comprises vessels over 15m long, as opposed to only 4 percent in 1965 (Kailola *et al.* 1993). The overall size of the New Zealand domestic fishing fleet increased by 16 percent to 1,766 vessels between 1994 and 1995, after decreasing slightly the previous year. Much of the increase occurred in the under 12-metre class, which numbered 1,185 vessels in 1995, but the number of vessels over 30 m also increased significantly (Peacey, 1996). In contrast, the number of foreign vessels operating under license, charter or joint venture agreements is progressively declining as New Zealand follows its process of fisher domestication.

Commercial fishing is the principal target of almost all government fishery development and management activities in the region, and is the area for which statistics and other forms of factual information exist. Because it makes a direct, visible contribution to the national economy, especially where fishery products are being exported, the development of commercial fisheries is a priority for all Pacific Island countries, and in particular those atoll countries which have few alternative resources.

In the countries of the Pacific Islands area however, subsistence fishery harvesting generally exceeds commercial harvesting of inshore resources by a factor of four or more. Subsistence fishing provides a major source of protein for residents of coastal rural areas and outer islands, and contributes significantly to household food security and dietary health, especially for children, whose protein requirements are high.

Much of the subsistence catch is consumed at home, while some is sold, traded, bartered or forms the subject of customary exchange. In Papua New Guinea, GPNG (1995) estimates that the traded proportion is only about 15 percent of the total, but anecdotal information suggests that the true proportion could be higher, and increasing. Subsistence fisheries are undergoing a gradual transformation to commercial or semi-commercial activity and this sometimes blurs the distinction between what is truly commercial and what should be classed as subsistence.

Increasing commercialisation is not necessarily positive from the viewpoint of food security. Observations in the Pacific so far suggest that much imported food is nutritionally inferior to a diet based on subsistence products, being low in complex carbohydrates and high in salt, sugar and fat. Many lifestyle-related diseases and nutritional disorders, including obesity, diabetes, vitamin A deficiency and, among children, low birth weights, slow growth rates, and anaemia, are directly attributed to a growing dependence on imported, low-quality foodstuffs that, because of their low cost, are progressively replacing local products. The development of commercial fisheries at the expense of subsistence fishing may therefore be detrimental to food security, at least at the household level.

In most countries of the Pacific Islands area a large proportion of the subsistence fishery harvest comprises invertebrates and is gathered almost entirely by women. Fisheries development policies tend not to recognise or acknowledge the importance of subsistence fisheries in general, of inshore invertebrate harvests, or of the role of women in these fisheries. Most fishery development and management attention throughout the region continues to focus on the commercial components of the catch.

Recreational fishing is an important, and perhaps under-estimated source of fish supply in Australia and New Zealand. Recent unofficial estimates are that Australian recreational fishers caught 54,000 mt of fish in 1994, equivalent to about a third of the commercial catch (Roberts, 1995). Recreational fishing and collection of shellfish on the seashore is also widespread in New Zealand. In many cases this might be more correctly classified as subsistence fishing, since most of the catch is consumed at home (or illegally sold).

Pacific Islands area

It is quite difficult to gauge the relative importance of the fisheries sector in the countries of the Pacific Islands. This is sometimes due to the fact that the fisheries sector is combined for administrative and statistical purposes with agriculture. The difficulty of obtaining reliable statistics from small-scale fisheries, especially in the remote locations where fisheries are usually most important, also makes the estimation of the size of the fisheries sector difficult to estimate.

Nevertheless some estimates have been made. UNDP (1996), using a variety of sources, produced the following estimates:

Table 6. Employment, GDP, and export earnings from fisheries (UNDP, 1996)

Country	Fisheries employment (% of total)	Size of fisheries sector (% of GDP)	Export earnings (% of total)
Cook Islands	6.2	17.8	n/a
Fiji	2.4*	1.6	7.1
Kiribati	23.5*	0.6	31.5
Marshall Islands	n/a	n/a	n/a
PNG	39.6*	26.0	0.6
Solomon Islands	5.5	6.4	48.0
Tonga	49.1*	32.2	8.1
Tuvalu	5.3	4.9	0.0
Vanuatu	n/a	n/a	n/a
Western Samoa	n/a	29.8*	n/a

* Includes agriculture and fishing

The World Bank has made alternative estimates of the size of the fisheries sector in four Pacific Island countries (unpublished information, based on IMF data). These are: Fiji (fisheries is estimated to be 1.2 percent of GDP at factor cost), Marshall Islands (8.2 percent), Solomon Islands (11.0 percent), and Western Samoa (11.0 percent).

There are some anomalies in the above information, such as the extremely low proportion of GDP attributable to fishing in Kiribati, and the extremely high proportion in PNG. These underline the difficulty in accurately determining the importance of the fisheries sector in many Pacific Island countries. It can, however, be seen there is a great difference between countries and that overall, fisheries is an important sector for the Pacific Islands.

In the above data, the contribution of subsistence fisheries may not be fully appreciated. For example, ANZDEC (1995) puts an assigned value of 26 million Kina (MK) on PNG's marine subsistence fishery, based on a nominal value of K 1.00/kg for the 26,000 mt estimated to be taken annually. Assigning the same nominal value for the estimated 13,500 mt of freshwater fishery products harvested by small-scale fishermen results in a total estimated value for subsistence fisheries of some 39.5 MK, more than twice as much as the 16.4 MK currently being generated from domestic commercial fishing. In fact a fairer estimate would place the value of the subsistence fishery at K 2.00-K 2.50/kg, giving it a gross worth of some 80-100 MK, or about 5-6 times the production value of the local commercial fishery.

Australia/New Zealand area

In terms of fishery production, Australia and New Zealand have several features in common. Fisheries in both countries are highly export-oriented, and promotion of increased export of fishery products is a feature of national fisheries policy in each case. Marine fishery production in both countries is likely to be constrained in future by resource limitations (since most fishery stocks are now thought to be at or close to full utilisation), and by competition for access to wild resources. Freshwater fisheries are insignificant, and aquaculture is in its infancy, but is expanding in both nations. Human populations are small relative to the available land area, and are affluent by world standards, with an average per-caput income of US$ 11,816 in 1990 (FAO, 1995c). Protein consumption is high (116.8 kg/caput/year), with fish comprising a relatively small, but steadily increasing, proportion of total protein intake.

Despite these similarities, there are also significant differences between the fisheries and fishery resources of the two countries. Australia's fisheries are characterised by their multi-species nature: commercial fish markets commonly handle at least 200 species of fish, and the commercial and recreational catch includes more than 60 species of crustacean, 30 species of mollusc and a handful of echinoderms. About 100 species of fish, 26 species of crustacean, 18 species of mollusc and one echinoderm made up 85 percent of the total commercial catch for 1990. Most Australian species may be taken by several types of fishing gear, and are thus caught (and managed) in association with other species. Fisheries such as the rock lobster, scallop, jack mackerel and southern bluefin fisheries, in which the catch is dominated by a single species, are the exception rather than the rule.

New Zealand, on the other hand, has fisheries that are often more typical of temperate-water zones, where catches are greater in volume and are dominated by smaller numbers of species. In 1993 about 41 species of fish and some 13 species of mollusc and crustacean made up almost all of New Zealand's commercial catch (Parker, 1994). New

Zealand's waters are more productive than those of Australia, and despite the fact that New Zealand's EEZ is less than a quarter the size of Australia's, the 1992 marine catch of 677,836 mt from New Zealand's EEZ was well over twice the 229,551 mt caught in the Australian zone in the same year (FAO, 1994b).

Commercial fishing is Australia's fifth most important agricultural industry, after meat, wool, wheat and dairying. Over the past decade the gross value of Australian fisheries production has quadrupled to reach A$ 1.6 billion in 1993-1994 (Battaglene and Lancaster, 1995). The total value of production from commercial wild fisheries and aquaculture in Australia has exceeded A$ 1 billion each year since 1988. This high value, which is out of proportion to the quantity of landings, is generated partly because the commercial catch has a large component of highly-priced shellfish species such as abalone, scallops, penaeid prawns and rock lobsters. In 1991-1992 these species comprised 58 percent of the total production value (Kailola et al, 1993).

The production value of Australian fisheries was forecast to increase by a further 2 percent in 1995-1996, based on additional value-adding, increased targeting of high-value overseas markets, aquaculture development and stock enhancement (Battaglene and Lancaster, 1995). However more recent projections now predict a stabilisation or even a slight fall in both the gross value of and the export receipts from Australian fishery products (Battaglene, Standen and Smith, 1996).

In terms of landings, FAO statistics up to 1993 indicate that Australia's capture fishery production has stabilised, but again more recent data indicates that catches are actually falling. Roberts (1995) states that "according to the Bureau of Resource Sciences, Australia's commercial catch fell from 232,286 mt in 1992 to 226,219t in 1993, and 188,363t in 1994 despite improved fishing technology, and that trend looks set to continue". The New Zealand fishing industry produced over 645,000 mt in 1995 (fisheries and aquaculture production combined), an increase of about 10 percent over 1994. The industry is the country's fourth largest export earner (Tierney, 1995) and only about 10 percent of market receipts arise from domestic sales (Peacey, 1996). Despite the increased landings in 1995, however, the industry did not show a parallel growth in market returns, a fact which is attributed partly to the strengthening of the New Zealand dollar, and partly due to poor competitiveness with subsidised fishing industries in other countries.

In 1993, following a period in which industry growth exceeded 10 percent per annum for over a decade, the industry set itself the target of increasing the value of fishery product exports from NZ$ 1.2 billion to NZ$ 2 billion by the year 2000. This was to be achieved through a combination of increased value-added processing, better marketing (including increased targeting of high-value overseas markets), aquaculture, stock enhancement, improved management, and the development of new fishery activities (Parker, 1994). However, given the flat performance of the industry since that time, this goal has been reviewed. It is now considered that, based on the 1994-95 annual growth rate of 6 percent, exports of NZ$ 1.65 billion might be achievable by the year 2000 (Peacey, 1996).

3.2 Marine Capture Fisheries

Pacific Islands area

In terms of volume and value, the Pacific Islands area is dominated by the industrial tuna fisheries. About one million mt of tuna was caught in the Pacific Islands area in 1993 and again in 1994. Eighty percent was taken by the 180 purse seiners operating the region, with most of the remainder being caught by pole/line (7 percent) and longline gear (13 percent). The vast majority of the catch is harvested by vessels from Asia and the United States. The catch composition is skipjack (59 percent), yellowfin (32 percent), bigeye (5 percent), and albacore (4 percent). Although preliminary estimates indicate that the catch decreased by 6 percent in 1995 (Lawson, 1996), this does not appear to be indicative of over-fishing.

In June 1993, by region-wide agreement, all purse seine fleets were required to cease transshipment at sea, resulting in reduced catches. Large-scale research on the target species of tuna over the past 20 years does not suggest that a condition of overfishing is occurring. On the contrary, scientists from the South Pacific Commission believe that present yellowfin catches could probably be doubled and skipjack further increased. There is, however, concern in some island countries (e.g. Kiribati) that the large tuna catches of the industrial tuna vessels may adversely impact those of the small-scale troll fishermen.

Although dwarfed in volume by the offshore tuna fisheries, the coastal fisheries provide almost all the non-imported fish supplies to the region and hence have a crucial role in food security. Dalzell and Adams (1994) estimate that, of the 108,242 mt of fish supplied by the coastal fisheries, 76 percent is from the subsistence fisheries, with the remainder from medium and small-scale commercial operations. They indicate that the commercial catch is made up of reef and deep slope fish (43 percent of total weight), coastal pelagics (18 percent), trochus/green snail/pearl shell (9 percent), crustaceans (8 percent), beche-de-mer (7 percent), and estuarine fish (6 percent). Subsistence fisheries in the area generally involve a large variety of species. For example, Zann (1992) reports that in Western Samoa the subsistence fisheries make use of 500 species.

Australia/New Zealand area

Though they are diverse and occupy one of the world's largest fishing zones, Australia's marine fishery resources are not as abundant or productive as those found in many other parts of the world. This is thought to be because, on average, Australian waters are low in nutrients compared with other regions (Kailola et al, 1993).

