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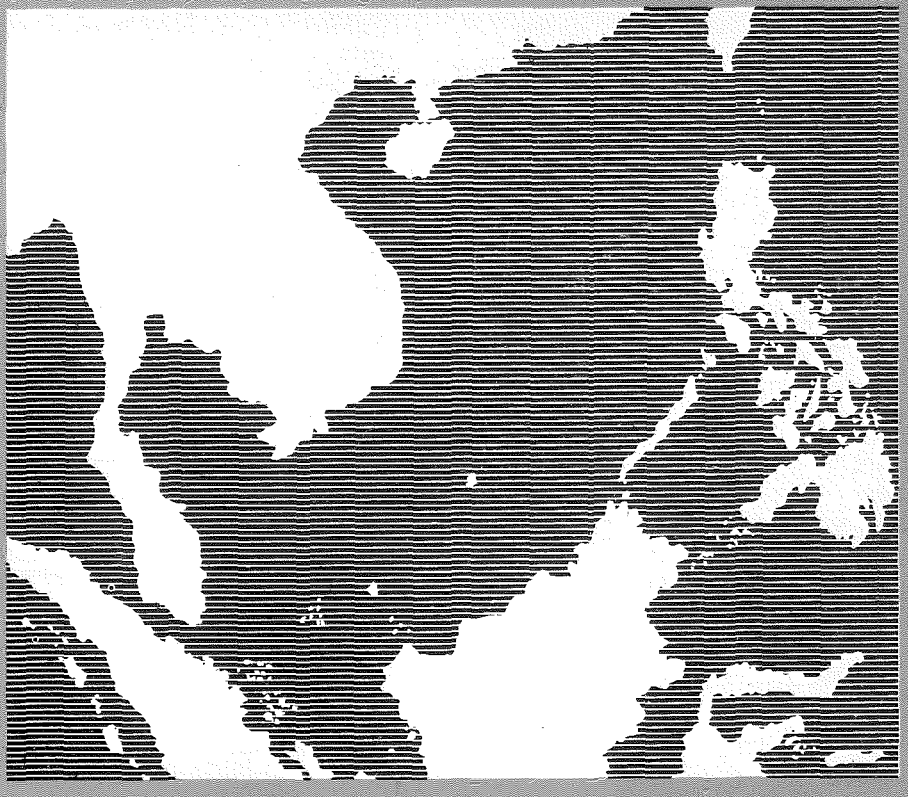
JOINT ADB/FAO (SCSP-INFOFISH) MARKET STUDIES

Vol. 1: highlights and conclusions



UNITED NATIONS DEVELOPMENT PROGRAMME

Joint ADB/FAO (SCSP-INFOFISH) Market Studies

Vol. 1: Highlights and Conclusions

SOUTH CHINA SEA FISHERIES DEVELOPMENT AND COORDINATING PROGRAMME
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I. PREFACE

Well over two thousand million people — close to 50 percent of the world's population — live in the developing countries of the Asian/Pacific region.

Although there are wide disparities among these countries with respect to their level of development, with notable exceptions they are characterized by low levels of *per capita* income, inadequate health and educational services, and widespread protein shortage.

An acceleration in the pace of economic development is urgently needed in order that national governments in the region can move to efficiently attack these pressing problems and meet the growing needs of the future. An expansion of protein supplies is necessarily of paramount importance in these efforts; given the prominence of fish in diets in nearly all developing Asian/Pacific countries, the accelerated development of the fishery industry in these nations must be considered a top priority in national development programmes. Another crucial element in fishery development programmes is the expansion and diversification of exports. A growing export sector provides needed foreign exchange to finance imports of capital goods and technology; export diversification can aid in protecting a vulnerable economy against the often violent fluctuations of world commodity markets.

The vast oceans of the Asian/Pacific region contain very substantial fishery resources, including many species in great demand on the world market. These resources, although partially tapped in some areas, offer further potential to contribute to the alleviation of local protein shortages. They also offer considerable potential to contribute to national economic development through the expansion of fishery product exports. Besides greater export earnings and structural diversification, the development of export-oriented fishery enterprises can also indirectly but materially contribute to the alleviation of local protein shortages. Skilled labour, technical expertise and vital infrastructure are created which can be drawn upon and applied to fishery development projects aimed at supplying local needs.

This Report, which comprises nine volumes, was prepared in order to provide vital background information to assist the Asian Development Bank, its member countries, and entrepreneurs in the region in formulating and evaluating investment programmes aimed at accelerating the growth of national fishery industries in and fishery product exports from the region.

Background of the report

This Report represents an expanded up-date of a similar study published in 1977 and entitled "DEVELOPMENT POTENTIAL OF SELECTED FISHERY PRODUCTS IN THE REGIONAL MEMBER COUNTRIES OF THE ASIAN DEVELOPMENT BANK". The first report was accomplished through the cooperative efforts of the Asian Development Bank and the Food and Agriculture Organization of the United Nations (FAO), and was coordinated by the FAO/UNDP South China Sea Fisheries Development and Coordinating Programme in Manila. The success and usefulness — to the Bank, FAO, and governments and entrepreneurs in the region — of the first report, and the growing appreciation of the significant changes occurring in the region's domestic and key export markets for fishery products, culminated in the preparation of the present Report. It offers an expanded and more detailed coverage as compared to the first effort.

Preparation of the report

The possibility of a follow-up to the 1977 report was first discussed between the Asian Development Bank and the FAO South China Sea Programme. During late 1980 and 1981, terms of reference for the study were developed with the participation of the Bank, South China Sea Programme and FAO Headquarters staff. It was agreed that the study would be coordinated by FAO Headquarters in close collaboration with the South China Sea Programme and FAO's newly established Marketing Information and Advisory Services for Fish Products in the Asian/Pacific Region (INFOFISH), operative in the region since July 1981 with virtually the same geographical coverage as ADB.

The main objectives of the study are to analyze the present market situation and projected future absorptive capacity of domestic markets for fishery products in developing member countries of the Bank, and also to examine export market prospects for selected fishery products important to these countries. Present and projected market needs are compared with present and potential production and export volumes; supply, demand and price levels for key fishery products are forecasted for 1990. These efforts are foreseen as assisting the Bank and its member countries in planning future investments in fish production and marketing facilities in the region.

The study was carried out under the ADB/FAO Cooperative Arrangement which provides a vehicle for cooperative activities on a cost-sharing basis. The studies and related appendixes were prepared by FAO staff members and individual consultants as noted below. The coordination of the study was carried out by Mr. B. Lanier of FAO Headquarters, Dr. W. Krone of INFOFISH, Mr. A. Woodland of the South China Sea Programme, and Dr. R.C. May, Senior Aquaculturist of ADB.

The complete Report comprises nine volumes as follows:

The present Vol. 1 provides a brief executive summary of all commodity studies and country profiles on a regional basis.

Vol. 2 **The international market for tuna**
by D L'Hostis and G Kitson

Vol. 3 **The international market for shrimp**
by R Rackowe in collaboration with H Branstetter, D King and G Kitson

Vol. 4 The international market for cephalopods
by M Hotta

Vol. 5 The world market for fishmeal with particular attention to the Asian/Pacific region
by Landell Mills Commodities Studies Ltd.

Vol. 6 The world seaweed industry and trade
by D J McHugh and B V Lanier

Vol. 7 Dried fish markets in Asia
by J Maynard

Vol. 8 High-valued finfish markets in Hong Kong, Singapore and Japan
by G Kitson and J Maynard

Vol. 9 Fishery sector profiles and briefs for selected countries
by R Schatz

Report Lessons

The significant change which has occured in the markets examined in this Report in the relatively short interval since the publication of the first study emphatically underscores several important conclusions concerning the planning and formulation of investment and development programmes in the fishery sector in the region. One is that the regular — even continuous — monitoring of key domestic and international fish product markets is essential, not only for established concerns, but also to avoid the commission of serious investment errors in new projects. This monitoring requires the regular gathering and dissemination to concerned individuals and organizations of fish marketing information. INFOFISH, established by FAO in Kuala Lumpur, Malaysia in 1981, has started to provide this service in the Asian/Pacific region. Individuals and organizations wishing to obtain information about current production, supplies, demand, prices and market contacts relevant to the fishery products covered in this Report, as well as other fishery products, should contact INFOFISH.

Another lesson garnered from this Report is that, with the growing pressure on key fishery resources in the region and the escalation of competition in international fishery product markets, any fishery investment or development project must include a detailed and informed investigation of the relevant market situation, prospects and potential. Successful projects are those which are strong in all components from production to marketing, with marketing involving much more than the inclusion of appropriate price estimates during project evaluation. It also involves the building of appropriate and sensitive relationships and institutions, an appreciation that markets are dynamic in nature, and that successful marketing institutions are those which are sensitive to changes and capable of adjusting to negative changes and taking advantage of positive opportunities. Without appropriate institutional arrangements and personnel, and sensitive channels of communication, this is not possible. Appropriate institutional arrangements and relationships can ensure that returns to developing countries are enhanced beyond the weak bargaining position that many developing countries find themselves in, especially where products are non-standard and inadequately specified. Such enhancement of returns can contribute materially to the improved economic performance of fisheries projects which would otherwise be of marginal viability.

II. THE INTERNATIONAL TUNA MARKET

USA

Market Characteristics and Outlook

The United States market for tuna may be broadly characterized as follows:

1. It is the world's largest market for canned tuna, the only significant form of tuna consumption in the USA.

2. There is a strong preference for light-coloured flesh, with albacore (white meat) tuna being at the top of the product price hierarchy. Consumption is greatest, however, for light meat tuna, for which skipjack and yellowfin are the principal raw materials.

3. Light meat consumption is principally in chunk form in brine, while white meat consumption is mainly in solid form. White canned tuna consumption in the United States grew rapidly to a peak in 1978 principally as a price competitive substitute for chicken. The subsequent economic recession, resulting in a depressed market climate in the United States, and increasingly competitive poultry prices have caused a fall in tuna consumption since 1978. It is probable that chicken will remain highly competitive through the end of this decade. The US tuna industry's traditional market strategy — to promote canned tuna as a cheaper chicken substitute — is now of dubious merit.

Prospects for future rapid growth in consumption are therefore poor, and strategies directed largely toward the maintenance of current market shares will emphasize lower cost raw material procurement. Market development opportunities in the short term would appear to be confined to achieving a position in the developing seafood restaurant sector. This is unlikely to be successful for the canned product, suggesting that serious research into the market possibilities for other tuna preparations as restaurant menu items is necessary.

Industrial Restructuring and Investment Opportunities

While investment opportunities may emerge from such market research, others are likely to emerge only as a result of the recent negative developments in an industry which will come under increasing pressure to restructure in order to become competitive. Such restructuring could lessen the emphasis on canning in California and create more opportunity for processing outside the US. Further analysis of relative processing costs in California and other countries, especially those under different exchange rate regimes, should ascertain the validity of this opportunity.

The opportunity for increased canned exports to the US is, however, dependent on the willingness of the United States

government to allow continued imports of canned tuna above the quota level. This in turn is likely to be determined by the role the American canning industry defines for itself in any future restructuring which occurs in the industry, and will emphasize a secure place in any further non-US-continental processing for American canning companies. In view of increasing costs of canning in Puerto Rico of product sourced in the Pacific, additional processing operations are likely to be located in the Pacific. The other major element in the determination of future investment opportunity in the United States canned tuna market is the impact of the embargo on imports of tuna from certain nations (particularly Mexico) by the United States. Both the current impact of this policy, as well as the future effect of the resolution of the problems at the root of the embargo are uncertain.

Japan

The Japanese tuna market and industry, on a world scale, represents not only the largest fresh tuna (sashimi) consuming market, but also the largest tuna market by value of product. Further, it is the world's third-largest canned tuna market and encompasses the largest tuna catching industry.

While overall fish consumption in Japan is tending to decline from very high levels as other animal protein consumption increases, the market for high-value products, such as sashimi tuna, continues to expand, with increasing emphasis on substitutes for the very expensive bluefin. At the same time, the capacity of the domestic tuna industry to supply the market is likely to be reduced in the future as the domestic tuna-catching industry adjusts to a less-favourable environment in which the rising costs of operations and resource access become increasingly problematic.

The dominance of sashimi in tuna consumption in Japan has created some unique characteristics in this nation's tuna market and industry. The most desirable and expensive species, for example, is bluefin, with its high fat levels. While this is essentially a cold-water species and therefore of little relevance to most developing countries of the Asian/Pacific region, warmer water species are becoming increasingly important in the sashimi market. The most sought-after of these is bigeye, followed by yellowfin. For Asian/Pacific developing countries to capitalize on the Japanese sashimi market, however, will require a substantial transfer of skill and technology from Japan. Not only are catching methods specific (mainly long-lining), but post-catch treatment (freezing or chilling), and subsequent storage and transport are highly specialized. The major element of this, the need for very low temperature cold storage (minus 55-60°C) to preserve product quality, especially colour, requires investment in expensive infrastructure. The alternative of chilling and transport by air is also specific and expensive.

The Japanese market is also characterized by unique processed forms of tuna. The major such product for skipjack, *katsuobushi*, is being produced in a number of developing countries in the region in its simplified form, *arabushi*. As arabushi forms the basic component for sliced fish (*keruzi-bushi*), a product which market prospects are good, there seems to be room for increasing production in and exports from Asian/Pacific countries. Prospects also exist for another skipjack product known as *tataki*, for which the market has shown substantial growth and for which the preference is pole-and-line caught skipjack. Prospects for other processed tuna products appear very limited.

Europe

Major canned tuna consumption areas are in Southern Europe, particularly France, Spain and Italy. Of these countries only the former two have significant catching industries, Spain being a net exporter of tuna as raw material as well as of canned tuna, and France importing about half its total consumption, mainly from West Africa-based French companies. Italy on the other hand imports most of its raw material for domestic processing. Other European countries depend on imports for their supplies of canned tuna. Although the markets for these countries are smaller than France, Italy and Spain, consumption is increasing significantly in Britain and Finland in particular. *Per capita* consumption of canned tuna is highest in Spain, followed by France and Italy. For the latter two countries, consumption is estimated to be growing at about 4-5 percent per annum.

Other features of consumption in Europe include the relatively high level of albacore (white tuna) consumption in Spain, with about one-third of total catch being of that species. In other countries, light meat tunas predominate. The European market is also distinguished from the American market in that in some countries, particularly Spain and Italy, consumption of tuna in oil is dominant; this form of consumption is also growing in the Federal Republic of Germany. Among developing Asian/Pacific countries active on the European market are Thailand (Federal Republic of Germany, Denmark and Finland), and Malaysia (West Germany, Sweden and Denmark), while Fiji and the Solomons have established growing market shares in the UK.

Political and economic linkages between European countries and supply countries have been important in determining trade patterns. France for example has particularly close associations with former colonies in West Africa, which enjoy special privileges of market entry.

Similarly, Fiji and Mauritius are benefitting significantly within the EEC under the Lome Agreement provisions for processing tuna from other countries of origin. Under this agreement several countries benefit from special entry privileges. It is also expected that Spain will receive significant benefits from EEC entry.

III. THE INTERNATIONAL SHRIMP MARKET

World shrimp landings increased steadily up to 1977, but have remained relatively unchanged since then. The 1980 production of 1.7 million tons live weight was about 60 percent above the 1970 level. The top 20 producing countries accounted for about 85 percent of total world landings,

although there have been wide fluctuations in the catch of individual countries. Cold-water shrimp made up between 12 and 17 percent of the total during the 1970-1980 period. While world production levels of farmed shrimp is not recorded, it is estimated to account for about 5 percent of total supplies.

Production

Of the top ten producing countries seven are from the Asia/Pacific region: India, Indonesia, China, Thailand, Malaysia, Vietnam and Japan. Between them they accounted for more than 50 percent of world landings in 1980. An additional four Asian/Pacific countries (Republic of Korea, Pakistan, Philippines and Australia) are to be found in the top 20 producing countries. These 11 Asian/Pacific countries together produced almost 1 million tons of shrimp in 1980, equivalent to 58 percent of total world production.

Indian landings rose to 246 000 tons in 1974, but since then production has been subject to wide fluctuations. Catch in 1980 was 224 000 tons, equivalent to 14 percent of the world total landings. There is concern about possible depletion of some shrimp fishing grounds, but other areas are thought to be capable of increased production. India plans to modernize and increase its fleet of shrimp trawlers in order to fish in deeper waters.

Shrimp landings in *Indonesia* have expanded rapidly from 52 000 tons in 1970 to 169 000 tons in 1980, representing 10 percent of world catch in the latter year. Over-exploitation in some areas has been countered by a ban on trawling, which is estimated to result in a reduction in shrimp landings in Indonesia of about 20 000 tons. However, increased catches from small-scale fishing operations and introduction of other fishing techniques are expected. The impact on export supplies is likely to be more significant since, with the gradual implementation of the ban export volumes have declined from 32 000 tons in 1980 to 26 000 in 1981.

Catches by the *People's Republic of China* rose from 107 000 tons in 1970 to a high of 234 000 metric tons in 1978. In 1979, landings dropped sharply to 131 000 tons, but recovered to 167 000 tons in 1980, equivalent to 10 percent of total world catch.

Catches by *Thai* vessels rose from 61 000 tons in 1970 to a high of 143 000 tons in 1978. They have since declined to 108 000 tons in 1980, equivalent to 6 percent of world landings, at least partially owing to the loss of access to non-Thai fishing grounds.

Malaysian landings increased from 49 000 tons in 1970 to 84 000 tons in 1980, which represented 5 percent of total world catch.

Future shrimp catches in the world will be affected by market prices, resource management, operating costs, availability of capital, access to fishing grounds and changes in coastal areas. High prices for shrimp in the major markets attract investment into the industry, which will be used to renew existing boats and equipment as well as to increase production capacity. Many of the world's shrimp fisheries were developed 20-30 years ago and require additional investment in order to improve operating efficiency.

However, most major fisheries for shrimp are presently harvested to full or nearly-full capacity. An increase in yields, however, can be achieved by better handling of raw material, by improved resource management, such as closed seasons, control of coastal pollution and other measures. The major increases of supplies are, however, expected to come from aquaculture.

Markets

Demand for shrimp has been rising steadily in the major markets during the 1971-1981 period: in Japan by a total of about 60 percent, and in the USA by 11 percent. Consumption in Western Europe has shown rapid growth, the major part of which has been in coldwater species. During the period, Japan passed the USA as the principal market for tropical species. *Per capita* consumption in Japan is about twice that of USA. The three major markets — Japan, USA and Western Europe — are thought to consume about 50 percent of the annual world catch of tropical shrimp.

United States market

United States fishermen provide about half of the country's shrimp requirements, the remainder being imported. The major suppliers to the market have been North and South America and the Asian/Pacific region. The share of imports from the Asian/Pacific region during the 1971-1981 period has fluctuated between 18 and 33 percent of the total. India was, until 1980, second only to Mexico in volume shipped into this market and accounted for from 6 to 18 percent of total imports during the past decade. Mexico has supplied between 32 and 39 percent of the total US imports. Ecuador, as a result of investment in shrimp farming, has increased its share of US imports by a factor of more than four during the period and in 1981 accounted for 11 percent of the total.

The major part of all imports is in the headless, shell-on form. Peeled shrimp is supplied chiefly from the Asian/Pacific region and the east coast of Mexico. Headless shell-on shrimp is imported mostly from Latin America. Canned shrimp represents on average only about 2 percent of total imports.

The apparent consumption/usage of shrimp is derived from domestic landings, imports, exports and inventory adjustments. It has varied in the period 1970-1981 between 356 million lbs (162 000 tons) and 437 million lbs (199 000 tons). There have been wide annual fluctuations with slow overall growth in the period; the average annual consumption during the period 1976-1981 was 6 percent higher than that of the 1970-1975 period.

Annual *per capita* consumption of all preparations of shrimp has fluctuated in the 1970-1981 period between 1.32 lbs and 1.56 lbs edible meat weight; the average annual *per capita* usage for the period 1976-1981 increased slightly to 1.45 lbs from 1.42 lbs for 1970-1975. A key determinant of demand is the availability of disposable personal income (DPI). About four-fifths of all shrimp is consumed away from home. The consumer considers shrimp an item to be

eaten when entertaining or dining out, whereas at home preference is given to less-expensive food. A reduction in DPI therefore causes the consumer to eat out less frequently.

The population of the USA is predicted to increase at the rate of about 1 percent per year up to 1990. If real DPI rises by 1 percent per year, *per capita* demand is predicted to increase at the rate of 0.5 percent per year. Under these circumstances, the total increase in demand would be about 1.5 percent per year, which is equivalent to about 6 million lbs product weight. On the other hand, if real DPI declines by 1 percent per year, this results in a predicted drop in *per capita* consumption of 2 percent. In this case, the net result would be a decline in demand of 1 percent per year, equivalent to about 4 million lbs product weight. These forecasts are based upon an assumed price increase of 9-10 percent per year. On this basis, and assuming that economic recovery occurs during the period to the extent of an average increase in real DPI of 1 percent per year, then demand in 1990 will be about 50 million lbs higher than 1981 levels.