In the past, projections of Australia's fisheries potential were optimistic. In 1970, a Food and Agriculture Organization report estimated that Australia's coastal and continental shelf waters could yield a catch of 2.3 million mt annually (Gulland, 1970). Twenty-six years later, however, total Australian capture fishery production has reached only about one tenth of this amount. In terms of total landed weight, Australia's fisheries catch is no longer expected to grow much beyond its present level, and may decrease, at least in the short term. Few areas of the Australian Fishing Zone are still to be explored and, while much remains to be learned about the full effects of fishing on at least half of Australia's fishery resources, only 9 commercially significant species are currently thought to be under-exploited or capable of supporting higher catches without affecting their productive potential. On the other hand, 9 species or groups are thought to be over-exploited, and 22 heavily or fully exploited (Kailola et al, 1993). FAO (1995a) notes that there is no potential for future catch increases in either the Eastern Indian Ocean (statistical area 57) or the Southwest Pacific (statistical area 81), which covers most of Australia's Fisheries Management Zone.

In New Zealand, marine capture fisheries have developed very quickly since the beginning of the 1970s, when total landings were only 143,500 mt (FAO 1995c). According to the Ministry of Agriculture and Fisheries (1993), most major fish stocks in the New Zealand EEZ are now fully developed. In addition, some major stocks of orange roughy, rock lobster and snapper are below their optimal size. There may be room for modest increases in catches as stocks are fished down or as they are rebuilt. Any large increases in catches from the EEZ will have to come from new stocks or developing fisheries for new commercial species. The probability of finding large, unexploited stocks of existing commercial species in areas that have been traditionally fished are considered slight.

In both countries, increases in capture fishery production may be possible through stock enhancement. Parker (1994) refers to the success of a New Zealand scallop stock enhancement programme based on spat collectors, while enhancement experiments for several species are under way in Australia. In addition, fishery development prospects in areas that have not been thoroughly explored, such as parts of the sub-Antarctic area, are unknown. These potentials have not been demonstrated so far, however, and for the time being most projections assume that fishery production from Australian and New Zealand marine capture fisheries has now peaked at levels of about 0.21 and 0.55 million mt respectively.

3.3 Inland Capture Fisheries

From the point of view of food production, inland fisheries are really only important in two countries of the subregion, Papua New Guinea and Fiji. In the rest of the subregion, including Australia and New Zealand, they do not constitute an important sector.

The PNG mainland has several substantial waterways, particularly those of the Sepik/Ramu and Fly/Purari river basins, as well as an extensive system of marshes believed to be one of the largest in the world (NSO, 1994). Inland subsistence fishery harvests in PNG are estimated at around 13,500 mt/year, equal to about half of the marine subsistence catch. Coates (1996a) estimates that PNG's inland waters have the biological potential (after restocking and resource enhancement) to yield at least ten times as much as they presently do, and possibly as much as 400,000 mt/yr. of freshwater fish and invertebrates. An FAO programme of identifying and introducing suitable freshwater species for fishery enhancement has been underway for some years in PNG's highlands provinces. DFMR (1993), however, states that, at present "with the exception of the migratory barramundi, fish resources in most inland waters are not adequate to support commercial fisheries".

In Fiji, a single species of freshwater swan mussel, which is gathered and sold exclusively by women, produces over 1,500 mt annually, and is one of the country's most important small-scale fisheries. Apart from this species, freshwater fishing is restricted mainly to the collection of small quantities of freshwater prawns.

Most other Pacific Island countries have minor subsistence fisheries based on freshwater prawns or fish, but the quantities taken are minuscule. Lack of important inland water bodies means that this sector will probably remain unimportant except for certain specific localities in most countries.

In Australia, inland catches have been stable at about 3,400 mt during recent years (FAO, 1995c). Their economic value is related principally to leisure activities, since recreational fishing is popular. Some infrastructure developments (dams and spillways), as well as pollution and habitat destruction, may have decreased the availability of freshwater fishery resources. In 1985 three species of freshwater fish having commercial value were placed on an Australian endangered species list (Michaelis, 1985).

In New Zealand, inland catches form a very small proportion of total capture fishery production (less than 0.03 percent). Furthermore, most of the species taken in New Zealand's inland fisheries are those which have a freshwater phase and a marine phase in their life cycles, including eels, salmon, and sea trout. Again, the principal interest is as a leisure activity, with recreational fishing being widespread. It is unlikely that inland fisheries will develop any further in Australia and New Zealand, considering the ease of access to the sea and the lack of important inland water resources in the two countries.

3.4 Aquaculture

Pacific Islands area

Aquaculture does not contribute significantly to food supply in the Pacific Islands area. The most successful operations are for pearl oysters, a non-food species. Prawn culture in Fiji and Tahiti produces about 20 mt and 75 mt respectively for local markets, while New Caledonia produces around 800 mt for local and export markets. Although tilapia culture has been attempted in most countries of the area since the 1950s, it has had mixed success. Tilapia provides substantial food in Papua New Guinea (a majority of the freshwater yield, but from a capture fishery, not aquaculture) and Fiji (over 100 mt recently from aquaculture) but is ignored or considered a pest in many other countries.

The inaccuracy of published FAO aquaculture statistics for the Pacific Islands[3] results in this information not being useable. For example, FAO (1996c) gives aquaculture production in Fiji as ranging from 656,300 mt to 204,000 mt in the period 1984 to 1994 (a thousand times greater than that reported for India) when in reality the Fiji production was about 200 mt.

Australia/New Zealand area

Aquaculture production in Australia and New Zealand, while still small by world standards, has increased more than threefold in less than a decade. The collective 1984 production of 19,400 mt (FAO, 1992) has grown to over 70,000 mt in 1992 (FAO 1995a).

In 1993 New Zealand's aquacultural production was 51,716 mt, of which New Zealand "Greenshell" mussel was by far the most important product (47,000 mt). Australia's

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3 More correctly, national aquaculture statistics as reported to FAO.

production was somewhat lower at about 18,260 mt in 1993, of which oysters were the most important component, comprising 9,711 mt.

Although unimportant in volume terms, a substantial proportion (about 44 percent in 1993) of the value of Australian aquaculture production (equivalent to A$ 315 million in 1994/95, according to Battaglene and Lancaster, 1995) comprises pearls, a non-food item. Disregarding this component, however, the general trend in both countries is for the production of high-value food species destined for export or for the upper segments of the domestic market.

Both Australia and New Zealand predict strong future growth in this sector and, given the constraints on the expansion of capture fisheries in the subregion, are actively promoting aquaculture development as the only realistic means to substantially increasing the volume of fishery production. Aquaculture is not only a means of increasing production but can also be used to improve returns from capture fisheries through coordinated marketing efforts and possible stock enhancement of some commercially caught species.

3.5 Distribution and Trade

General

One of the elements which makes a significant contribution to food security is trade. Because trade in fishery products does not distinguish between marine, inland or aquaculture production, distribution and trade are discussed collectively.

Table 7 indicates that 1993 exports from countries of the subregion were worth US$ 1,405 million, as opposed to imports of about US$ 503 million in the same year. Note that not all countries in the region are covered by the Table, in particular the US territories which are important exporters of fish.

FAO statistics indicate that, in dollar terms, the region is a net exporter of fishery products. This generalisation arises, however, because there are a handful of major exporters in the region, including Australia and New Zealand, followed by Solomon Islands, Fiji, Papua New Guinea and New Caledonia. Most of the small countries of the region import more fishery products than they export. Many import large quantities of canned fish (Pacific Island area average 10kg/person/year), and export almost no fishery products.

Since most exports from the region are high in value, exports are generally much less than imports when measured in terms of quantity rather than value. The main exception is New Zealand, whose exports include some low-value products (frozen “white fish”).

The international distribution figures are somewhat misleading because much importing and exporting of fishery products is actually internal to the region. New Zealand is Australia’s second largest supplier of fishery products (after Thailand) and also exports to other countries of the region, including large quantities to Fiji, New Caledonia and Papua New Guinea. Reef fish exports from Pacific Island countries are often destined for Polynesian communities in New Zealand. Considerable trade in reef fish occurs between Micronesian countries, most of which goes unrecorded. Within the larger Asia-Pacific region, much of the production exported from Oceania is destined for markets in SE Asia, including Hong Kong SAR, Singapore, Korea and Taiwan Province of China.

Table 7. Fishery product imports and exports in the Oceania subregion (US$ 000's) (FAO, 1996[d])

State/territory	Imports			Exports		
	1991	1992	1993	1991	1992	1993
Pacific Islands area	**73 537**	**82 769**	**106 680**	**107 484**	**85 920**	**86 249**
Cook Islands	589	620	585	-	-	-
FSM	1 261	1 647	1 140	1 158	815	430
Fiji	20 602	25 546	37 080	38 968	26 284	28 143
French Polynesia	6 390	8 579	8 243	-	-	-
Kiribati	235	293	280	235	544	550
Marshall Islands	210	230	230	580	530	625
New Caledonia	4 428	4 603	5 497	8 288	8 258	7 121
Northern Marianas	-	-	-	18	22	30
Palau	-	-	190	-	-	-
Papua New Guinea	35 400	36 200	47 800	14 163	13 817	13 880
Solomon Islands	179	198	185	42 765	33 950	33 760
Tonga	364	333	350	1 199	1 558	1 630
Vanuatu	579	1 020	1 140	-	12	55
Western Samoa	3 300	3 500	3 960	110	130	25
ANZ area	**396 893**	**412 504**	**396 528**	**1 134 155**	**1 293 756**	**1 318 686**
Australia	359 809	378 877	360 421	577 937	639 223	670 432
New Zealand	37 084	33 627	36 107	556 218	654 533	648 254
Total	**470 430**	**495 273**	**503 208**	**1 241 639**	**1 379 676**	**1 404 935**

Australia and New Zealand are committed to the process of agricultural trade liberalisation. Both argue that not all countries or regions have the capacity to produce sufficient food, or a sufficient variety of food, to sustain their expanding populations. Both support the concept of self-reliance in agriculture, but note the difference between this and self-sufficiency which may rely on trade-distorting forms of support for agricultural industries.

Pacific Islands area

Much of the fishery production exported from the island countries of the subregion consists of high-value items (beche-de-mer and shark fin from most countries, aquacultured prawns from New Caledonia, lobsters, barramundi and mud-crabs from Papua New Guinea). Some countries export larger volumes of products, especially the three countries and territories which have tuna canneries. A few countries, especially Fiji and Tonga, have well-established fisheries which export fresh sashimi-grade tunas and deep-water demersal fish. Other countries are also attempting to develop fresh-fish export industries to take advantage of the improved air services that have developed in recent years alongside the tourist industry.

The major market destinations of Pacific Islands fish are Japan (fresh tuna), Thailand (frozen tuna), other Asian countries (shark fin, beche de mer), USA (bottomfish, canned tuna, fresh tuna), and Europe (canned tuna). Many of these destination countries will be implementing the Hazard Analysis Critical Control Points (HACCP)-based seafood inspection schemes, for which the Pacific Island countries are largely unprepared.

The countries of origin of fishery products imported into the region are Thailand, Latin America, Canada, and South Africa for canned fish and New Zealand, USA, and Africa for frozen fish. Japan was formerly a major supplier of canned fish to the area, but has been largely displaced by products from other countries. In 1993 a can of Japanese mackerel in Fiji was almost twice as expensive as the price of a similar product from Latin America or South Africa (FAO 1993).

The future effects of trade liberalisation and globalisation on fishery commodities are not well understood in the region. It has been suggested (FAO 1996f) that a regional approach should be taken to study the implications of these new arrangements and of membership in the various international trade groupings.

Australia/New Zealand area

Overall, Australia is a net importer of fishery products, having imported approximately 64 percent of its seafood supply requirements (by weight) in 1990 (Laureti, 1992). Nevertheless, Australian exports are substantial (44 percent of domestic production in 1990) and comprise the highest-value components of the catch. In 1994/95, Australia imported 116,220 mt of seafood worth A$ 598 million, while exporting 51,873 mt worth A$1,143 million, meaning that the unit value of export products was 4.3 times the value of imported products (ABARE, 1996).