To meet this increase in demand additional supplies must be found, or prices will increase disproportionately and slacken demand further. Although tropical shrimp landings have increased slightly in recent years, overall domestic catches in the US have dropped 24 percent from the peak year of 1977 to 219.2 million lbs, headless weight, in 1981. This decline has been caused by a sharp drop in landings of cold-water shrimp, principally in Alaska. Since landings of tropical species are thought to have reached maximum production levels and the recovery of cold-water species cannot be predicted with any degree of certainty, future supplies from domestic sources are not likely to increase much above present levels.

Landings of shrimp in the Latin American countries, which traditionally provide the major part of exports to USA, have stabilized. Continued growth in shrimp aquaculture can be expected in Ecuador, Panama and Peru. Other countries in this region will also develop shrimp culture industries. Aquaculture is therefore seen as the principal hope to satisfy additional demand in the US market.

A limiting factor for cultured shrimp is the range of sizes produced. The best economic return with current technology in use in Central and South America is obtained by growing the shrimp to sizes from 21-25 to 41-50 count per lb, with a high percentage of 31-35 and 36-40 count shrimp. Cultured shrimp has been well accepted in the US market. The product is normally packed and frozen within a few hours of harvesting, which ensures excellent quality.

Japanese market

Domestic landings in Japan provide only about one-quarter of total shrimp supplies. Catches have declined from 79 000 tons live weight in 1974 to around 50 000 tons in the last three years. About one-third of this production originates from culture.

Imports of shrimp have grown steadily and rapidly since 1970. The 162 000 tons imported in 1981 were almost three times the 1970 level. Over 60 countries participated in this important trade, but five countries — India, Indonesia, China, Australia and Thailand — accounted for 62 percent of total Japanese imports in 1981. The growth in imports has come chiefly from India and Indonesia, whose combined exports to Japan expanded from about 10 000 tons in 1970 to 64 000 tons in 1981, accounting for 40 percent of total Japanese shrimp imports in the latter year.

The greater part of shrimp marketed in Japan is sold in the raw-headless, shell-on form, which accounts for about three-quarters of the total usage. Peeled undeveined (PUD) shrimp accounts for 10-15 percent of the total, and head-on shrimp 5-10 percent. Consumers have tended in recent years to increase their consumption of cheaper items, either by buying smaller sizes of headless shrimp, or by turning to PUD shrimp instead of headless products.

The apparent usage of shrimp increased from 125 000 tons in 1971 percent to 202 000 tons in 1978, or 62 percent. Since 1978, it has remained stable, except for a drop in 1980. Average annual shrimp consumption during the 1976-1981 period was 21 percent higher than the 1971-1975 average.

The increase in demand over the past 20 years has been the result of a rapid rise in disposable personal income, together with the movement of the population into urban areas. This brought shrimp within reach of most Japanese consumers, who now consider it a normal part of their diet. As such the key determinant of demand is the price of shrimp, since it must compete with a very wide variety of seafoods. Contrary to the United States, where shrimp demand depends more on income than on price, in Japan demand for shrimp is far more sensitive to changes in prices.

Statistical forecasts predict an increase of 5-6 percent per year in shrimp prices, the consequence of which is a predicted drop in *per capita* demand. Population is expected to increase at the rate of about 1 percent per year. The trend of movement into the urban areas has slowed and disposable personal income is expected to rise at a much slower pace. Demand will be dependent on decisions based on consumer's comparison of shrimp prices with prices of substitute products.

However, the availability of supply is seen as being the key factor in determining the direction which the Japanese market will take up to 1990, since the level of supply determines shrimp prices, and their relation to those of competing products determine demand. Overall supply during the last three years has been essentially stable. Recent increases in imports have been merely compensating for the lower levels of domestic landings. Assuming that domestic production remains at 1982 levels, a slow growth in total import requirements of approximately 1 percent per year can be expected up to 1990. It should be noted, however, that the Ministry of Agriculture, Forestry and Fisheries has predicted that total apparent usage will reach 261 400 metric tons in 1985, which would require an additional 50 000 tons of shrimp imports.

The Japanese market is undoubtedly capable of absorbing additional supplies of shrimp, which will tend to stabilize prices and thus increase demand. Imports derived from catch fisheries should fluctuate at about their present levels, but growth is expected to be generated by growing aquaculture production as the effects of investment are felt.

Western European market

Landings from domestic sources provide over two-thirds of total shrimp supplies to Western Europe, of which the major part consists of cold-water species. Shortages in supply combined with increased prices have encouraged European importers to market tropical shrimp even in countries with a traditional preference for cold-water species. The countries of Southern Europe prefer tropical shrimp principally in head-on form. Although total usage of tropical shrimp in Europe is still small in comparison with USA and Japan, consumption has increased in recent years, particularly in France, Spain and the UK.

Domestic shrimp landings in Western Europe have increased from about 100 000 tons in 1970 to 167 200 tons in 1980, more than 60 percent. Domestic landings include catches from Greenland, Iceland and the Faeroe Islands. They also include catches by Italian, Spanish, Greek and French trawlers working off Africa. It is estimated that less than one-third of these landings are tropical species.

It is expected that the market for tropical shrimp in Western Europe will grow at the rate of 5-10 percent for the next few years. The market consists of several countries, each with its special requirements with regard to packaging, product types, currency, tariff barriers and distribution arrangements. The overseas exporter must enter the Western European market on a country-by-country basis, with the result that quantities in each case will not be large.

In *France*, domestic landings of mostly cold-water species form less than 10 percent of the total supplies of almost 30 000 tons in 1980. Imports have increased steadily from 17 000 tons in 1976 to 27 000 tons in 1980. Trade sources expect consumption to grow at the rate of 5-10 percent per year during the next five years. Since landings are declining, growth will have to come from imports. France is considered a promising market for overseas exporters. The demand will be principally for whole head-on shrimp, raw or cooked. Opportunities will also exist, on a lesser scale, for headless and peeled products, and for canned shrimp.

Domestic landings are an important factor in the supply of shrimp to the market of the *Federal Republic of Germany*; catches, however, have declined steadily from 18 000 tons in 1977 to 15 000 tons in 1980. Imports have risen continuously during this period, reaching just over 10 000 tons of frozen and canned shrimp in 1980. Shortages of supply and increased prices for cold-water shrimp are leading to acceptance of tropical shrimp products in the Federal Republic of Germany. Canned tropical shrimp has lost ground because of quality problems, so increases in imports are expected in frozen products. While direct trade with overseas exporters is increasing, exporters in the Netherlands and Belgium continue to play an important role, chiefly because they can offer prompt deliveries from inventory.

In the *Netherlands* domestic landings of small cold-water shrimp have declined in recent years. Imports of shrimp have expanded (to more than 15 000 tons in 1981), but are largely re-exported to other countries in the EEC. Apparent consumption is just over 6 000 tons. This country presents interesting possibilities for overseas exporters in view of the fact that consumers are learning to accept tropical species. Furthermore, the Netherlands is expected to remain the leading transit centre for trade to other European countries. Dutch importers handle, in addition, a substantial volume of international trade where the product does not enter the Netherlands but goes directly to third countries.

Domestic catches are an important part of total supplies to the *Spanish* market. A substantial share of the landings comes from Spanish vessels operating off the coast of Africa. Loss of access to distant-water fishing grounds is affecting production, and imports are increasing. Of the total of 10 800 metric tons imported in 1980, only 9 percent was cooked, while 91 percent was raw frozen. Spain's most important supplier is Cuba which has provided between 27 and 33 percent of total imports between 1976 and 1980. A high proportion of imports is reported to be head-on shrimp.

Apparent consumption in Spain fluctuated between 37 000 tons and 45 000 tons between 1977 and 1980. Although these figures are only indicative, Spain is by far the largest European market for shrimp. The fluctuation in the Spanish market in recent years has shown no clear signs of growth. Requirements for imports are expected to increase to replace a probable decline in domestic landings. The principal product demand is for whole raw shrimp, but peeled shrimp is gaining acceptance. Spain is thought to offer opportunities for exporters for future development. However, overseas suppliers face strong competition from the domestic fleet which has many years of experience in producing the special head-on form desired in the market.

In the *United Kingdom*, domestic catches play only a minor role in total supplies of shrimp, less than 10 percent. Imports increased from 17 000 tons in 1976 to 25 000 tons in 1980, but some of this product is re-exported; annual apparent consumption is therefore about 20 000 metric tons. Trade sources expect an annual increase of about 5 percent during the next few years. No additional supplies can be expected from domestic landings; demand must therefore be satisfied through increased imports. Opportunities are expected for increased shipments in all types and sizes of shrimp, especially large-sized shrimp frozen in blocks, or semi-IQF.

Other markets

Outside the main three market areas — accounting for about 50 percent consumption of tropical shrimp catches, but much more of world shrimp imports — there are several countries exhibiting strong and accelerating demand. Markets

like *Hong Kong* and *Singapore* have been absorbing increasing quantities of shrimp — not only for reprocessing/packing and re-export, but also for domestic consumption. Also *Australia* — an important exporter itself — has growing import needs for certain species, grades and products. Furthermore, there are growing markets in some of the producing countries themselves.

It is not unreasonable to assume that consumption in such 'minor' export markets, and in the producing countries, will rise faster than in the three major market areas, owing to the more rapid growth of population and potential consumers.

Outlook

In recent years, world markets have felt the impact of high inflation and the general economic slow-down. Unusually high interest rates have had a serious impact on costs and tended to reduce speculation, since both producers and buyers are unwilling to hold product in anticipation of higher prices owing to the high cost of maintaining unsold inventories. Fluctuations in exchange rates in the major markets have caused dislocations in trade and changes in the competitive position of buyers in relation to their suppliers. These factors are expected to continue to affect both the markets and the producers in the years to come.

Market growth in the period up to 1990 is expected to be slow in both US and Japan. Europe presents the likelihood of more rapid expansion in usage of tropical species, but from a much smaller base.

Virtually, all expansion of the three markets is expected to necessitate heavier imports. Assuming a 1 percent annual growth rate for Japan and the US and a 5 percent annual growth rate for Western Europe, an estimated 55 000 tons of imported shrimp (product weight) will be required by these markets in 1990; this corresponds to about 84 000 tons live weight. If it is further assumed that 50 percent of total production is either consumed in producing countries or exported to 'minor' markets, then an increase of 168 000 tons live weight will be required to fill world demand requirements by 1990. Since the 'minor markets' are likely to have higher growth rates in demand, a proportionately greater increase in world shrimp production will be required to achieve the desired level of additional supplies, probably in excess of 200 000 tons.

It is conceivable that most of these additional supplies will have to come from aquaculture. Despite wide fluctuations of annual output levels in individual countries, total world shrimp catches have remained relatively stable between 1977 and 1981. World landings are expected to continue fluctuating from year to year, but further growth in production from shrimp catch fisheries in North and South America and Africa is not expected, as fisheries in these areas have reached a level of full exploitation.

The Asian/Pacific region is well situated to take advantage of the opportunity to provide a major part of the additional production required. Further investments in catch fisheries should be viewed in light of limited additional shrimp resources available for exploitation and the vulnerability of such operations to increased costs, especially fuel. On the other hand, aquaculture operations are much less fuel-intensive and, since shrimp may be packed and frozen within a few hours of harvesting, consistently good quality can be obtained.

The culture of shrimp in the Asian/Pacific region is traditionally a small-scale activity. In recent years, extensive techniques have been applied successfully on a larger scale in both the Asian/Pacific region and in Latin America. Encouraged by high prices, a rapid expansion of shrimp aquaculture projects is being undertaken. Furthermore, substantial resources are being devoted to research, the aim of which is improvements in hatchery techniques, disease control, feed formulations, and other aspects of culture technology.

Although over the period up to 1990 it is anticipated that demand will tend to exceed supply, consistent good quality should continue to be a fundamental element in exporters' marketing strategy. A reputation for good quality facilitates sales to an important degree in times of cyclical weakness in the market.

The remarkable growth achieved by producers in the Asian/Pacific region in the development of shrimp fisheries over the past decade provides a firm base from which to take advantage of the opportunities to supply the markets' additional needs in the years to come.

IV. THE INTERNATIONAL MARKET FOR CEPHALOPODS

Supplies and resources

During the last decade there has been a fifty percent increase in the world production of cephalopods. World catches amounted to some 1.5 million tons (live weight) in 1980 as compared to about one million tons in the early seventies. Squid now accounts for a little over 75 percent of the total, with cuttlefish and octopus each accounting for half of the remainder. Japan, the world largest cephalopod producing nation, catches about 40 percent of the total, although its share has declined over the last decade parallel to the increase in the number of countries exploiting world cephalopod resources. The Republic of Korea, Spain and China rank among the largest producers, with annual yields ranging from 80 000 tons (China) to 127 000 tons (Republic of Korea). But world production is on an upward trend because interest has grown in many countries in developing squid fisheries to increase export earnings, as well as to supplement supplies of food on domestic markets.

The extension of national jurisdictions through the establishment of Exclusive Economic Zones (EEZs) in the mid-seventies had important implications for world cephalopod fisheries. Virtually all major established fishing grounds came under the control of coastal states. The effects of the establishment of EEZs — on national policies and on catch distribution among countries — have already emerged on many fronts. Cephalopod production in some countries, such as Canada, Argentina and New Zealand, has increased significantly, while catches by other countries — e.g. Thailand and distant-water catches by Japan — have declined. Another

result has been an increase in the number of joint-venture arrangements; Japan alone is at present involved in more than ten joint-ventures on squid fisheries.

In the long-run, the new regime of the sea can be expected to lead to a further decline in the cephalopod fisheries prosecuted by non-local vessels, and their replacement by local fleets. In the short-term, however, production is likely to increase due to the existence of under-exploited resources in several parts of the world's oceans and the lucrativeness of cephalopod product sales on the international market.

Despite the rather fragmentary nature of resource data, it is clear that world cephalopod resources are quite large in relation to present catches, and by implication, large also compared with demand levels likely to emerge in the immediate future. Cephalopods are considered to be one of the under-utilized marine resources in several areas of the world's oceans and offer considerable potential for greater exploitation. FAO estimates that the potential catch of squid, cuttlefish and octopus on continental shelfs and the upper part of continental slopes is of the order of several million tons; but if oceanic resources are included, the potential is many times this figure. The future expansion of cephalopod supplies, particularly squid and cuttlefish, will depend to a large extent on whether further efforts are made to exploit stocks which have not yet been utilized. But the outlook for the further expansion of cephalopod production seems bright, the main factor being whether coastal states will take full advantage of the opportunities to exploit such resources more extensively with appropriate management. The extension of national jurisdictions has focused attention on the need for better evaluation of the cephalopod resources to achieve sustained development of local fisheries as well as to allocate appropriate catch quotas for foreign vessels. In many regions, even currently exploited cephalopod resources remain under-utilized. Given appropriate development, management and control, these waters have potential for expanded exploitation.

Utilization and demand

Cephalopods are marketed in many forms: fresh, frozen, canned, dried, salted, salted-fermented, etc. All but three percent of total annual landings of cephalopods are used for human consumption. Nearly 75 percent of the production for human consumption is marketed frozen or fresh. About ten percent is generally subject to some form of curing, about ten percent is utilized for canning, and 14 percent in preparations. The growth of fresh and frozen products over the last several years has been remarkable. Input for preparations has also shown a steady increase. The quantity cured is on an upward trend, although this form of utilization seems to be quite sensitive to production trends. Production of canned squid has shown a considerable decline during the last several years. The amounts used for bait have grown, particularly in Canada and the USA. It is likely that much of any future increases in output will be utilized for fresh and frozen products, and for preparations. Further emphasis upon drying, smoking or other forms of curing may be expected in developing countries where curing is of great significance to prevent product spoilage in light of the shortage of freezing equipment.

The greater part of the world catch of cephalopods is consumed in Japan, which, together with China, the Republic of Korea and other Far East countries, account for nearly 70 percent of the total world consumption. Increased consumption of cephalopods in Southeast Asian countries, in particular the Philippines and Indonesia, are worthy of note. Cephalopods are highly valued in southern European countries, of which Spain and Italy are the most important. Interest in cephalopod products has begun to grow in the northern European countries — e.g. the U.K. and Federal Republic of Germany — in recent years as a result of catering to the needs of southern European workers and the excursions of holiday makers to Mediterranean countries. In North America and Oceania, consumption of cephalopods is still largely confined to ethnic and gourmet groups. Cephalopods are eaten in a number of Latin American and Carribean countries such as Mexico, Uruguay, Argentina, Venezuela and Cuba; the level of consumption, however, is still very low. Cephalopods are not yet accepted in the Scandinavian countries.

Total world requirements for cephalopod products are expected to expand to two million tons by 1990, an increase of over one-third of the 1980 world consumption level. Whilst such marked increases will arise principally from Japan, the demand for cephalopods is likely to increase considerably in other established markets, particularly Spain, Italy, the Republic of Korea and Thailand. Increases will also be notable in developing countries where cephalopods are already known, in large measure owing to the high rate of population increases. However, the pace of growth will be somewhat slower than that of the 1970-1980 period. Available knowledge of resources indicate that world requirements are still far below the estimated potential of world cephalopod resources; there thus seems to be sufficient scope for further expansion of cephalopod fisheries and the maintenance of optimism about the economic and financial viability of harvesting and marketing these large cephalopod resources.

While cephalopod products are not as yet commonly consumed in some large fish-consuming countries, real potential does exist in these countries for obtaining consumer acceptance of cephalopod products by, for example, developing acceptable pre-cooked, processed products, removing the "fishy" flavour from the protein, and other adaptations. But this will require the development of sophisticated marketing strategies suitable to local conditions.

Exports and the prospects for future expansion

World trade in fresh and frozen cephalopods has increased very rapidly over the last decade, the total quantity of such commodities entering world trade channels having grown from 90 000 tons in 1970 to nearly 360 000 tons in 1979. Increases in value have been even more notable, from US$47 million in 1970 to US$936 million in 1979. The main impetus to this increase in trade has been a large expansion of import demand in Japan. Imports by Spain and Italy have also increased

sharply and these three countries together accounted for about 85 percent of world cephalopod imports in 1979. World trade volume in cured cephalopods has been fairly stable over the last several years, ranging from between 4 000 and 5 400 tons. World trade in canned squid has decreased in recent years. The recent emergence of New Zealand, Canada and Argentina in the export market has been a notable outcome of the establishment of the 200-mile EEZs.

In a number of developed as well as developing countries cephalopods are now the most important fishery export item, after shrimp. Prices obtained in export markets have risen steadily year after year due to an increasing demand for fresh food, raw materials for processing, and bait for other fisheries.

The outlook for further expansion in the demand for cephalopod imports is favourable in a number of developed countries. There are clearly considerable additional opportunities for the expansion of exports of cuttlefish to Japan, and for cuttlefish and squid to already-established European markets — particularly, Spain, Italy and France. Consumption is also expected to grow from its present small bases in northern European countries — i.e. the UK and the Federal Republic of Germany — and in the USA and Australia.

It should be remembered, however, that the recent rapid development of cephalopod fisheries by numerous producing-nations for export to Japan and other major market countries, and the increasing level of participation of market countries in joint-venture arrangements, have made for increasingly severe competition among exporters in these established markets.

The cephalopod industry: investment considerations

The establishment or expansion of cephalopod-producing ventures should of course be initiated only after satisfactory answers have been obtained to questions of the resource size, the level of demand in potential markets, the capability of processing products acceptable in the target markets, existing marketing obstacles, and satisfactory returns to fishermen, processors and exporters. But market demand must exist for a venture to be viable. If significant demand obstacles exist in the domestic market, then either overseas markets or small, specialized domestic markets — catering to ethnic, gourmet or tourist groups, for example — should be established first. In this context, the recent Canadian and Argentine experience is instructive. In these nations, the rapid expansion of cephalopod production has been based almost exclusively on export marketing, primarily in Japan. Difficulties arose and production dropped sharply in Canada and Argentina in 1980 when demand for imported cephalopod products fell in Japan due to abundant Japanese domestic landings. This experience argues in favour of cephalopod-producing countries endeavouring to establish a domestic market for cephalopod products, in order to protect producers from the vagaries of the international market and to absorb surplus project output. Market diversification almost always increases the soundness of any commercial venture.

The viability of any venture also rests on the possession of the required expertise. Cephalopod fishing ventures require expertise of a high standard in, for example, the location of and operations on fishing grounds (apart from the problems of increasing operational and marketing costs). In recent years there has been a trend toward employing jigging to catch squid, as squid caught by this gear usually bring a higher price due to the higher degree of freshness. No matter what type of catching method is adopted, it is essential to identify the most suitable methods by taking into account the effects on the other fisheries, cost advantages associated with the different types of methods, and resource conditions. In this context, considerations should be given to whether cephalopods would best be fished by existing fishing gear (e.g. trawling) as an incidental catch, or by specialized gears with cephalopods the target species. When the domestic market for cephalopods is small, large-scale fishing operations are often not viable unless they also aim at catching other species (e.g. hake in the case of Argentina). If this is the case, it would also be necessary to explore the market for the other species caught as well as that for cephalopods.