Japan, Hong Kong SAR and Taiwan Province of China were the main markets for Australian seafoods during 1992-93 (37 percent by value). Most Australian exports are in unprocessed or lightly processed form. There has been no significant increase in production or export of highly processed seafoods and most value-adding of exports has been because of higher real prices resulting from exchange rate movements, and from targeting of higher-value markets for fresh or live products rather than more “traditional” markets for frozen, canned, cured or other processed fishery product forms (Geen and Battaglene, 1992).

New Zealand, conversely, is a net seafood exporter, and the fishing industry is the country’s fourth largest foreign currency earner. New Zealand imported only 8 percent (by weight) of domestic seafood supply requirements while exporting about 54 percent of its total production in 1990 (Laureti, 1992) and about 49 percent in 1995 (Peacey, 1996). In value terms, however, almost 90 percent of fishing industry market receipts in recent years have come from exports (Peacey, 1996).

A large component of New Zealand’s exports goes to Australia. The Bureau of Agricultural Economics (1986) notes that in the period 1985-86 New Zealand was the major supplier of Australian fishery product imports, accounting for 18 percent by value of all fishery products and 32 percent by value of fish imports, while in 1995 the NZ$ 131 million of seafood products exported to Australia constituted 11 percent of New Zealand’s total fishery export earnings (Peacey, 1996). New Zealand also makes significant exports to other countries of the subregion, especially Fiji, New Caledonia and Papua New Guinea (Peacey, 1996). Conversely, the Bureau of Agricultural Economics (1986) indicates that New Zealand is not an important export destination for Australian fishery products. The same is probably true of other Pacific Island countries.

Some of New Zealand's major fisheries land high volumes of relatively low-value species that are marketed as frozen fillet blocks or used as surimi, and that compete directly with the "white fish" (cod, Alaska pollack, etc.) produced by some of the world's biggest fisheries (Parker, 1994). Australian fisheries land a greater proportion of high-value species which attract their highest values when sold on prime overseas markets with a minimum of processing (Kingston and Brown, 1993).

Both Australia and New Zealand are expecting to benefit from the reduction in tariffs on seafood products that will take place over the next 5 years as a result of the Uruguay round of the General Agreement on Tariffs and Trade (Smith and Tran, 1994: Parker, 1994), and both are expecting major growth in seafood exports to Hong Kong SAR, Korea, Taiwan Province of China and the People's Republic of China, where rapid economic growth and associated increases in disposable income, as well as geographic proximity, favour seafood producers in Australia and New Zealand.

4. Contribution to Food Security

4.1 Employment and Income

With regards to inshore and coastal fisheries, Hamnett (1990) estimated there are about 82,000 people involved in small-scale commercial fishing in the Pacific Islands. FAO (1996c) indicates there are about 5,400 Pacific Islanders employed in tuna fishing and processing in the Pacific Islands. The actual figure, however, is probably much greater; nearly 5,000 people are directly employed at the two tuna canneries in American Samoa alone (Gillett, 1994). There is also substantial additional tuna-related employment at the other two canneries in the region, the pole/line fleets in Fiji and the Solomons, the troll fisheries in French Polynesia, Kiribati, and Western Samoa, the locally-based foreign fishing operations in Kiribati, Fiji, Vanuatu, American Samoa, and Guam, and the local longline operations in PNG, Solomons, Fiji, Tonga, Cook Islands, French Polynesia, New Caledonia, Marshall Islands, FSM, and Palau. Tuna transshipment facilities employ Pacific Islanders at several locations in the area. Employment ancillary to the fishing is also significant: work related to food catering, fuelling engineering, crew recreation, catch transportation, port services, gear sales, etc. It is estimated that the tuna fisheries of the Pacific Islands probably support around 15,000 jobs.

UNDP (1994) estimated that there were only 370,000 wage earning job opportunities in the 14 independent Pacific Island countries, out of an economically active population of 1.8 million. Although the methodology of job estimation in the above studies may not be strictly comparable, the general conclusion is that fisheries-related jobs are very important in the economies of the area and therefore to food security.

Although coastal fisheries do not appear to be able to support substantial additional employment in most Pacific Island countries (apart from PNG), the situation is remarkably different for the offshore fisheries. Although there are well over a thousand foreign tuna fishing vessels operating in the region, only a small number employ Pacific Islanders as crew. Initiatives are underway both to estimate the actual amount of employment on these foreign vessels and to identify opportunities and mechanisms for additional employment.

The processing of the tuna catch also represents additional potential employment. In addition to the three countries of the area which have tuna canneries (American Samoa, Fiji, Solomons), additional canneries are being planned or developed in PNG and FSM. Wilson (1994) estimates that for every 30,000-mt tuna cannery, over 1,700 local jobs are created.

Employment opportunities provided in the Government industrial fisheries and processing plants of the area must be reconciled with the economic realities. FFA (1995) points out: "much of the local employment has only been achieved at the great cost of loss-making and continually subsidised Government owned and operated industry. This employment may not be sustained in the long term".

New Zealand's fishing industry employed 10,002 persons in 1995, a record level and one which increased from 8,900 in 1993. Of these 10,002 jobs, 5,100, or just over half, were in the processing sector, the first time that seafood processing employees outnumbered those in the catching sector (Peacey, 1996).

Direct employment in the Australian fishing industry catching sector was estimated at 14,000 in 1990, a small increase from the 1964/65 estimate of 13,000 persons (Kailola *et al*., 1993). The number of employees in the processing sector is unknown, but is likely to be a much lower proportion than in New Zealand because there is little processing of Australian fishery products.

Employment figures are not readily available for related industries such as vessel construction, maintenance services, and fishing gear and electronic equipment suppliers.

While the numbers of people employed in the Australian and New Zealand fishing industries are larger than in the Pacific Islands area, the relative importance of the fishing industry to the overall labour market is less because of the larger size of these two economies.

4.2 As Food

To gauge the importance of fisheries as food, different approaches are required in the two main sub-divisions of the Oceania region. The poor quality of the Pacific Islands fisheries information reported to FAO means that this information cannot be used, and alternative ways to obtain production information must be found. Conversely, the fisheries statistics that Australia and New Zealand furnish to FAO appear to be more accurate and can be used for analysis.

The fisheries contribution to food security is intricately connected to questions of overall supply, including that from national production and imports, and to demand, both of which are influenced by a wide range of factors. These are discussed in more detail in the following sections.

4.3 Supply and Consumption

Pacific Islands area

Relative to other regions of the world, the estimation of fish production and consumption in the Pacific Islands is difficult. Reported quantities in the region are frequently erroneous. Reasons for this include lack in some countries of mechanisms for estimating catches, low priority given to accurate reporting of known information, inconsistency of inclusion/exclusion of industrial catches, the difficult-to-monitor nature of subsistence fisheries which produces most of the food catch, and the widely dispersed or isolated landing areas. The difficulty of obtaining accurate information on fish imports, especially canned fish, further compounds the difficulties.

Little of the catch from the industrial fisheries enters the food systems of the region[4]. Of the one million mt of tuna caught in the Pacific Islands area, about a quarter is processed in regional canneries, but only about one percent of the canned product is consumed in the region.

In the prevailing situation in the Pacific Islands, the most accurate method of estimating consumption may be to disregard the offshore industrial catches and obtain the best information available on coastal fisheries and population. Accordingly, in Table 8 population data from SPC (1993) is used in conjunction with information in Dalzell and Adams (1994) who use a variety of annual reports, technical reports, nutritional surveys and knowledge of the region to estimate the coastal fisheries production for the 22 countries in the early 1990s.

[4] Notable exceptions to this would be in the Solomon Islands where local sales of frozen tuna from the industrial pole/line fleet are significant and amount to about 2.4 kg per caput. It should also be noted that unofficial “leakage” from the industrial fishery to domestic consumption is difficult to estimate but probably substantial at transshipment points and canneries.

Table 8. Information on coastal fisheries contribution to domestic fish supplies

Country	Subsistence fisheries production (mt)	Commercial coastal fisheries production (mt)	Total coastal fisheries production (mt)	Early 1990s population	Early 1990s per-caput fish supply from coastal fisheries (kg)
American Samoa	215	52	267	47 200	5.7
Cook Islands	858	124	982	17 000	57.8
FSM	6 243	637	6 880	108 500	63.4
Fiji	16 600	6 653	23 253	732 000	31.8
French Polynesia	3 691	2 352	6 043	196 300	30.8
Guam	472	118	591	133 900	4.4
Kiribati	9 084	3 240	12 324	71 800	171.6
Marshall Islands	2 000	369	2 369	46 200	51.3
Nauru	98	279	376	9 400	40.0
New Caledonia	2 500	981	3 481	169 900	20.5
Niue	103	12	115	2 200	52.3
Northern Marianas	2 825	141	2 966	44 600	66.5
Palau	750	736	1 485	15 200	97.7
Papua New Guinea	20 588	4 966	25 554	3 727 200	6.9
Pitcairn Islands	8	0	8	100	80.0
Solomon Islands	10 000	1 150	11 150	320 000	34.8
Tokelau	191	0	191	1 600	119.4
Tonga	933	1 429	2 362	94 400	24.5
Tuvalu	807	120	927	9 000	103.0
Vanuatu	2 045	467	2 512	147 500	17.0
Wallis and Futuna	621	296	917	13 700	66.9
Western Samoa	3 281	208	3 489	160 300	21.8
Total	**83 913**	**24 330**	**108 242**	**6 068 000**	**17.8**

To obtain per-caput total fish consumption from the above information, allowances must be made for imports, exports, and other factors.

With the exception of beche-de-mer and shells (trochus, pearl-shell, green snail), exports from the coastal fisheries in most countries are small, with the deep-slope bottom fish fishery in Tonga being a special case (approximately 150 mt per year). For the purpose of estimation, it can be assumed that exports from coastal fishery production are less than 5,000 mt per year for the whole region and would therefore be very small on a per-caput basis.

Factors affecting the Pacific Island coastal fishery product supply include the effectiveness of fisheries management, transportation logistics to markets, fisheries development efforts, and subsidy programmes, especially for boat building. Factors affecting offshore tuna production include the licensing conditions for foreign fishing vessels, fishing conditions in other areas of the world, El Nino conditions, and the characteristically high natural variation in tuna abundance.

All countries of the region import substantial amounts of canned fish and some countries import much smaller quantities of frozen whole fish for consumption. Papua New Guinea and Fiji import mackerel for canneries serving the domestic markets. Although it is difficult to determine the amount of fish imports for the region, fish imports for domestic consumption for every Pacific Island country would be greater than exports from the coastal fisheries. National per-caput fish consumption would therefore be in all cases greater than the per-caput production from coastal fisheries given in Table 8.

A recent study (FAO 1995b) provides detailed information on Fiji and shows that the amount of canned fish consumed is about 9.4 kg/caput/year. In Papua New Guinea, industry sources indicate the amount of canned fish consumed is about twice that of domestic coastal fishery production or about 14.4 kg/caput. The available nutrition literature (summarised in Coyne *et al.*, 1984) suggests that a reasonable approximation of a regional average for imported canned fish consumption would be about 10 kg/caput.

Adding 10 kg to the per-caput coastal production figures in Table 8 could therefore produce a crude estimate of per-caput fish consumption. Disregarding the special cases of American Samoa and Guam[5], the per-caput consumption ranges from 16.9 kg for Papua New Guinea to 181.6 kg for Kiribati. Excluding Papua New Guinea which is quite distinctive from the other Pacific Island countries, the regional average is about 45 kg/caput.

Forty-five kg per year is substantially higher than the world average of about 13 kg. The consumption rates of the atoll countries of Kiribati (181.6 kg), Tokelau (129.4 kg), and Tuvalu (113.0 kg) are amongst the highest in the world. According to Laureti (1992), fish protein represents 38.7 percent of the total animal protein intake in the region, which is much greater than the world average of 16.1 percent. On many small Pacific Islands the *only* source of animal protein is fish.

The South Pacific Commission has published estimates of coastal fisheries production in the region on three occasions. The results are not strictly comparable due to different methodology, but general trends should be valid. The results from these three SPC studies are given in Table 9.