V. THE WORLD MARKET FOR FISHMEAL WITH PARTICULAR ATTENTION TO THE ASIAN/PACIFIC REGION

Overview

The study presents a thorough description and analysis of the world fishmeal economy, and considers the position of the Asia/Pacific region within the world market. Accordingly, trends in production and consumption are examined, and this analysis serves as the basis for projections of supply, demand the price up to 1990.

Fishmeal is a high protein animal feedstuff, which is particularly valued over its vegetable-based competitors for its excellent balance of amino acids, its vitamin-B content, and its unidentified growth factor (UGF). These features make it an important component of the diets of simple-stomached animals, particularly in the early stages of their growth, and allow it to command a price premium over its competitors. The largest concentrations of demand for fishmeal are found in countries where production of poultry and pig meat is a large-scale activity, although fishmeal is imported in small quantities into a large number of countries.

Production of fishmeal is determined by the level of available resources. The relatively few large producers and exporters of fishmeal concentrate on the exploitation of a small number of species and annual production of fishmeal is therefore constrained by the behaviour of the stocks of these species. The tightness of this link between the level of fish resources and fishmeal output has injected considerable instability in the market. World production grew steadily throughout the 1960s, but in the early 1970s a fundamental shift occured in the world fishmeal economy in response to the disappearance of the South American anchovy stocks which had been the basis of the Peruvian fishmeal industry. Since 1973, production of fishmeal has shown no tendency to increase; rather, it has fluctuated, often quite widely, around a mean volume of just over 4.5 million tons per year.

Demand for animal feeds in general has continued to grow quite rapidly in response to large and growing consumer demand for meat and animal products. This growth has occured in both developed and developing countries, and the subsection of the animal feed market in which fishmeal competes — the market for high protein feeds — has participated fully in the growth. Faced with a fundamental supply constraint, this growth in demand has led to increases in price over the past decade. This tendency for price to increase is somewhat obscured by the large annual fluctuations in fishmeal production which cause wide fluctuations in price, but evidence is presented that real fishmeal prices have been moving upwards.

These features of production and demand, and the behaviour of prices which they jointly imply, are used in developing projections of the likely evolution of the fishmeal economy to the year 1990. The analysis suggests very strongly that world fishmeal prices will continue to rise, reaching US$542 per ton (in constant, 1977 dollars) by 1990. Fishmeal will continue to command a substantial price premium over soyabean meal, its most serious competitor, but that premium will be approaching its maximum possible level by 1990. These projections are based on quite conservative assumptions, but forecasting methodology is explained in considerable detail to allow an assessment of the sensitivity of the projections to different assumptions about the future behaviour of supply and demand.

The Asia/Pacific region is of considerable importance in the world fishmeal economy. This is largely because Japan is the world's largest producer and consumer of fishmeal, but demand for fishmeal is large and growing in all countries of the region. This is due to the massive demand for meat which exists in the region; however, the mechanisms employed in the region for the satisfaction of this demand have led to the production of large amounts of fishmeal which is of low quality in terms of both its protein content and its toxicity. Although it is stressed that the production of this low quality fishmeal is, to a large extent, a rational response to the economic environment in which fishmeal manufacturers and livestock farmers operate, valuable fishery resources are wasted by being used in its manufacture. Outside Japan, where there is a substantial industrial fishery, fishmeal production in the region relies primarily on trashfish, the by-catch of vessels fishing for the human consumption market. The possibility of establishing a mesopelagic fishery in the region to support fishmeal manufacture is examined in this study, but it is concluded that it is not a feasible option at the moment.

The main body of the report clearly indicates that the prospects for fishmeal are favourable over the next decade, and this conclusion constitutes a recommendation for careful investment. More specifically, attention is devoted to ways in which existing fishery resources can be used to produce more, better-quality fishmeal, in the event that financial resources are invested in fishmeal manufacture. In terms of quality, the importance of links between fishmeal users, fishmeal producers and raw material suppliers is stressed. In terms of increasing production, the availability of ice for the preservation of trashfish is identified as a constraint. It is also pointed out that the expansion of fish processing activities in the countries of the region will result in the increased availability of raw material for producing fishmeal.

Development constraints and opportunities

Examination of the fishmeal economy in Asia has led to the conclusion that there are three major constraints to the further development of the fishmeal industry in developing Asian nations, the importance of which varies from country to country. They are, first, the quality of the meal produced, second, the official aversion, in some countries, to diverting fish from the human consumption market, and third, the availability of resources. Each of these constraints prompts different recommendations, which are discussed below. The investigation embodied in this report also gives rise to some more general conclusions, which are presented at the end of this section.

Raw material

It is stressed throughout the report that fishmeal production is largely a question of the fishery resources available for processing. The resource constraint is, therefore, the fundamental one, and is the most important reason behind the steady increase in world fishmeal prices projected in this report. Thus perhaps the most serious obstacle to the development of the region's fishmeal industry is the availability of raw material suitable for processing into fishmeal. This arises because of the very high consumer demand for fishery products in all the countries of the region, and has two effects. The first is that fishery resources are heavily exploited for the human consumption market — there are no industrial fisheries outside Japan. The second is that extensive fish processing is not widely developed in the region, since consumers have a marked preference for fresh or dried over frozen, and to a lesser extent, canned fish. This reduces the availability of offal for reduction into fishmeal. Accordingly, the fishmeal industry in the region relies almost entirely on trashfish for its raw material, an arrangement with certain disadvantages.

The relatively low level of fish processing in the region and the absence of industrial fisheries means that fishmeal production must rely on the availability of trashfish for raw material supplies. There are two principal disadvantages of such a reliance. The first is that the quality of the raw material is difficult to control. In Thailand, excess sand is not washed off the fish, and elsewhere fish which are simply not fresh enough to be sold for human consumption are diverted to meal production. This lowers the quality of the finished meal. There is also a difficulty caused by the mixture of oily and white fish which are found in the trash fish haul, since the oil content of the fish affects the oil and protein content of the meal. The second disadvantage is that the links between meal production and the fresh fish market are too close, which has two effects. When supply of trashfish for meal production is profitable (or at least reduces the losses on other fishing operations), there are incentives to fish too heavily, and,

since a proportion of trashfish will inevitably be immature fish of species which are caught for human consumption, fishing to maximize a trashfish haul will have consequences for the future yield of fishery resources. In addition, the constraints on storage space and refrigeration on a trawler at sea for more than a single day means that it is usual for only the last day's haul of trashfish to be saved; the catch on previous days is simply returned to the sea. Since most of the fish in such a catch will be dead by the time they are returned to the sea, this constitutes a serious waste of resources. The wastage from the point of view of the fishmeal industry is even more serious, since the trashfish caught while a trawler is operating in deep water are better for meal production purposes than those caught in shallow water on the last day of fishing, or by inshore boats. ("Better" in this regard means that the catch contains less mud and a lower proportion of crustaceans and other species less suitable for processing into meal).

There are two possible steps which could be taken to improve this situation. The first is to institute quality grades which encourage fishermen to wash their trashfish before storing it. This is properly seen as the responsibility of the fishmeal manufacturers. The second is to increase the availability of ice. Icing trashfish from trawl catches on early fishing days would preserve this superior raw material for processing, and would also improve the freshness of even the last day's haul of trashfish. The cost to fishermen of icing their catch would necessarily have to be lower than the extra return they could be offered by meal manufacturers for the improved raw material. But there is a serious shortage of ice in almost all the countries discussed in this report. It is particularly acute in Malaysia and the Philippines. But the easing of this shortage would benefit not only the fishmeal producers; ice is of great importance to the distribution of fish for human consumption. It is recommended that possible investments in ice manufacturing facilities be considered in the light of the impact they would have on the fishmeal economy.

The relatively low level of extensive fish processing activities in the region precludes processing offal as an important raw material for fishmeal production. But the outlook for increasing supplies of offal is reasonably encouraging. The fish canning industry has expanded rapidly in recent years in Thailand and the Philippines. Canning operations 'automatically' create raw material for fishmeal production, in that fish heads, tails and other offal must be either processed or thrown away. The manufacture of meal from the offal of canning — and freezing — operations can increase the profitability of such operations. The profitable use of fish processing offal for meal production should be encouraged in the region. Investment plans for canning and freezing operations should be considered in the light of the possibility of establishing fishmeal operations in tandem. Given the high demand for fresh, rather than processed, fish in the region, such operations may be geared towards export markets; the foreign exchange arguments in their favour apply also to import-substituting fishmeal. The feasibility of such joint operations will depend on an assessment of the size of the canning operation (and thus the volume of available offal) and the type of fishing operation which is involved (i.e. the target species, and whether any supplies of trashfish would be available to augment the supply of offal).

The most important 'new' resource available for fishmeal production in the region are mesopelagic resources. We are unable to recommend that a mesopelagic fishery be established in the Asia/Pacific region at present. However, this conclusion could change in the light of new information. Developments in the fishing industry in the Arabian Sea should be closely followed; this is the area of the world where a mesopelagic fishery is most likely to be established, and the information which would come from the establishment of such a fishery would be valuable for countries in South East Asia. This information would be both economic (catch rates and costs, for example) and scientific (the response of mesopelagic stocks to extensive fishing). Further, scientific research in the Eastern Indian and Western Pacific Oceans should be encouraged in order to establish with greater confidence the concentrations of mesopelagic resources, and to identify areas where fishing might begin.

Fish for human consumption versus fishmeal

There is a widespread feeling, both in the countries in the region and in the major international donor institutions, that the priority in expanding fisheries industries must be given to catching fish for human consumption. This feeling manifests itself in varying degrees of government hostility to the fishmeal industry. In Japan and Thailand, this is not a consideration, but the Indonesian government has only recently reversed its policy of attempting to divert all fish to human consumption, and, in the Philippines, the recently published Integrated Fisheries Development Plan makes scarcely a mention of fishmeal. The concern is not only over the use of fish stocks, but reflects the fear that investment resources used in the production of animal feeds are not an efficient means of improving standards of human nutrition. These concerns are certainly laudable, but it must be appreciated as fact that consumer demand in the region for meat is large and growing, and implies a demand for animal feeding stuffs. This demand can be suppressed by taxation or other government regulation, it can be met by imports, or it can be met, to some extent at least, by domestic production. Governments will decide among these alternatives on the basis of their own criteria. It is assumed in this that import substitution will be welcomed, although it is not necessarily optimal for all countries to increase their fishmeal output. Further, it is worth pointing out that fishmeal is readily converted into Fish Protein Concentrate (FPC), which has been marketed as a human food and is of great nutritional value. Standards of hygiene must be high in its manufacture, of course, but the advantages of such processed foods are many. There are, nevertheless, well known difficulties in securing consumer acceptance of nutritional concentrates which are very often perceived unfavourably, and the chances of FPC gaining widespread popularity must be assessed as slim. A factory making FPC has recently been established in Sri Lanka, after the product was successfully marketed on a trial basis. It is

recommended that this experiment be monitored closely, with the aim of reviewing, in a few years, whether the Sri Lankan experience with FPC has any lessons for the fishery industry in Indonesia or other countries in the region. In the meantime, the right of governments to oppose expansion of fishmeal production must be respected, although it should be noted that none of the recommendations proposed in this report involve the utilization in fishmeal manufacture of fishery resources which can be used for human consumption.

Fishmeal quality

The fishmeal produced in the Asia/Pacific region falls into one of three categories. The Japanese produce a meal which is high in protein, low in oil, low in extraneous waste material (such as sand), and free from bacteria. This meal is produced to very high standards. Indeed, the market for fishmeal in Japan is extremely quality conscious. Although the domestic market is protected to a certain extent, domestic producers do compete with international supplies and thus must guarantee the highest quality standards. Outside Japan, there is only limited production of fishmeal of such a high-quality.

In Thailand, fishmeal is of lower quality. Protein content is lower, and the oil and sand content of the meal is higher. Thai fishmeal at the moment cannot compete with meal from the major Latin American and European suppliers. The European and Japanese markets are effectively closed to Thailand because demand in these markets is for a standard of quality which Thai fishmeal does not attain.

Elsewhere in the region, the bulk of fishmeal production is of still lower quality. Produced either in small factories with basic technology, or made by the farmer himself by sun-drying and grinding fish, the meal is of indeterminate but low protein content, high in oil and other extraneous matter, often rancid and most often diseased. Many major feed compounders in the region will not use locally-produced fishmeal in their mixes. The manufacturer of such meal relies on direct sales to farmers for his market. There is a small amount of high-quality production in many countries, notably in Malaysia, but the above characterization of the industry is, in broad outline, correct.

Clearly, there are good economic reasons for this: low-quality product is a rational response by producers to a perceived set of demands. The Thais, for example, are certainly capable of producing fishmeal which meets European and Japanese standards. Thai fishmeal producers employ highly trained technicians and use sophisticated machinery in their production. Their incentives, however, are such that it is rational for them to produce low-quality fishmeal. And a parallel argument works for the large numbers of small-scale producers in other countries, which manufacture fishmeal of extremely low-quality. It is necessary to examine briefly the pattern of consumer demand for meat in the region, the ways in which this demand is met, and the nature of trade-offs between animal weight gain and the price at which meat is sold in order to appreciate the demand to which fishmeal producers in the region are responding.

In Indonesia and the Philippines, the demand for protein feeds is enormous. Livestock production is increasing rapidly, and even conservative assumptions about the growth of livestock populations lead to a projected demand for feed which is greater than local feed compounders can reasonably be expected to meet. A considerable amount of livestock production must therefore rely on informal feeding. In these countries, livestock production takes one of two forms. There are large, sophisticated operations which raise animals intensively, and produce meat for the urban market. Producers in this sector buy pre-mixed compound feed, manufactured by feed compounders to high nutritional standards. Imported fishmeal (i.e. high-quality fishmeal) finds its market here. These livestock and feed operations are finely costed; feed rations are calculated to optimize growth in a specified period of time, to prepare the animals for slaughter and final consumption in an urban market. Second, there are much smaller operations in great numbers, where animals are fed less intensively and where livestock production is integrated in other operations of a farm. The farmer in this 'extensive' sector probably cannot afford compound feed, and his animals are not treated like the animals in intensive livestock operations. These two industries demand different types of protein feed. Although both of them demand a commodity going under the generic title of 'fishmeal', in other respects the differences between the product they each require are enormous.

Feed compounders are in the business of meeting the total nutritional needs of animals at minimum cost. Their operations demand accurate knowledge of each commodity they utilize. Without this knowledge they cannot be sure that their final mixes will meet the desired specifications, nor can they be sure that the formulations they have used in mixing their feeds are indeed least-cost solutions. A farmer in the extensive sector in contrast, does not need such accurate knowledge about the fishmeal he buys. It is not part of a carefully controlled total diet and, since he is not able to quantify the other components of the diet, it would be pointless for him to pay for very precise knowledge about the properties of the fishmeal he buys. One way of describing the difference is to say that the sophisticated compounder is buying not just fishmeal, but also accurate knowledge. The farmer does not need, and should not pay for such knowledge. The world price of fishmeal is set with reference to the demands of sophisticated feed compounders, and this is determined by the value of fishmeal in a carefully controlled diet for intensively raised livestock. The farmer raising a small number of chickens for sale in the local market would be foolish to pay a price for fishmeal which is based on its value in production activities in which he does not engage.

If the production of high-quality fishmeal required no additional costs beyond those of producing low-quality fishmeal, then it would make sense to recommend the upgrading of existing fishmeal facilities. But in reality the costs appear to be significant. This can be seen with reference to Thailand, where fishmeal is not of the highest quality. The reasons

offered by the Thai industry for the low protein content of the meal, provide some insight into the problem of the costs of low and high-quality production. High oil content, which is explained by the fact that no serious effort is made to extract the oil from the fish during processing, is maintained as the principal reason. (Certainly, failure to extract oil does lower the protein content, but this is, we think, secondary to the problem of sand). The processing technology employed in Thailand is straightforward, and involves only a few less stages than standard European technology. The Thai industry further maintains that 'European' technology requires heavy capital outlays and high energy costs. The technology utilized in Thailand at present uses wood chippings and sawdust as the primary energy source, which are very cheap. Thus, it can be seen that the perceived costs of improving quality are greater than the perceived gains, since the demand for the present product is strong. (Fishmeal is also sold in Thailand by weight, not by unit of protein, which in itself is hardly an incentive to increase protein content).

There are other incentives for low-quality production on the supply side, in addition to these demand factors, which can again be seen with reference to Thailand. Demand for protein feeds in Thailand is very strong, and this demand is behind the rapid expansion of the Thai fishmeal industry. Supplies of alternative forms of protein are not readily available, which gives fishmeal a price premium, and allows the producers to skimp on quality. The profitability of production has led to a heavy bidding-up of the price of trashfish, the raw material, which is sold by weight. It is therefore not in the interest of fishermen to clean the fish of all sand, since sand adds to the weight of what they sell. Fishmeal producers would only have an interest in imposing quality grades on trashfish if poor quality affected the price at which they can sell their fishmeal. Since other supplies of protein are not available, and since animals respond well even to poor quality fishmeal, suppliers are not faced with a discount for poorer quality fishmeal. Thus they have no incentive to increase the quality of their production. Thai fishmeal finds a ready export market in the region because it is of superior quality to much other local production, and thus is readily incorporated into the mixes of feed manufacturers whose standards (and markets) are less sophisticated than those of the large compounders in Japan or even the Philippines.

Since the costs of producing high-quality meal are significantly greater than those of producing low-quality meal, it is rational for fishmeal manufacturers to continue to produce low-quality fishmeal for as long as there is a market among small livestock producers for a product which contains protein, but not in the carefully measured and precisely predicted proportions needed by the sophisticated feed compounder. Only if available supplies of raw material are in excess of what is needed to meet this 'informal' demand, or if the premium offered by feed compounders rises substantially, will local fishmeal manufacturers expand the production of high-quality fishmeal.

The linkage between demand for meat, techniques of meat production, supply of compound feed, and demand for and supply of the ingredients used in feed mixing are complex, and high-quality fishmeal finds a market only when meat and feed production techniques are 'westernized' (e.g. in Japan, and in parts of the Philippines). In the remainder of the region's meat/feed economy, the quality of the fishmeal is a response to the demand of meat producers and feed compounders. Therefore, upgrading the quality of all the fishmeal produced is inappropriate unless the other sectors of the meat/feed economy are similarly changed. This does not mean, however, that quality does not constitute a constraint on the development of the fishmeal economy in the region; it is not sufficient to claim that quality will improve, on its own as it were, as the meat/feed economy becomes more sophisticated. For although Thailand certainly has the potential and capability to become a supplier to the world market for high-quality meal, it has not done so. And although the market for high-quality fishmeal is expanding rapidly in the region and represents a substantial drain on foreign exchange (and, perhaps, lost profits for domestic entrepreneurs), and there is thus the opportunity for substitution on the part of manufacturers away from low-quality production towards high-quality production, the quality of much of the fishmeal produced in the region remains a major impediment to its acceptance on the world market, and to its utilization in domestic feed compounding.

There is thus considerable scope for the improvement of the quality of fishmeal production in the region. Improved quality is essential for locally-produced meal to take a part in meeting the massive demand of Japan for fishmeal, and the demand of the large feed compounders in other countries in the region. Improvements in the quality of fishmeal reaching the 'informal' livestock producers will also lead to benefits in terms of animal health and farm income. The problem, as we have stressed, is the pattern of economic incentives for existing fishmeal producers. In these circumstances, a key task is to demonstrate the profitability of manufacturing high-quality meal. This can be done by establishing reasonably close cooperation between raw material (especially trashfish) suppliers, manufacturers and feed compounders. The Thai economy is sufficiently flexible that the fishmeal manufacturers could improve the quality of their production quickly if the incentives existed. Limitations on quality improvements are imposed by the absence of oil extraction equipment in the factories, but the most important problem is the level of sand in the finished meal. This could be remedied by the institution of quality grades for trashfish; the Thai Fishmeal Manufacturers Association could impose such grades. This will not be an easy task, however, given the strong competition for trashfish among Thai producers, and the strong demand for Thai meal at present quality levels. But if local feed compounders were willing to guarantee the purchase of local fishmeal of guaranteed quality at sufficiently attractive prices, locally-produced fishmeal could replace imported meal to some degree, and Thai fishmeal manufacturers would be able to guarantee sufficiently attractive prices for improved quality trashfish. A similar arrangement might be more easily arranged between fishmeal operators associated with fish canning operations and fishermen supplying

these plants. Fishmeal of high-quality could be manufactured, for example, from the offal from tuna processing and the by-catch of tuna vessels.

Such arrangements as discussed above might be effectively instituted in the Philippines. Fishmeal production levels in that country are currently low, but there is a strong, geographically concentrated demand for high-quality ingredients for feed mixing that could at least be partially met by meal produced in association with canning operations. Malaysia is also concerned to reduce its dependence on imported fishmeal, and the demand for compound feeds is strong and growing. Better use of the landed trashfish could be made by a high-quality fishmeal industry, and the upgrading of the local industry is both feasible and desirable. Malaysia also has some experience with the installations of capital equipment for the production of high-quality fishmeal.