Table 9. Historical estimates of coastal fisheries production

Source	Period	Coastal fisheries production (mt)	Population of region	Per-caput fish supply from coastal fisheries (kg)
Van Pel (1961)	1960	31 420	3 150 000	10.0
Crossland and Grandperrin (1979)	Late 1970s	55 130	4 410 000	12.5
Dalzell and Adams (1994)	Early 1990s	108 242	6 068 000	17.8

Because fish consumption in the Pacific Islands has a strong relationship to coastal fisheries production, per-caput fish consumption has probably followed a trend similar to that

5 American Samoa is the location of two very large tuna canneries resulting in a large per-caput consumption of canned food which Coyne *et al.* (1984) estimated be 56.6 kg/year in the 1970s. Guam is a United States territory and has a large military and tourist population It is therefore likely that the per-caput imports of fishery products are many times greater than the assumed 10 kg regional average.

of the per-caput production in Table 9, that is, substantially increasing during the last three decades.

From the above information it can be seen that fish consumption is extremely important for the Pacific Islands area. Passfield (1996) uses an alternative method for gauging the importance of fish as food in the Pacific Islands. On the basis of the cost of purchasing the seafoods which are normally captured/collected by villagers, he calculates that local seafoods are worth US$ 344 per caput in the Verata District of Fiji and US$ 610 on Tongareva Atoll in the Cook Islands. Similarly, the World Bank (1995), using "substitute value method" (valuing subsistence fisheries at the market price of their closest marketed substitute) estimated the value of subsistence fisheries to consumers in selected Pacific Island countries as follows: Fiji US$ 6.3 million, Vanuatu US$ 2.2 million, Solomon Islands US$ 7.8 million, and Western Samoa US$ .5 million.

It should be noted that, with the exception of some pet food produced as a by-product of tuna canning operations, there is almost no fish used for non-food purposes.

Australia/New Zealand area

Because FAO fisheries statistics for Australia and New Zealand are much more accurate than those for the Pacific Island countries, it is a much more straightforward task to examine amounts and trends in fisheries production.

Table 10 shows data on fish supply, population and per-caput supply (i.e. apparent consumption) in Australia and New Zealand over the past 25 years. The derivation of the net supply data in this table is shown in Table 13.

Table 10. Fish consumption in Australia and New Zealand (Laureti, 1992)

	1965	**1970**	**1975**	**1980**	**1985**	**1990**
Australia						
Net supply of fishery products ('000 mt)	145.7	167.3	187.2	204.4	271.8	323.0
Population (million)	11.4	12.5	13.6	14.7	15.8	17.1
Fish supply/caput (kg live weight)	12.8	13.3	13.7	13.9	17.2	18.9
New Zealand						
Net supply of fishery products ('000 mt)	47.9	45.0	45.4	65.3	81.1	100.3
Population (million)	2.6	2.8	3.1	3.1	3.3	3.4
Fish supply/caput (kg live weight)	18.2	16.0	14.7	21.0	25.0	29.6
Total						
Net supply of fishery products ('000 mt)	193.6	212.4	232.6	269.6	352.9	423.3
Population (million)	14.0	15.4	16.7	17.8	19.0	20.4
Fish supply/caput (kg live weight)	13.8	13.8	13.9	15.1	18.5	20.7

The table indicates that there has been a gradual increase in per-caput fish consumption over the 25-year period. This is attributed to increased perceptions of fish as a healthy or desirable food, availability of a wider range of product forms, better presentation, packaging and marketing, and a growing per-caput income. While still quite low by the standards of most of the developing countries in the Pacific region, fish consumption in Australia and New Zealand is now well above the world average of about 13 kg/caput/year.

Contrary to expectations, the increase in consumption of seafoods has taken place in the face of increasing prices of fishery products. The Bureau of Agricultural Economics (1986) noted that in Australia, "Domestic consumption of fisheries products is unlikely to increase and may decline, given the increase in fish prices relative to the prices of other products, the expected slowdown in economic growth, and the impact of the fringe benefits tax on the restaurant sector." However FAO statistics indicate that seafood consumption, and particularly the consumption of fresh fish, has increased each year since 1985. In 1992 the aggregate increase was about 10 percent over 1985 levels.

In New Zealand also, apparent consumption of seafoods has increased substantially during a period when seafood prices have been rising in real terms. Unlike in Australia, however, the price of meat in New Zealand rose faster than that of seafoods in 1991-1993, while the price of poultry continued to decline.

Statistics in Laureti (1992) give some indication of trends in consumption of various types of seafood products in Australia and New Zealand over the past decade, as shown in Table 11 below.

Table 11. Apparent consumption of fish and fishery products (kg product weight/caput/year) (Laureti, 1992)

	Average 1980-82	Average 1988-90	% change
Australia			
Fresh/frozen fish	5.4	8.0	+48.1
Fresh/frozen shellfish	1.2	1.2	0.0
Tinned fish/shellfish	1.8	2.0	+11.1
Other	0.8	0.6	-25.0
Total*	9.2	11.8	**+28.3**
New Zealand			
Fresh/frozen fish	13.6	13.6	0.0
Fresh/frozen shellfish	4.5	8.4	+86.7
Tinned fish/shellfish	1.5	2.6	+73.3
Other	<0.1	0.2	+260.0
Total*	19.6	24.8	**+26.5**
Subregional total			
Fresh/frozen fish	6.9	8.9	+30.3
Fresh/frozen shellfish	1.8	2.4	+36.1
Tinned fish/shellfish	1.8	2.1	+16.8
Other	<0.1	<0.1	-37.5
Total*	**11.1**	**13.8**	**+24.9**

* Because the data is presented as product weight, figures in this table do not agree with the per-caput fish supply information (expressed as live weight) shown in Table 10 above.

Broadly, these data indicate that, for these two countries, per-caput consumption of most forms of fish and shellfish is remaining stable or increasing, in some cases substantially. The trends are somewhat different in the two countries concerned, however. Per-caput consumption of fresh fish and seafood is stable in New Zealand but increasing rapidly in Australia, while consumption of tinned and frozen fish and seafood products is increasing rapidly in New Zealand and less rapidly, or not at all, in Australia. In both countries the consumption of "other" seafood products, which includes cured, pickled and miscellaneous forms, already low, appears to be stable or in decline. (While a very large percentage increase in this category is indicated for New Zealand, the actual product volumes involved are minuscule).

The first direct measure of Australian seafood consumption habits was made in 1976-77, when a survey carried out in the six Australian state capitals indicated that urban Australians consumed 10.1 kg of fish per caput annually, of which 7.8 kg (77 percent) was fin-fish and 2.3 kg (23 percent) other seafood (Fisheries Division, 1978). This estimate is lower than the FAO assessment of consumption (12.8 kg/caput in 1976 and 14.4 kg/caput in 1977) during the same period (Laureti, 1992). The disagreement may be due to several factors: the 1976-77 survey was based on a sample of the Australian population which did not include rural dwellers; the survey involved the assignment of a standard weight to take-away fish portions which may have introduced a bias; there were difficulties experienced during the survey in estimating the exact portion weights of certain product forms; and the FAO estimate is an apparent consumption figure based on dividing total fish supply by the total population of the country, rather than on any direct measure of consumption.

Both sets of figures include fresh, frozen, canned and cured seafoods, as well as some other product forms. The 1976-77 survey indicated that tinned fish was the most frequently consumed form of seafood (28 times per household per year) followed by fresh fish (18 times per year) and cooked fish from take-away outlets (8 times per year). In terms of quantity, however, fresh and frozen fish and seafood made up the largest component of consumption (36 percent), followed by tinned products (19 percent), and food served at take-away outlets (16 percent). Prawns were by far the most popular type of non-fish seafood consumed. While three quarters of all fish was prepared and cooked at home, only one third of non-fish seafood was prepared and cooked at home, the remainder being consumed in restaurants, clubs, bars, take-away outlets or the homes of friends and relatives.

A more recent Australian survey, carried out in 1992, confirms that seafood demand in Australia has continued to show strong growth since 1977 (P+A Consulting Group Ltd., 1992). The survey estimated that Australian consumption of all seafoods was about 175,600 mt (meat weight) in 1990-91, excluding institutional seafood use by non-household residents (prisons, etc.). If this rate of growth were to continue, the survey projects that domestic consumption would rise to around 220,000 mt total by the year 2001, after accounting for population growth. This represents an increase of nearly 25 percent on 1991 levels of consumption estimated by the survey. (Note that while the projected future increase in consumption is consistent with the trends indicated by the FAO data, the actual figures do not agree with FAO estimates).

Detailed information on seafood consumption in New Zealand is less readily available. The annual Household Income and Expenditure Survey carried out by the New Zealand Statistics Department indicates that household expenditure on fish and seafoods declined slightly in 1992 and 1993 after peaking in 1991, but no data is given on the quantities or types of seafoods consumed.

Over the past three decades fish has increased in importance as a component of animal protein intake in Australia and New Zealand, as shown in Table 12 below.

Table 12. Fish and seafood as a percentage of total animal protein consumption (from Laureti, 1992)

	1965	1970	1975	1980	1985	1990
Australia	4.2	4.7	4.4	5.1	5.8	6.5
New Zealand	5.6	4.6	3.3	6.7	8.0	10.6
Total	**4.5**	**4.7**	**4.2**	**5.4**	**6.2**	**7.2**

While increasing in importance, fish and seafoods still play a far less important role in satisfying protein demand in Australia and New Zealand than other forms of animal produce, in particular poultry and various forms of meat, the supply of which in 1990 averaged 116.8 kg/caput/year in the two countries. In general, seafoods continue to be viewed as a desirable but sometimes expensive alternative form of protein which is eaten occasionally or irregularly as a flavour alternative, a luxury item, or because of a growing awareness of dietary health. As noted earlier, a substantial amount of seafood consumption is associated with restaurant or take-away dining rather than with home-prepared meals.

Table 13 provides summary statistics on fish supply in Australia and New Zealand over the past 25 years.

Substantial increases in production from the region have taken place in recent years, due in particular to massive increases in New Zealand’s marine capture fisheries. These have been compensated for to some extent by a net rise in exports such that the increase in fishery products available as food supply to Australia and New Zealand, while still substantial, has been less dramatic. There is considerable trade in fishery products between Australia and New Zealand, hence the regional totals for import and export figures may be somewhat misleading, since some imports/exports are actually internal to the region.

The principal factors influencing the supply of fishery products to the subregion (other than the potentials for increased production) will be the overall economics of fishing, aquaculture and fishery product trade, and in particular the profitability of seafood exports. These factors will themselves hinge on large-scale features of the global economy such as global currency movements, trends in the major US, European and especially Asian markets for Australia and New Zealand seafoods, and domestic economic and political issues that impinge on fisheries.

Table 13. Fish supply in Australia and New Zealand (Laureti, 1992)

Quantity ('000 mt)	1965	1970	1975	1980	1985	1990
Australia						
Production	78.9	102.4	108.4	132.0	161.0	210.4
Imports	86.5	102.0	124.6	143.2	195.8	210.8
Exports	18.6	36.0	43.8	80.4	78.4	92.9
Net supply	146.8	168.3	189.2	206.6	277.8	328.3
Non-food use	1.1	1.0	2.0	2.2	6.0	5.3
Food supply*	145.7	167.3	187.2	204.4	271.8	323.0
New Zealand						
Production	48.4	59.3	63.5	215.0	304.8	565.4
Imports	5.8	6.7	7.5	9.2	14.5	24.1
Exports	6.3	17.5	23.5	148.7	215.2	303.5
Net supply	47.9	48.5	47.5	75.5	104.1	285.8
Non-food use	0.0	3.5	2.1	10.2	23.0	185.8
Food supply*	47.9	45.0	45.4	65.3	81.1	100.3
Area total						
Production	127.3	161.7	171.9	346.9	465.7	775.8
Imports	92.3	108.7	132.1	152.4	210.3	234.9
Exports	24.9	53.5	67.3	229.1	293.6	396.4
Net supply	194.7	216.9	236.7	282.0	381.9	614.3
Non-food use	1.1	4.5	4.1	12.4	29.0	191.0
Food supply*	193.6	212.4	232.6	269.6	352.9	423.3

* In theory, food supply = ([production + imports] - [exports + non-food uses]). However, some data also includes a correction for changes in inventories, hence the totals may not tally completely.

At a more "local" or tangible level, factors that directly influence fishery product supply will include fisheries management measures aimed at reducing exploitation, increasing competition for access to limited natural resources, environmental issues, and questions of improved catch utilization. Considerations on these factors are detailed below.

Fisheries management. Several marine fishery stocks currently being fished in Australia and New Zealand are being exploited at levels beyond what is thought to be sustainable in the long-term. An example is orange roughy, which is currently reaching the end of its "fish-down" phase (the period at the start of a new fishery when accumulated or virgin biomass is removed). About 50 percent of Australia's fin-fish (as opposed to seafood) exports in the early 1990's were derived from the sale of this species to the USA. Landings of orange roughy in Australia are expected to decline in the remainder of the 1990s (Geen and Battaglene, 1992), while in New Zealand the quota management system for this species is becoming increasingly more restrictive in order to reduce levels of exploitation (Parker, 1995). This is one of the more important fisheries in both countries, and its reduction, along with management restrictions on other species, may lead to declines in both the volume and value of landings.

Competition for access. The growing importance of recreational fisheries in Australia and New Zealand will almost certainly lead to future fishery management measures that restrict the activities of both commercial and recreational fishermen targeting the same fish stocks (Lal, Holland and Power, 1992). The net result may be a shift of landings out of the commercial and into the recreational/subsistence sector, resulting in an apparent (or in some cases real) drop in fishery production.

Another form of competition for access to marine resources has also arisen in New Zealand recently as a result of the recognition by the Government of the special circumstances of indigenous peoples. Maori claims to control of fisheries and fishing rights were recently addressed by the passing of the Treaty of Waitangi Settlement Act, which has seen Maori communities become the largest fish quota owners in New Zealand. Nearly 40 percent of all quotas are now exclusively owned by Maoris (Tierney, 1995), and while these are for the most part still available to the commercial fishing industry through joint ventures and other arrangements, there is no guarantee that arrangements will not change in the future, possibly altering patterns of fish supply. The Waitangi Settlement Act also supplemented existing customary fishing rights with provisions for local Maori communities to assume responsibility for managing fisheries within coastal areas of traditional significance, again possibly impacting on commercial fishing activities.

By-Catch Utilisation. Several fisheries operating in the subregion take substantial quantities of unwanted “trash” fish which, apart from the odd species of value, are usually discarded immediately at sea. Bottom-trawl fisheries in particular tend to have high levels of by-catch, with some Australian prawn fisheries showing a by-catch:target species ratio (by weight) of 8:1. Some research effort is being aimed at reducing levels of by-catch, but in many fisheries it will not be possible to completely eliminate incidental catches. Development of improved methods of utilising or adding value to by-catch species could result in the processing of some of these species becoming economic, leading to increased fish supply.

There has been a substantial increase in the use of fish for non-food purposes (manufacture of fish-meal, pet food, stock feeds, etc.) in the subregion during the past five years, as shown in Table 14.

Table 14. Percent of fish used for non-food purposes (Laureti, 1992)

	1965	1970	1975	1980	1985	1990
Australia	1.4	1.0	1.8	1.7	3.7	2.5
New Zealand	0.0	5.9	3.3	4.7	7.5	32.9
Total	0.9	2.8	2.4	3.6	6.2	24.6

All of the increase in non-food use of fishery landings in the subregion is attributable to changing practices in New Zealand. According to FAO (1994), this is almost entirely due to reduction of certain components of the catch to fish-meal, a feature which is associated with the increased landings of high-volume, low-value fish species in recent years. In future, changes in patterns of world fishery supply and demand may make it economic to process some of this catch for human consumption, a practice which could technically increase supply from the subregion by up to some 190,000 mt.

Environmental issues. As in many developed countries, public awareness of environmental issues has become heightened in recent years, and this has impacted on fisheries, where unsustainable marine resource exploitation and fishing practices that result in waste or habitat destruction have become the object of public censure and Government regulatory attention. Incidental takes of endangered species such as turtles and seals, or discarding of by-catch species (which in some Australian fisheries include corals), are becoming important issues in some fisheries. Pressure to discontinue fishing practices perceived by the public as being undesirable may ultimately result in management measures that restrict fishing activities for some target species.

According to Geen and Battaglene (1992), "Declining catch rates, changing market conditions, growth in recreational fishing and the increasing environmental awareness of Australian society as a whole are all factors putting pressure on fishermen to adjust their fishing and marketing activities. The medium-term outlook for the profitability of the fishing industry is highly dependent on how well the industry responds to these and other adjustment pressures".

The impact of global climate change on fisheries production in Australia cannot be fully predicted, but a preliminary examination of possible impacts proposed that climate change was likely to affect prawn stocks through changes in critical coastal habitats, western rock lobster stocks through changes in oceanic circulation, and some of the southeastern fisheries species through ocean temperature rises (Kailola *et al.*, 1993).

4.4 Demand

Pacific Islands area

Major factors influencing demand for fish are population, urbanisation, real income, price, dietary preference, and natural disasters. As most of the fish is consumed on a subsistence basis, population is by far the largest determinant of fish demand. Between 1970 and 1990 the population of the region grew by 2,222,000 people which is equal to an annual growth rate of 2.3 percent, high relative to the world average of 1.8 percent.

A population movement from the outer islands to towns and cities is a dominant feature in most Pacific Island countries. According to World Bank data, the average urbanisation rate across the region was 17 percent in 1970 but had increased to 24 percent in 1990. Although city dwellers have more difficult access to fishery resources, urbanisation does not necessarily decrease fish demand, but rather shifts demand to the products of commercial fisheries, especially imports. For example, a dietary study in the Solomon Islands (Jansen and Wilmott 1973) showed that the overall intake of fish products did not change substantially with movement from the outer islands to the capital, but the canned fish component significantly increased. Increased consumption of canned fish in urban areas may also be a reflection of the convenience nature of cans; in the urban environment with increasing demands on time due to paid employment, precooked, ready-to-eat canned fish is a time-saver.

Another important factor in the demand for fish, especially in the urban environment, is real income and the price of fish relative to this income. World Bank/IMF data shows that the per-caput GDP, a measure of real income, actually decreased in the region by 0.3 percent between 1970 and 1990.

In general, Pacific Islanders have a strong tradition of eating fish, and this preference for fish often dominates economic considerations, especially in Micronesia and Polynesia. Fresh fish will frequently be purchased even though it is more expensive than the alternatives, often imported mutton flaps, turkey tails, or canned meat.

Natural disasters in the Pacific Islands, most often tropical cyclones, characteristically create a greater dependence on imported food, much of which is canned fish.The high incidence of cyclones in Fiji in 1985 is thought to be responsible for canned fish imports increasing 22 percent over the previous year.

Australia/New Zealand

Smith and Tran (1994) note that demographic factors (population growth, ethnic mix and changes in the population age structure), taste factors, the tourist market for seafood, and relative prices are among the principal determinants of domestic demand for seafood in Australia. These considerations also apply in large part to New Zealand.

Demographic factors. Seafood consumption varies among people of different ethnic origin. The Fisheries Division (1978) noted that country of origin had no discernible effect on the overall amount of fish and seafood consumed but had a marked influence on the types preferred. Families of Italian, Greek and other Mediterranean origins ate almost twice as much fresh fish as families of British origin, who ate more fish fingers, packaged frozen and tinned fish, and more cooked fish outside the home.

In recent years immigration into the region has continued to be a major component of population growth, especially in Australia, where it has been responsible for 40 percent of total growth over the past two years (Smith and Tran, 1994). The highest growth has been in the proportion of Asian-origin immigrants, which grew from 1.3 percent of the population in 1981 to 3.8 percent in 1991. This continuing change is expected to result in increasing demand for seafood, particularly non-traditional types.

The changing age structure of the population of Australia and New Zealand may also result in a strengthening of the demand for seafood because of the relationship between seafood consumption and age. The populations of both countries are aging, with people over 20 years of age comprising 69.8 percent of the total Australian population in 1991, as opposed to 66.3 percent ten years earlier. Australian consumer surveys have shown low seafood consumption among younger age groups, with increasing consumption among older age groups based on perceived health advantages of seafood products, higher levels of disposable income, and a higher proportion of meals eaten outside the home (P+A Consulting Group Ltd., 1992). In New Zealand, consumers aged over 40 are responsible for 68 percent of total expenditure on seafoods (Parker, 1994).

Taste factors. Australian and New Zealand consumers tend to have positive attitudes towards seafood, based on the perceived healthiness of these products. However, they also have a range of concerns in relation to the products and their marketing, including the freshness of the product, misrepresentation by traders who sell lower grades of fish as more valuable species, and product safety issues. Many consumers are concerned at the impact of marine pollution on seafood, and the health aspects of seafood may be further eroded by competitive promotion of the health advantages of other potential substitute products (Smith and Tran, 1994).

An example of the importance of health-related issues to seafood consumption occurred when a major outbreak of biotoxicity ("red tide") took place in New Zealand early in 1993 (the first such event in that country) and caused paralytic shellfish poisoning in consumers of mussels and other molluscs. As a result of the incident, consumption of locally-harvested molluscan shellfish in New Zealand effectively ceased and over 1,000 jobs in the seafood processing industry were temporarily lost. Only at the end of 1993, after the fishing industry and the New Zealand Government had spent over NZ$ 1 million on a major seafood promotion campaign and a further NZ$ 4 million on a long-term research programme to investigate biotoxicity, did consumer confidence return and seafood consumption reach the same levels as earlier in the year.

Tourism may also be a source of growth in demand for seafood, especially in Australia, which has one of the fastest growth rates in the number of short-term visitors of any OECD country, (an increase of 10 percent per year from 1981 to 1991), with the number of short-term visitors in 1991 estimated at 2.37 million (Bureau of Tourism Research, 1992). Tourists, and especially overseas visitors, have a high per-caput expenditure and a high propensity to consume meals in restaurants. Smith and Tran (1994) estimate that tourists consumed about 3,000 mt of seafood in Australia during 1991, and that this demand will probably increase to at least 6,800 mt (edible weight) by the year 2001.

Prices and the availability of disposable income can clearly be expected to have an effect on demand for seafood. Referring to a survey of consumer attitudes towards seafood, Kitson (1992) states that "When respondents were asked what actions taken by the fishing industry would encourage greater consumption in their household, almost a third sought reasonable/cheaper prices". Greater availability of fresh fish and seafood was also a common response. Smith and Tran (1994) note that "Prices of fisheries products on the Australian market appear likely to strengthen further in the medium term as a result of continued high export demand, a continued weak Australian dollar (which boosts import prices) and little prospect of significant increase in domestic supplies. This will be expected to reduce the quantity of fish and seafood demanded in comparison with other products, but the impact will vary between sectors depending on the substitutes available".

As noted earlier, however, the relationship between seafood price and demand may not be simple. In the past, seafood consumption in the subregion has risen despite real price increases, a factor which is thought to be largely attributable to positive consumer perceptions of seafood products. The populations of both Australia and New Zealand are relatively affluent, with 1990 per-caput gross domestic product (GDP) estimated to be US$ 11,816 at 1980 constant prices. The average annual GDP growth rate during the period 1970-1990 was estimated to be 1.4 percent, while for the period 1990-2010 GDP in the subregion is projected to rise by an annual average of 1.9 percent (FAO, 1995c). In view of the resultant increased affluence of the population, other factors, such as continued positive perceptions of seafood products, may prove more important than price increases in determining future demand for fish and fishery products.

4.5 Supply and Demand Scenario 2010

Pacific Islands area

Because the demand for fish in the Pacific Islands is strongly linked to population, changes in population should correspond to some extent to changes in demand. According to SPC (1993), between 1990 and 2010 the population of the region will increase from 6,068,000 to 8,871,060 or 46 percent. This would result in a demand for fish of 166,776 mt in 2010, or 58,535 mt more than at present.

This demand increase will be tempered to some degree by real income and price, especially for that portion of the population living in urban areas. World Bank/IMF data suggests that the annual growth of GDP per caput in the period from 1990 to 2010 will be a modest 1.7 percent. NCDS (1994) predicts that urbanisation will occur in the region at an increasingly rapid rate. For example, in Papua New Guinea the urban population will increase from the present 16 percent to 48 percent in 2010. During the same period in the Solomon Islands the proportion of people living in cities and towns will double to 32 percent.