General policy considerations

Fishmeal production in the region has grown up on the back of the large and important fishery industry. But it has grown to the point where it plays an extremely important role in the satisfaction of the huge and expanding consumer demand for meat in the region's economies, and thus should no longer be regarded as a minor by-product of the fishery industry. Although the possibilities for expansion of fishmeal production identified are few, there is a strong case for considering the impact on the fishmeal economy of broadly-based fisheries projects, especially since fishmeal production can be seen as complementary to fishing activities directed at human consumption markets. This is a general recommendation about the way in which all fisheries projects should be viewed. More specifically, an investigation of the potential role of fishmeal in the Philippines, in the light of the recently completed Integrated Fisheries Development Plan, would be an extremely useful undertaking. It is believed that a proposal for such an investigation would be favourably received by authorities in that country, and the possible outcome of such a study — the expansion of the fishmeal industry in the Philippines — would be a major stimulus for the examination by other countries of the potential of their fishmeal industries.

Standards of animal nutrition in the countries examined in this report are not particularly high. But mechanisms of livestock production which have grown up in these countries are efficient responses to the large demand for meat in the region; however, this degree of economic efficiency is attained at the cost of technical inefficiency in the production of livestock. Of course, what is optimal from the point of view of technical efficiency is rarely the same as what is optimal from the point of view of economic efficiency, and this divergence is not usually cause for concern. In the case of livestock production in the region, the demand for meat is so strong that farmers can profitably produce it even though the technical conversion rates they achieve are low. Better feeding practices would improve this position considerably. (In this context, "better" refers to the quality of individual ingredients and the nutritional mix of feeds animals receive). It is therefore strongly recommended that support be given to programmes of education about animal nutrition, especially those directed at the 'informal' sector where there are considerable gains to be made. Education and extension efforts should, of course, concentrate on improving the use of feedstuffs which are readily available to local farmers. Once farmers are in a position to appreciate the nutritional and economic advantages of better feeding, economic pressure will be exerted on local fishmeal producers to upgrade the quality of their production.

Furthermore, the extent to which the production of low-quality fishmeal is a rational response to perceived demands for animal feedstuffs should not be allowed to disguise the fact that animals' health can be seriously impaired when they are fed on toxic meal. Alpha toxin and salmonella are major problems in the locally-produced fishmeal of many of the countries discussed, and the fact that the economic rationality of present production arrangements have been emphasized does not mean that animal health is an unimportant consideration. Education about animal health could and should be linked to education about animal nutrition.

A final point is that the barriers to international trade in high-protein feeds noted in this report are seriously distorting the economics of meat production in the region. The livestock sector would benefit greatly from a liberalization of trade in both fishmeal and its competitor products. Additionally, the institution of the practice of buying and selling fishmeal on the basis of its protein content rather than its weight would help stimulate improvements in the quality of fishmeal produced in the region. To some extent, the development of the compound feed industry and improvement of the level of farmer education in animal nutrition will lead to the institution of such a purchasing system, but autonomous moves in this direction should be encouraged.

VI. THE WORLD SEAWEED INDUSTRY AND TRADE

Due in large part to its complexity — biological, technical and commercial, the world seaweed industry remains among the least-known of the world's marine-based industries. This is in spite of the fact that the industry contributes in some way to almost every aspect of modern life. Seaweed products find use as fertilizer, animal feed, and as food for direct human consumption. The most dynamic sector of the industry — and the focus of this report — utilizes selected seaweed species to manufacture a formidable array of seaweed colloids which, in turn, find use in a truly remarkable variety of commercial applications, from air freshners and textiles to pharmaceuticals and processed foods.

Marine seaweeds occur in an incredible variety of life-forms, but are generally classified into four main groups, largely on the basis of pigmentation: red, brown, green and blue-green seaweeds. This report focuses on red and brown seaweeds, which account for the majority of seaweeds of commercial importance. Over 650 000 tons (dry weight) of seaweed were harvested during 1980 for use in the manufacture of seaweed colloids (about 270 000 tons), and for use as food for direct human consumption (about 385 000 tons — almost exclusively in Asia). But of the thousands of species

of seaweeds that grow in marine waters, relatively few are of commercial value, and end-product usage dictates very strictly which species may be utilized as well as their relative values.

While the seaweed industry has traditionally relied on the exploitation of naturally growing, or wild, seaweeds to fill its raw material requirements, the accelerating pace of advances in seaweed culture techniques in concert with the expanding demand for seaweed products and the rising costs of operation in industrialized countries (where most of the seaweed processing industry is located) have created forces with the potential to alter the global distribution of the seaweed industry. This is particularly true for the seaweed colloid industry.

Seaweed colloids

Various red and brown seaweeds are utilized to manufacture four seaweed colloids: agar, alginate, carrageenan and furcellaran. A colloid is a non-crystalline substance with very large molecules, which dissolves to give viscous or sticky solutions. Seaweed colloids are used to thicken (increase the viscosity) of aqueous solutions, to form gels, to form water-soluble, oil-repellant films, and to stabilize some products. Their use, based on these properties, cover a wide range of products in a variety of industries. Utilization of seaweed colloids is increasing, the growing popularity of prepared, pre-packaged and "instant" foods being an important element in this increase.

Exacting technical requirements for the manufacture of seaweed colloids — especially carrageenan and alginates, involving production technologies which are closely guarded by the world's few manufacturers, and the requisite expertise and costs associated with the effective marketing of these colloids, make for barriers of significant consequence to developing producers wishing to enter the trade.

Agar and seaweeds for agar

International trade in agar and in seaweed for agar manufacture is active and expanding. Both are expected to continue expanding because, primarily, of the increasing demand — from both developed and developing countries — for bacteriological agar, and for agar strip for foods in Asian countries. The current high price of agar is limiting its use in Asian foods, and is allowing some competitive colloids, like carrageenan, to replace it in other uses, such as the canning of meats. Increased production of agar-bearing seaweeds, particularly those yielding bacteriological agar, would no doubt facilitate the expansion of the agar industry as a whole if it resulted in some moderation of agar seaweed price levels.

Many of the developing Asian nations discussed in this report could certainly participate in the future expansion of production of agar-bearing seaweed and of the agar itself. India has already developed a process for agar manufacture, using wild (naturally growing) *Gelidium* and cultured *Gracilaria*. Indian agar production currently does not meet the domestic demand. Expanded production is dependent on additional supplies of seaweed; research is now in progress on the mariculture of *Gelidiella,* a seaweed which gives a higher quality agar (greater gel strength) than *Gracilaria*. The mariculture of *Gracilaria,* already established in the Republic of China and India, is under study in the Philippines, Malaysia, Indonesia and Sri Lanka. Field trials have begun in the Philippines, Malaysia is negotiating arrangements to begin small-scale trials, and Indonesia has surveyed areas for suitable sites. Sri Lanka ran pilot trials in 1975, but have not proceeded further.

In that the present production of agar-bearing seaweeds in the two main producing areas among developing Asian nations — India and the Republic of China — are now fully utilized, market potential for additional volumes of such seaweeds from mariculture operations in other countries in the region is judged to be very encouraging. If some of the countries considered here do undertake the mariculture of *Gracilaria,* however, it would be logical to link such efforts to the manufacture of agar, rather than simply export dried seaweed. In this way value-added benefits would accrue to the national economy(ies) involved, and present imports could be supplanted by a domestic product, with potential for the generation of export income from any surplus supplies. The production technology for agar manufacture is not overly complex or inaccessible, and the development of the requisite technology is not outside the resources of any of the countries discussed in this report. Agar manufacturing has the advantage of being feasible on both a small or a large scale, with the corresponding capital outlay. Development work on a process for agar extraction should commence at the same time as mariculture trials are begun, using the species selected for mariculture.

Carrageenan and seaweeds for carrageenan

The supply and demand for kappa-carrageenan seaweeds is in reasonable balance at present, with the usual minor periodic fluctuations. Nearly half of the world supply now comes from mariculture of *Eucheuma cottonii* in the Philippines. Unfortunately, however, the marketing network in that nation is poorly organized, so that detrimental cyclical variations of good/poor quality, excess/insufficient output, and high/low prices are a serious problem. The demand for iota-carrageenan, produced from *Eucheuma spinosum,* is increasing steadily, and there is a need for an improved supplies of this seaweed (better quality and more constant production). The mariculture of *E. spinosum* has not been as successful as that for *E. cottonii*; to date the growth pattern of *E. spinosum* in culture operations has been somewhat erratic.

While there is potential for developing Asian nations to produce and enter the market for carrageenan-bearing seaweeds, caution should be exercised. At present market demand for *Eucheuma spinosum,* which yields iota-carrageenan, is stronger than that for *E. cottonii,* yielding kappa-carrageenan. Any significant increase in supplies of the latter species through mariculture could quickly lead to an over-supply situation. Indonesia is experimenting with the production of *Eucheuma,* especially *E. spinosum,* and is negotiating with UNDP for assistance. In Sabah, Malaysia there

is interest in developing *Eucheuma* culture in the Balabac Straits at the northern extremity of the country; some initial tests have been made. Any developing Asian nation wishing to develop mariculture of either type of *Eucheuma* would be wise to ensure a market for the output by simultaneously establishing itself in the production of either semi-refined or refined carrageenan.

The market for the normal grade ("refined") of carrageenan is growing slowly, about five percent per annum. Utilized in many prepared, pre-packaged foods in developed countries, its use has been affected by the current world recession. However, in the last two to three years a new type of carrageenan ("semi-refined") has been produced in the Philippines. This product contains some insoluble material, and thus will not yield clear gels, but its price is about 50 percent of that for refined carrageenan, and it may be used in many applications where gel clarity is not important. Semi-refined carrageenan also has the advantage of being easier to manufacture than refined carrageenan. It is feasible for an entrepreneur to develop the processing technology on an experimental scale for a modest capital outlay, and then gradually increase the scale of operation. This is in contrast to the production of refined carrageenan, which involves a much more complex process. But before committing any funds to the establishment of a plant for the manufacture of semi-refined carrageenan, any investor should carefully examine the status of the market for this product. If new applications for semi-refined carrageenan are found, the market could well be expanding; otherwise, any new production might simply replace refined carrageenan in established uses, resulting in a much more limited sales potential. But because of the lower price for semi-refined carrageenan, it is very possible that the rate of market expansion for carrageenan will accelerate as new applications for the new, lower-priced semi-refined product are found.

While it may be feasible to develop independently the processing technology for refined carrageenan on a small-scale, expansion would present many problems which can be both time consuming and costly. The marketing of refined carrageenan is also considerably more difficult and expensive. Investors interested in entering the refined carrageenan trade may find it safer and faster to enter into a joint-venture with an established producer. Joint-ventures with producers in France, Spain or Portugal, in particular, may be feasible; it would be necessary, however, to identify a potential foreign partner who wishes to expand his manufacturing capabilities, and who is thus willing to commit the required capital investment to do so. Any entrepreneur who embarked independently on producing and selling refined carrageenan should be prepared to wait two to three years for any appreciable return on investment; it would be advisable in this case to scale up production, and hence sales, in small, gradual steps.