Major increases in food supplies accessible to medium and small-scale fisheries are unlikely due to the fully exploited nature of most of the accessible resources, tuna being a prominent exception. Due to the nature of tuna fishing, the yields from medium and small-scale tuna fishing have not been great. The situation could change if, for example, developments occur affecting fish aggregation devices (FADs) or small scale longlining.

On the other hand, there is the possibility that, with high international prices, exports of fish from coastal fisheries could increase. It is likely that, with lack of effective management, destructive fishing, and coastal zone degradation, the yields from coastal fisheries in many areas could actually decrease between now and 2010. The coastal resources in Papua New Guinea are quite distinct from those in the region in this regard. It appears as though they are substantially underexploited and yields many times the present 25,000 mt could be possible.

There is the possibility that aquaculture could contribute substantially to the future food supply of the countries in the region, but if future potential is related to past performance, the probability of this occurring is not great.

In view of the population increases expected and the limited coastal resources of most of the countries, the most likely situation is that fish consumption per caput from coastal resources will decline. If this occurs there are two consequences: either there will be greater consumption of non-coastal fish resources (tuna or imports) or total fish per-caput consumption will decline.

Indications of the ability of Pacific Island countries to pay for increased fish imports are not promising. The World Bank (1995) states "Past patterns of growth and development in the Pacific Island Member Countries do not appear to be sufficient to provide a progressive improvement in living standards in the future." Similarly, NCDS (1994) concludes "Rapid population growth is not a cause for concern if it is matched by similar levels of economic growth. But for most of the Pacific island countries real per-caput income declined in the 1980s and if low rates of economic growth continue, they could decline in the next two decades."

The most probable scenario is that an increasing dependency on non-local foods and a decreasing diet quality will cause the food security situation in the Pacific Islands region to deteriorate.

Australia/New Zealand area

In order to project future demand for fishery products, some basic assumptions are needed. Here it is assumed that per-caput seafood demand over the next 20 years will continue to grow as it has in the past 20, due to the range of demographic and economic factors outlined above which will, on the whole, tend to lead to increased demand for fishery products. A projected increase of this scale, which represents the maximum likely to be experienced, would lead to a per-caput consumption of 27.6 kg/ annum.

If the area's population increase is as projected by FAO (1995) then the total population of the subregion will be 25,401,000 in 2010, and total seafood demand at this time will be in the order of 700,000 mt.

Capture fisheries are considered fully exploited in Australia and New Zealand. While newly-discovered resources or improved management systems may lead to small increases in landings, these may be compensated for by reduced access to resources by commercial harvesters, environmental degradation, or other forms of marine resource management and conservation. The greatest potential to increase the actual volume of production from capture fisheries appears to be by diverting fish landings that are being used to manufacture non-food products into the human food supply. In recent years, however, the actual trend has been the reverse, with a growing percentage of landings being used for non-food purposes. For the purposes of projection, therefore, it will be assumed that food supply based on landings from capture fisheries will be static, at about 750,000 mt.

There is potential for increased production from aquaculture in both countries. However, as current levels of production are small (67,000 mt), much more increases would be needed before aquaculture could make the same level of contribution to food supply as capture fisheries currently do. In fact, if aquaculture production for food continues to increase at the same rate as in the last eight years, production in the year 2010 will reach approximately 160,000 mt, or about 20 percent of production from capture fisheries.

Under this scenario, therefore, total commercial fish and seafood production from the region will be about 910,000 mt, of which slightly less than 18 percent will come from aquaculture, and the remainder from capture fisheries, mostly marine. No allowance is made for the recreational/subsistence catch, but this is likely to be of the order of an additional few percent, bringing the total up to somewhere around 1,000,000 mt.

Based on the above seafood demand and supply considerations, the following scenario might be envisaged in the year 2010:

- commercial demand for seafood products within the subregion will be of the order of 700,000 mt maximum;

- supply from commercial operations within the region will be of the order of 910,000 mt maximum (ignoring any supply from recreational fishing).

There will be a continued drive to increase exports from the region, especially high-value products to lucrative established or developing overseas markets in Asia. There will also be an increase in imports, probably of lower-value canned and frozen products, to satisfy the growing domestic seafood demand within Australia and New Zealand.

Gradually increasing per-caput income in the region, as well as a domestic supply that nominally exceeds demand, will both act to support a continuation of the current trend towards increased per-caput seafood consumption, which might reach a maximum of about 27.6 kg/caput/year by 2010.

Irrespective of seafood product supply and demand considerations in the future, the implications for food security in Australia and New Zealand are not significant. The major concern from a food security viewpoint may be that a reduction in seafood consumption in Australia and New Zealand may lead to a gradually increasing incidence of coronary and other non-communicable diseases that seafood apparently plays a role in combating.

5. Role of Public and Private Sectors

5.1 Government Intervention and Political Commitment

<u>Pacific Islands area</u>

Government intervention in the fisheries sector has historically consisted of fisheries development efforts. More recently in some of the Pacific Island countries the emphasis has shifted to fisheries management.

Past efforts in fisheries development have included: resource surveys (e.g. bottom fish exploratory fishing in most Pacific Island countries), gear development (fish aggregation device engineering, fishing craft development), species introductions (many international transplantations of trochus), facilitation of marketing (major fish markets in Tonga, Tuvalu, Western Samoa, and Vanuatu), improvements in fish handling (regional fish handling workshops), and promotion of women's involvement in fisheries. Aquaculture trials, sometimes extensive, have also been undertaken in most Pacific Island countries.

As commercial fishing pressure on coastal resources increased, especially on the high-value sedentary species, signs of over-exploitation in many countries led to attempts by central government authorities to manage the fishing effort using conventional legislated regulations such as gear restrictions, minimum sizes, closed seasons, and closed areas. In general, these efforts were not successful. This was due to the lack of involvement and understanding on the part of local communities and the inability of the central governments to enforce the regulations, especially in remote locations.

Traditional management regimes for coastal resources were widespread in the Pacific Islands area before the colonial period and commonly relied on limiting access to the fishing grounds, usually by excluding outsiders. Recently there has been some degree of recognition on the part of government fisheries officials that those regimes were effective and that one of the main reasons is that the management was an integral part of the local community. Based on these perceptions of success, attempts have lately been made in several Pacific Island countries to formally recognise traditional management regimes where they are still functional and to set up community-based management where it no longer exists. In some countries there is, however, a reluctance to devolve fisheries management control to lower levels of government. In some of the crucial areas for coastal fisheries management, namely the fishing grounds around urban areas, social structures for community-based management may not exist.

The situation is much different for the offshore fishery resources. With respect to management intervention, three characteristics are important:

- Scientific studies have shown that the commercial fishery resources in offshore areas, almost entirely tuna, can support additional fishing effort.

- The resource is shared by many Pacific Island countries.

- The harvesting is done largely by vessels from outside the region.

Government intervention has historically been oriented to extracting from foreign fleets the highest level of access fees possible. Recently, there has been greater government intervention focused on increasing Pacific Island participation in the fishery and ancillary industries.

Another area in which there has been substantial government fisheries intervention is in national fishing companies. Because the large amounts of capital required for industrial tuna fishing are largely absent in the Pacific Islands, one solution has been the establishment of government fishing companies. Countries in which this has occurred include Solomon Islands, Fiji, Tonga, Tuvalu, Nauru, Kiribati, Marshall Islands and the Federated States of Micronesia. Although there may have been some benefits (e.g. increased employment), few, if any, of the government fishing companies have been financially successful.

Political commitment for fisheries management is much easier to obtain for the offshore fisheries where the participants in the fishery and subjects of management are mainly foreign (e.g. the regional solidarity over banning driftnets). The placement of restrictive management measures on a country’s own citizens has proven much more difficult.

With respect to management, there are two areas of special concern: the prevention of excess fishing effort and the degradation of coastal marine environments by destructive fishing, mangrove removal, shoreline development, siltation from logging, pesticides, and sewage. Both of these types of threats to sustainable fisheries are likely to grow in severity as the population increases.

With the increasing pressure on inshore resources and subsequent drop in yield, the need for fisheries management and the requisite political commitment to do so will increase. Awareness of the severity of the problem and its implications for food security are not widespread in the Pacific, creating difficulties for the generation of adequate political will. In some countries measures which may have doubtful effectiveness, such as hatchery rearing of juveniles of some species for reef restocking, have been a politically appealing alternative to restrictive management.

Australia/New Zealand area

Various government bodies in Australia and New Zealand provide development assistance to the fishing industry through the provision of grants for exploratory fishing and product processing trials by the private sector, and through the conduct of overseas market evaluations, sponsoring of trade missions, etc. However in both countries the government's main involvement in fisheries is in relation to management and control.

In Australia, fisheries management is a complex mix of Commonwealth and state responsibilities. For management purposes fisheries resources are usually described and managed in units called a 'fishery', which is defined by a combination of the species caught (one or several), the gear and/or fishing methods used, and the area of operation. The various state and territory governments are responsible for managing those fisheries occurring within three miles of the coast, while the Commonwealth (Federal) Government has responsibility for those outside three miles, and up to the 200-mile EEZ. Since many stocks straddle these two areas of jurisdiction, there is also a third class of fishery management arrangements, called Offshore Constitutional Settlements, under which state and Commonwealth Governments have entered into agreements to transfer jurisdiction over particular fisheries to one or other party or to a joint authority.

About 70 fisheries were defined in Commonwealth and State Government legislation in 1991 (Kailola *et al.*, 1993). Defined fisheries do not always cover the full extent of inter-breeding populations of each species, and single populations may be managed as several different fisheries (e.g. the shark fisheries of southern Australia, which involve two main species, are managed under the Fisheries Acts of the Commonwealth and four different states).

Overall, the states and territories manage wild fisheries which account for about 58 percent of Australia's fishery production, and also have management responsibility for aquaculture, which accounts for a further 18 percent of production (Kailola *et al.*, 1993). The agency responsible for managing commonwealth fisheries, which account for the remaining approximately 20 percent of production value, is the Australian Fisheries Management Agency, AFMA, which was formed in 1992. The establishment of AFMA took place as a result of new Australian legislation and the passing of the Fisheries Management Act of 1991. Under the Act, the Government now manages fisheries under the principles of ecologically sustainable development.

A trend in recent years in Australia has been to increase consultation with the fishing industry and other resource user groups in the development of fishery management regimes. There is increasing acknowledgment by all involved - industry, scientists and managers - that "we are in this together", and the level of communication between these groups is increasing.

To improve the liaison, greater collaboration between fishers and scientists, and in particular more participation in research programmes by the fishing industry, is also being actively encouraged. The aim is for better management through better information, so as to ensure the long-term profitability and efficiency of the fishing industry (McCloughlin, 1992).

The Government plays a similar role in managing New Zealand's fisheries, but without the complications of state and national-level fisheries management systems. New Zealand's fishery management regime has undergone a major overhaul in recent years and this led to the recent introduction of new fishery legislation with the passing of the Fisheries Act of 1996. The provisions of the Act will be implemented over the next 3-5 years. The new Act incorporates objectives related to sustainable resource management and environmental protection. These include maintaining the long-term viability of species which are associated with or dependent upon the harvested species, maintaining the biological diversity of the aquatic environment, and protecting habitats that are of significance to fisheries management (Ministry of Fisheries, 1996a).

Most of New Zealand's fisheries are now managed under a comprehensive system of individual transferable quotas (ITQs), and it is intended that all commercial species will ultimately be managed in this way. Under the ITQ system fishery resources are no longer open-access but are owned by the quota holders. Once issued, quotas can be bought and sold as tradeable assets among fishermen or others. The system is intended to eliminate the tendency to over-exploitation and industry over-capitalisation that usually characterise open-access systems, or those managed through input controls (such as limits on vessel numbers).

Recent moves to recognise the traditional fishing rights of indigenous (Maori) New Zealanders have led to the allocation of quotas in certain fisheries to Maori groups, and also to the declaration of specific "local fisheries" where special management regulations favourable to Maori communities may be put in place (Anon, 1996a).

5.2 Inter-country Cooperation

The subregion has a strong history of "regionalism", which derives from several considerations: the fact that many countries share problems which justify a collaborative search for common solutions; the small size and limited human and financial resources of most countries, which constrains their ability to fully address the wide range of economic development problems they face; and the colonial history of the area, during which the main metropolitan powers established mechanisms for dialogue and mutually beneficial cooperation, some of which persist today.

Fisheries cooperation among Pacific Island countries, fostered by the regional organisations, is a striking feature of the region. The region has two organisations with major involvement in fisheries matters and several others with peripheral involvement:

- The South Pacific Commission (SPC) headquartered in New Caledonia has a fisheries programme which is primarily concerned with scientific research on the tuna fisheries and with research, development, and management of the coastal fisheries for the 22 countries and territories in the Pacific Islands. It is interesting to note that, apart from the fisheries programmes, there is a household food security programme at the SPC.

- The Forum Fisheries Agency (FFA) headquartered in the Solomon Islands is concerned primarily with economic and policy aspects of the offshore tuna fisheries in the 14 independent Pacific Island countries plus Australia and New Zealand. The FFA has achieved a high degree of success in coordination leading to the regional and international treaties.

In addition to the SPC and FFA, there are regional programmes relative to fisheries at the University of the South Pacific (located in Fiji), the South Pacific Regional Environment Programme (Western Samoa), and the South Pacific Applied Geo-Science Commission (Fiji).

On a larger, global, scale, Australia and New Zealand have been instrumental in the promotion and development of the Pacific Economic Cooperation Conference, PECC, which acts as a vehicle for the promotion of economic cooperation among Pacific rim and island countries, and which has 18 member countries including the USA, Canada, Japan, the People's Republic of China, and several Asian and Latin American nations. Several Pacific Island nations are participants or observers at PECC. In addition, eight Pacific Island countries are members of the African-Caribbean-Pacific group of countries which have been signatory to a series of economic cooperation arrangements (the Lomé Conventions) with the European Union. Australia, New Zealand, PNG, Solomon Islands, Vanuatu, Fiji, Tonga, Western Samoa, and the Cook Islands are members of FAO.

5.3 Private Sector

The private sector in Pacific Island fisheries is characterised by local companies being involved in small- and medium-scale activities, while firms involved in offshore fishing and large scale processing are predominantly foreign-owned. Section 5.1 indicates that government-owned fishing companies were common in the region, but their lack of viability is a major concern. Joint venture operations between local and foreign partners may be an alternative to wholly-owned government fishing companies.

The Australian and New Zealand private sectors are more extensive than their Pacific Island counterparts, and include well developed fishing fleets, shore-based processing and other infrastructure, and distribution and transport systems.

A few Australian fisheries are characterised by a significant amount of investment from larger companies, but for the most part the catching sector of the Australian fishing industry demonstrates a high degree of private ownership and involves many owner-operated vessels. The involvement of large companies in New Zealand fisheries is more extensive but private ownership and operation of smaller vessels is still common. The Governments of these two countries no longer operate commercial fishing vessels, although they have in the past.

Fish export activities out of Australia and New Zealand are carried out by private enterprise under prescribed conditions. Domestic handling and distribution of fishery products is also handled by the private sector, with state and territory governments in Australia, and national Government in New Zealand, providing the legislative framework for product standards and reporting. Major wholesale markets exist in each major city and these are managed either by the municipal (or, in Australia, state) authorities or by commercial interests.

New Zealand has actively and effectively promoted its seafood both on overseas markets and domestically through well-organised promotional campaigns run by the New Zealand Fishing Industry Board and by other private-sector producer organisations. The marketing of Australian seafood products is not coordinated on a national basis in this way (although marketing of many other primary products is). Some 'generic' promotion of seafood is done through state fisheries authorities, while for export markets the larger catching and processing companies undertake their own market research and promotion, often using agents or brokers in importing countries (Kailola *et al.*, 1993).

5.4 Other (NGOs, Bilateral/Multilateral Donor Agencies, Cooperatives/Associations)

Local non-government fisheries-related organisations are primarily involved with environmental, women's, and village-level development. Experience has shown that these NGOs can be more effective than Government departments in such activities as awareness and participatory planning. They also may be able to access funding not available to government departments. International NGOs with active involvement in fisheries in the Pacific Islands include The Nature Conservancy, Worldwide Fund for Nature, and Greenpeace. The two former organisations tend to have long-range activities, whereas Greenpeace appears to be campaign/issue oriented.

The major fishery donors in the Pacific Islands are the Governments of Japan, Australia, and New Zealand. The European Union and the United Nations Development Programme also have major commitments to fisheries projects. FFA (1989) lists 38 donor agencies active in the Pacific Islands fisheries sector. The number of agencies has since declined, with the withdrawal of the United States Agency for International Development being a notable example.

Associations of fishermen exist in many Pacific Island countries. Some of these associations have proven quite effective in assuring that government interventions in the fisheries sector are relevant to the needs of the fishing industry. In PNG the Fishing Industry Association, which represents commercial fishing interests, has a seat on the Management Board of the National Fisheries Authority.

Food and nutrition committees exist in many countries, with the membership frequently being those public servants with involvement in public health. Kofe (1990) gives the details of the committees set up in 10 Pacific Island countries. A main role of these committees is to assist the Government in the establishment of food and nutrition policies.

In Australia and New Zealand, numerous special interest groups, including fishermen's and seafood processors associations, recreational fishermen's clubs, and other affected or interested groups, are widely and increasingly involved in the management of fisheries. Management decisions relating to specific fisheries or localities are generally drawn up only after discussions with major industry or other resource user groups and a formal public consultation process.

In both these countries, community groups are also being encouraged to become involved in fishery management and conservation. In New Zealand the recently-introduced Fisheries Act provides mechanisms for Maori communities to make major inputs into the management of fishery resources in their localities, a process which is subject to formal public consultations. In Australia the Commonwealth, in cooperation with the state and territory governments, has established the National Fishcare Programme which aims to rebuild Australia's fisheries to more sustainable levels through raising community awareness of fishery issues and encouraging community participation in activities to improve fisheries ecosystems (Anon., 1995)

6. Policy Framework for Sustainable Contribution to Food Security

6.1 General

Based on the foregoing discussions, the following paragraphs identify several major policy issues relating to fisheries and food security in the subregion, and suggest possible actions that may be taken at the regional or national level in order to address these issues.

It should be emphasised that, while these issues are generally applicable across the subregion, not all are equally applicable to all countries. In particular, the large developed nations of Australia and New Zealand have rather different fishery policy problems than the Pacific Island countries, which relate more to the management and control of existing fisheries and industries, rather than to their development. These nations also have more extensive human and other resources with which to address their problems, and both countries have recently enacted new legislation and introduced new management systems to this end. They therefore require less external advice on policy matters relating to fisheries and/or food security.

As a result, most of the following policy issues and action items focus on the situation in Pacific Island countries.

6.2 Policy Issues and Policy Measures

<u>Policy issues: lack of effective fisheries management action combined with increasing need for action</u>

Although the coastal fisheries provide the vast majority of food for Pacific Islanders, their sustainability is uncertain due to several threats, the main ones being overfishing and habitat degradation. Overfishing is occurring from increased population as well as increased commercial pressures. Habitat degradation is occurring from destructive fishing practices, urbanisation, siltation from mining/logging, and competing uses of the coastal zone. Although these factors adversely affecting production from coastal fisheries are well known to fisheries and planning officials, effective corrective action has been limited. In many countries there is a feeling of complacency about the situation; the threats have been present for a considerable amount of time but the conditions with respect to the productivity of fisheries have somehow managed to continue and the consequences have been gradual rather than drastic. As a result, there is a lack of political will in many countries to institute the required fisheries management. The situation is, however, deteriorating at an increasing rate and the ability of the system to absorb the changes may be diminishing. Consider: (a) In general, increased fisheries production from the inshore/coastal areas close to population centres cannot be expected; (b) population increases, in some cases among the highest in the world, will increase fishing pressure, leading to decreased yields; (c) the per-caput consumption may be less because of the increased number of consumers utilising an amount of fish that is not growing; (d) as urbanisation is increasing at an ever-faster rate, the fish production in areas near cities where fish demand is greatest will suffer the greatest drop in yields; and (e) the ability of Pacific islanders to purchase fish supplies from overseas will probably be less in the future because of stagnant/declining economies, reduced aid, and likely decrease in remittance income.

Policy measures to address the issue

The required fisheries management is well-known in most countries of the region. This has been summarised in many documents and fora, such as FAO (1996c) which includes the following actions:

- fully informing village communities about the depletion of the resources and seeking to eliminate destructive fishing practices through both education and legislative enforcement;

- strengthening fisheries management and conservation of inshore resources, especially those resources close to heavy population concentrations;

- extending harvest capabilities of community fishermen to the near reef area outside the lagoon;

- investigating options for shifting inshore fishing to offshore areas;

- strengthening national fisheries administrations to achieve better management;

- in view of the fact that introduced systems of management have had only limited effect, assuring that management measures take account of, or be based on, traditional practices.

Unless governments attach greater priority to such fisheries management than in the past, it is quite likely that the fisheries contribution to food security, and subsequently food security in general, will sharply deteriorate. In addition to fisheries-oriented action, the following approaches outside the fisheries sector should be considered:

- The need for, and benefits of, effective fisheries management should be stressed in the educational and legislative systems.

- The food implications of the lack of effective management and the aggravation of the issue by population pressure should be brought to the attention of senior policy makers.

- Various agencies and NGOs involved in nutrition and public health should be sensitised as to the food contribution of well-managed fisheries, as well as the increasing threats to those fisheries.

- Policy makers should be made aware of the basic principles embodied in both the Code of Conduct for Responsible Fisheries and in the Kyoto Declaration and Plan of Action on the Sustainable Contribution of Fisheries to Food Security. Management options should be viewed in light of these agreements.

Policy issue: lack of appreciation of the contribution of fisheries to food security

Fisheries makes a major contribution to food security in the Pacific Islands. The per-caput consumption of fish is quite large, especially on the smaller islands where the annual consumption ranks among the highest in the world. The contribution of fisheries to the economy is similarly large; the sector supports a substantial number of jobs which enable those workers to purchase food. In short, the food security situation would be very much worse without the contribution of fisheries. This contribution may not be fully appreciated in some countries. An extreme example is Kiribati. In that country the best available information indicates that the annual per-caput consumption of fish is 181.6 kg, notable when compared to FAO data (Westlund 1995) which indicates that Maldives with a per-caput consumption of 132.6 kg has the highest consumption in the world. Fishing is also the most important source of employment on some of the islands in Kiribati. Mitchell (1994) shows that on several islands of Kiribati over 30 percent of households derive most of their income from fishing. Despite this enormous importance of fisheries to food security, a report on household food security in Kiribati (Deo, undated a) makes almost no mention of fisheries. Similarly, the situation analysis of household food security in Vanuatu (Foy 1991), the household food security report on Tuvalu (Deo undated b), and a study of household food security in eight selected Pacific Island countries (Kofe 1990) contain very little reference to fisheries.

Policy measures to address the issue

- Recognising that this lack of appreciation may stem from a scarcity of data on the subject, quantitative studies on the contribution of fisheries, especially the subsistence sector, to food security (including the impact on the quality of the diet) should be carried out at selected locations in the Pacific Islands area.

- Information on the large contribution of fisheries to food security of the region should be brought to the attention of the national food/nutrition committees and to the regional programs involved in nutrition and food security (South Pacific Commission, UNICEF, WHO, UNDP).

- The collection, collation and routine publication of statistics on all aspects of fisheries in Pacific Island countries should be improved and upgraded as a means of improving understanding and increasing awareness of the role of fisheries in food security and in national economies.

- All primary resource development - not just agriculture, but also livestock, forestry and fisheries - should be integrated into food national-level security strategies and action programmes.

Policy issue: aquaculture not contributing substantially to food security in many Pacific Island countries

Despite a large amount of external development assistance over several decades, aquaculture does not make a large contribution to the food supplies of the region. It should be recognised that the situation in the Pacific Islands is much different from areas of the world where aquaculture has enjoyed considerable success, and that models for aquaculture development from those areas are not necessarily applicable to the Pacific Islands. It should also be noted that, considering much of the initiative for aquaculture is from outside donor agencies, those agencies may not have the institutional memory combined with the necessary technical expertise to learn from past failures. Furthermore, the conditions conducive to successful aquaculture vary greatly between countries of the area.

Policy measures to address the issue

- Pacific Island countries should realistically re-assess the aquaculture situation in their countries: take stock of their previous experiences in aquaculture and based on their successes and, particularly, failures, determine the likely extent to which aquaculture can be developed in the country for domestic consumption and export markets.

- Countries should give careful consideration as to the amount of government intervention to be channelled into aquaculture development relative to fisheries management.

- In view of the low success rate of both aquaculture in the region and of government involvement in development initiatives, consideration should be given to channelling aquaculture-related assistance directly to the private sector.

Policy issue: coastal fishery production constrained by post-harvest situation

Although coastal fishery landings appear to have reached a "production plateau" in many Pacific Island countries, the actual situation is that there are difficulties in transporting the catch from the lightly exploited outer islands and remote areas to urban centres. Kofe (1990) states that "except for Fiji, one of the greatest constraints to small-holder agriculture and fishing is the lack of transportation and market outlets for produce". Inadequate fishery product transport and distribution systems are widely recognised as a major constraint to coastal fishery development in most Pacific Island countries, and even in the remote areas of Australia.

Policy measures to address the issue

- Governments should intervene and take measures that will facilitate the marketing of fishery products from remote locations, taking particular account of those measures which have historically been unsuccessful (e.g. specialised collection vessels, freezers at remote locations).

- Additional research should be channelled into the production of fishery food products which do not require freezing or rapid transportation to distant markets.

- In the design and operation of urban fish markets, special attention should be focused on the needs of producers from remote locations (e.g. distance from shipping terminals, charges for using marketing facilities).

- Government fisheries extension services should place greater priority on providing marketing support to small-scale fishermen from remote locations.

- Government fisheries extension services should facilitate the establishment of linkages between private sector producers in remote locations and private sector marketing opportunities in urban areas.

<u>Policy issue: reconciling development of export-oriented fisheries with the encouragement of fisheries for domestic consumption</u>

Much of the past fisheries development effort has been oriented to export products. With the increased global demand for fishery products and subsequent price rise, the incentive to export will increase. In general, export of high-value fishery products makes good economic sense if it permits a country to import larger quantities of cheaper but equally nutritious fishery products such as frozen or canned fish. However, some of the export-oriented fisheries have interfered with traditional sources of food (e.g. giant clam exports) and have even been destructive (live fish trade to Asia). In some cases the benefits of export fisheries are concentrated into a few individuals, while the adverse side-effects are experienced by many (e.g. the export of live coral). Information on the quantity of exported fishery products is often insufficient to gauge the benefits of the fishery or assess the sustainability of these export fisheries.

<u>Policy measures to address the issue</u>

- The export of fishery products should be regulated by legislation and accurate, verified statistics should be collected on the exported fishery products.

- Mechanisms should be established to evaluate the national interests involved in each export fishery, and where it is determined that the net benefits are negative, the export of the products should be prohibited.

- Fishery development efforts, especially those by governments, should include an evaluation of the impacts that those efforts may have on subsistence fisheries contributing substantially to household food security.

- The comparative advantages of Pacific Island fisheries should be analysed and recognised; there may be cases in which it may be beneficial to export high-value fishery products (e.g. sashimi tuna) and use the income to import more appropriate fishery products (e.g. canned fish).

Policy issue: there is little benefit from the large offshore tuna fishery with regards to the supply of food or to the provision of jobs

The following should be considered: (a) although a million mt of tuna is caught annually in the Pacific Islands area, little of this enters the domestic food supply; (b) a substantial portion of the catch is discarded at sea due to being undesirable species or the tuna being too small; (c) most of the tuna fisheries of the Pacific Islands appear capable of supporting additional fishing effort; and (d) the catch is harvested almost entirely by foreign fishing vessels who employ few Pacific Islanders. This situation appears incongruous when considered in the context of the almost-inevitable decline in per-caput supplies of fish for Pacific Islanders and massive unemployment in the area.

Policy measures to address the issue

- Focus additional attention on analysing the costs and benefits of encouraging the utilisation for domestic consumption of a portion of the catches of industrial tuna fishing.

- As has been done with the by-catch of trawl fishing in many parts of the world, investigate the possibility of utilisation of the by-catch of the tuna fisheries.

- Study the present situation, opportunities, and constraints to increasing employment of Pacific Islanders on the foreign tuna vessels operating in the region.

- Continue regional efforts to encourage localization of the activities of foreign tuna vessels such as transshipping in regional ports and local basing of foreign vessels.

Policy issue: the slow development of the private sector

Although it is widely recognised that the private sector is inherently better than government at fisheries food production and fisheries job creation, the growth of the fisheries-oriented private sector has been slow for several reasons. These include: lack of input into government initiatives from the private sector, lack of responsiveness from government fisheries agencies to needs of the private sector, lack of relevance of government fisheries interventions to the private sector, and direct government involvement in commercial activities leading to competition with the private sector. There also appears to be a reluctance on the part of government fisheries agencies to divest themselves of activities which may best be carried out by the private sector (e.g. boat building, fish markets).

Policy measures to address the issue

- Advocate the formation of independent fishermen’s associations in order to encourage relevance of government fisheries initiatives.

- Consider the establishment of fisheries authorities (e.g. as done in PNG) so that industry is represented on the board that established the work programme of the government fisheries agency.
- Establish that the government's main role in fisheries is to provide the basic infrastructure and create a favourable and equitable business environment.

- Facilitate access to fisheries-oriented credit.

- Identify and address the main causes of fisheries business failures.

- Avoid if possible commercial involvement in fisheries by governments.

Policy issue: limited capacity of national fisheries agencies

Although the government's capability in fisheries is critically important in assuring sustainability, many national fisheries agencies are deficient in various areas. These include technical capability, productivity incentives, structure of the agency, and responsiveness. Despite the multitude of training opportunities provided to the staff of government fisheries agencies, there is considerable concern over the relevance of the training and its impact on attaining established goals.

Policy measures to address the issue

- Carry out an external review of the structure and function of the government fisheries agency with special emphasis on accountability and the agency's role as an efficient guardian of the fisheries resources.

- Carry out a training needs study of the agency, including the establishment of a mechanism to assure that required action is taken.

- Consider the measures given above to increase benefits and relevancy to the private sector.

Policy issue: the small size of most Pacific Island countries results in limited ability to carry out the technical aspects of work required for effective fisheries management

Considering that the Pacific Islands area has some of the smallest countries in the world, the economy of scale works against countries in the region in their ability to carry out many crucial functions including stock assessment, effective negotiations with distant water fishing nations for access rights, surveillance of the EEZs, marketing intelligence, gear development, exploratory fishing, legislation improvement, and access to outside technology.

Policy measures to address the issue

- continued and enhanced subregional collaboration through the Pacific Island fisheries bodies: the Forum Fisheries Agency and the South Pacific Commission;

- continued and enhanced international collaboration with FAO and INFOFISH.

Policy issue: inefficient fishery management regimes and trade barriers distort international trade in fishery products to the detriment of countries of the subregion

Poor fishery management results in over-capitalisation, over-fishing and reduced profitability of fishing fleets world-wide. Many countries respond to this situation by providing direct or indirect subsidies to fishing fleets and other segments of the fishing industry, rather than taking the politically more difficult path of instituting better management systems. This is a characteristic of open-access fishery management systems, and is compounded in situations such as high-seas fisheries or shared stocks, where no one country or authority has jurisdiction to manage the resource. Subsidies to fishing operations or other aspects of the fishing industry allow some fishing nations to continue to market fishery products at prices which would not be economic if the fishery were unsubsidised. This in turn reduces the competitiveness of exports from countries of the Oceania subregion, where fishing is largely unsubsidised, and may be reducing the license fees and other benefits that accrue to Pacific Island countries who license access to their fishing zones in terms of a percentage of catch value. This is an issue which is directly related to food security and which requires action at the international and global level to supplement national and regional initiatives.

Policy measures to address the issue

- Countries of the subregion should actively participate in international meetings and fora which discuss the issue.
- The FAO Code of Conduct for Responsible Fisheries should be widely implemented.
- Government subsidisation of fishing activities should be reduced on a world-wide basis.
- International trade in seafood products should be liberalized.

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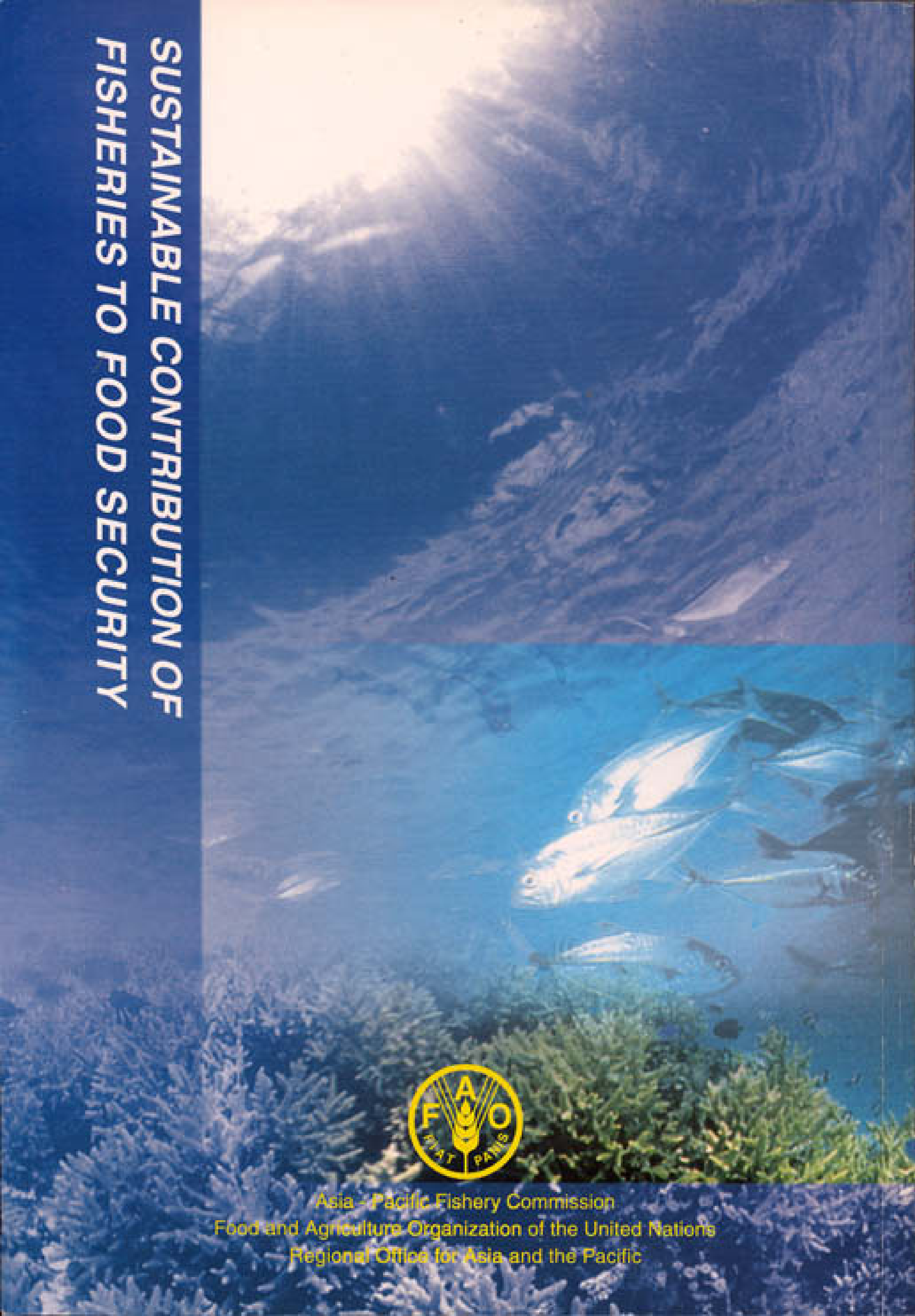

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