Alginate and seaweeds for alginate

International trade — in the traditional sense — in seaweeds for alginate production has never been great because most alginate producers arrange their own collection of seaweed and only enter the market when they have a shortfall from these normal sources. At present the supply is adequate to meet the demand. If anything, there is a slight oversupply because of the levelling-off of alginate sales associated with the world economic recession. The bulk of demand for alginates comes from the textile and food industries. Sales to the textile industry are currently down, while those to the food industry are rising marginally, so that overall the position is fairly static and will probably remain so until the current world recession eases.

Under these conditions, real potential for developing Asian producers and exporters can only exist where a domestic market for both the seaweed and the resulting alginate exists. There is a possibility of increased usage of alginate in India by the textile printing industry, but the source of alginate — *Sargassum* species — yields a poor-quality alginate for this use. The importation of better species could help the problem but the government prohibits seaweed imports. The Philippines is interested in alginate production from *Sargassum* but has little domestic market for it. The Republic of Korea has suitable seaweeds, and actually imports alginate in appreciable quantities, but the industry and government successfully pursue a policy of garnering the more substantial returns available from selling the seaweeds for food purposes.

Seaweed for direct human consumption

The primary consuming countries for edible seaweeds are Japan, the Republic of Korea and China, thus the bulk of international trade in edible seaweeds is between these nations. There is some minor trade with other countries where nationals of the former have settled (e.g. the Japanese community in the United States). The trade is mostly in dried brown seaweeds, some salted, wet brown seaweeds, and the red seaweed *Porphyra*. With the exception of the Republic of Korea, there is little potential for developing Asian producing nations to enter this market because their marine environments are too warm to allow the growth of the seaweeds in demand. The Republic of Korea does have suitable water and is already heavily involved in the mariculture of edible seaweeds.

There is, however, potential for selected developing Asian producers to expand production and augment domestic market supplies for fresh, edible seaweeds such *Caulerpa, Ulva, Gracilaria* and *Eucheuma*. In the Philippines, for example, *Caulerpa* has been cultured in ponds in the Visayas for some years, and pilot trials on a different species are being conducted near Manila. The product is in high demand as a salad vegetable.

Seaweed for fertilizer and animal feed

Seaweed meal, made from dried and ground brown seaweed — particularly *Ascophyllum* species — has traditionally been utilized for these purposes. The large suppliers were formerly European countries, but the rising price of oil has caused artificial drying to become too expensive, and their production has fallen. There is potential for developing Asian producers to enter this market; most, because of their climate, could arrange natural drying of the seaweed and offer a

cheaper product. The main brown seaweeds available in the region are *Sargassum* species, which have not been used widely for these purposes. Some trials, as fertilizers and animal feed additives, may be necessary to establish their usefulness to the market.

Liquid extracts of brown seaweeds have been found in recent years to be effective fertilizers suitable for use by market gardeners, orchardists, etc. This is another product with potential for both domestic use and for export by developing Asian producers. For such countries, this product has the advantage of very low technological requirements and a small capital outlay.

Seaweed as a feed for aquatic animals is a use which has been developed in the Republic of China. The same principle could be applied in other developing Asian areas where aquaculture is an important industry, such as the Philippines, Indonesia and Thailand, among others. In Taiwan, *Gracilaria* has been grown in ponds with milkfish and with shrimp, although the latter give a lower economic return. The milkfish graze on epiphytes on the *Gracilaria,* and eventually on the *Gracilaria* itself if they are left in the pond for long enough. Producing such a dual crop is quite profitable. More recently *Gracilaria* from mariculture has been used as a feed for abalone in Taiwan.

VII. DRIED FISH MARKETS IN ASIA

The volume of trade in dried fish products among the countries surveyed in this study is small compared to that in frozen and canned fish commodities. Production and consumption of dried fish, in these countries, however, exceed by far production and consumption levels of frozen and canned fish. Cured fish products are of prime importance in the diets of Asian populations, and domestic demand is so strong that prices attained in local markets leave intra-regional and international trade, with its necessary export procedures, mostly unattractive. Therefore the biggest producers are not necessarily the biggest exporters. Valuewise Thailand is the leading exporter, followed by Singapore and Malaysia. The two city states of Hong Kong and Singapore are of course in a special situation and lead as importers of dried fish in the group of countries covered in this study. A few higher-priced speciality items like sharkfins, beche-de-mer, fishmaws, dried abalone, dried shrimp and dried squid and cuttlefish, account for the lion's share of trade in the region, and are products which encounter excellent demand conditions. The reason for the traditional as well as current high consumption of dried fish in the region is that this was the only preservation method available for fish over many centuries. A variety of traditional dishes include cured fish products as the main portion of the meal, but they are also included in many dishes as condiments.

In many remote areas fish drying is the simplest method to preserve catches, but any efforts are required to upgrade the hygienic standards of processing. Simple drying equipment is a subject often raised in the countries surveyed, as insect infestation and seasonal weather changes often cause high spoilage rates.

Dried fish, regarded by many as "poor peoples" food, has not only maintained its importance in the major producing countries, production has even increased. However, consumers have become more quality conscious and improvement in product processing and presentation is becoming more important. With this process already underway — e.g. in the Philippines, where dried fish stalls in modern shopping centres are not uncommon — and market prices and requirements becoming more transparent, there is increasing interest in international trade. Countries in a position to provide the products in favour at a competitive price should find increasing demand. This refers especially to the high-priced items; lower-priced, poor-quality dried fish is expected to become less important, be replaced by fresh and higher-quality cured fish products.

VIII. HIGH-VALUED FINFISH MARKETS IN HONG KONG, SINGAPORE AND JAPAN

Overview

Market prospects for high-value fish species in Hong Kong, Singapore and Japan are encouraging, with all three markets experiencing growth. This is largely a product of the overall growth in these economies resulting in steady increases in disposable income. In the Japanese market growth in demand for high-value species has occured despite a general decline in demand for fish overall, accompanied by increases in animal livestock product consumption.

All three markets exhibit strong preferences for live fish, followed by chilled fish with few frozen fish products falling into the high-value category. As a result, considerable emphasis by those intending to exploit these market opportunities must be placed on infrastructure and arrangements which will enable products to be marketed in fresh, chilled or live forms. This would include air transportation and ancillary facilities, and rapid surface transportation.

Japan

The Japanese market, because of its long tradition of raw fish (sashimi) consumption, has become highly discriminating with respect to product type and quality. Development of the market by exporters therefore relies heavily on the establishment and maintenance of a reputation for high-quality. Suspicion of foreign product quality is a major obstacle to entry in and development of this market, and good distributor links are an important element in overcoming this problem. Projects based on high-value species for the Japanese market should therefore ensure that distribution links are well defined and established early in the implementation process. For such projects it is advisable to put initial research emphasis on end-users, whether these be retailers or restaurant trade. With positive response from these key contacts, other trade linkages if required will normally be by referral. This approach also has the advantage of ensuring the rapid committment of the importer, who will otherwise be very conservative without the support of his buyers, especially when new products or suppliers are involved. Direct links with end-users also enables better communication and understanding on

questions of product quality, presentation and modification (if required) than is frequently the case where an importer is the sole channel of communication.

In providing background on various end-use categories and distribution channels in Japan, it has been attempted to provide a guide on various marketing options. In addition to this basic information, marketing itself should be looked upon as an ongoing transfer of knowledge and the enhancement of capacity, by those making marketing decisions, to interpret this knowledge. In a Japanese context this places great emphasis on establishment and nurturing of human relations. In market planning therefore, opportunity should be created to equip those with marketing responsibilities with a sensitivity towards market requirements, the range of market options available, and the need for meaningful personal links.

Among developing countries of the Asian/Pacific region, the capacity to take advantage of more refined market opportunities varies according to the level of international marketing experience, the availability of physical, market-related infrastructure, and the experience of both the producing country and the market with the product in question. For new species, product knowledge and ability to interpret this knowledge is rudimentary, and requirements for market development skills is more exacting.

Among the higher-value species indicated as having immediate potential for development in the Japanese market are globefish, turbot, sea breams and herring roe in fresh, frozen or chilled form, with values being more attractive for fresh and chilled fish, indicating the importance of sashimi species in the market hierarchy. In addition, live eels (and eel fry), abalone and sea urchins present attractive prospects. Good prospects for other species also exist in Japan and these have been discussed in Volume 8 in detail; this other products, however, require further investigation as to resource availability.

Hong Kong and Singapore

For both Singapore and Hong Kong, grouper is the prime species of interest, with pomfret, Spanish mackerel and snapper also classified as high-valued in both markets. For Singapore alone, threadfin, rabbit fish and dorab are also included in this category, while gingko, horsehead bream, round herring and coral fish are important high-value marine species in Hong Kong with various carp species being somewhat lower value live fish in this category. The Singapore high-value finfish species market is estimated at about 14 000 tons per annum and Hong Kong about 53 000 tons.

Investment implications

With growth in the market apparent for high-value species, an opportunity exists for further analysis of investment opportunities. While indicative prices have been provided in this report, they should not be used without additional analyses of production opportunities and costs, and of requirements for the establishment of appropriate market links. To take advantage of most indicated market opportunities, further marketing infrastructural facilities will be required in many exporting countries in the region, especially facilities related to handling fresh and chilled fish. Similarly, the upgrading of technical skills in handling fish in this form will be required.

Investment in marketing infrastructure and production facilities should not, however, be made without the establishment of good market contacts and channels — particularly in the Japanese market. It is strongly recommended that initial relationships should be established with end-users such as restaurants, department stores or other retailers in order to both expedite market entry and ensure good communication on questions such as product modification, packaging and presentation. This will probably require investment in test marketing and/or customer testing, especially for new species. Above all, marketing systems should be thought of and used as a mechanism for the transfer of knowledge and expertise. This requires good, trusting relationships within the distribution network.

IX. HIGHLIGHTS OF FISHERY SECTOR PROFILES OF EIGHT SELECTED ASIAN COUNTRIES

The eight developing member countries[1] of the ADB chosen for fishery sector profiles stretch from the Philippines in the East to Pakistan in the West, and encompass most of the major fishing nations in Southeast and South Asia. These eight countries have a combined population of nearly 500 million, producing and utilizing nearly eight million mt of fish annually, over 10 percent of worldwide fish landings[2].

The fishery sector profiles presented in Volume 9 were prepared with the aim of summarizing the major trends in fish production and consumption in each country in order to identify future development prospects and problem areas in their fisheries sectors. Highlights of these profiles are presented in this section.

Problems and prospects for fisheries development in eight selected Asian countries

General economic setting

The eight countries selected for fishery sector profiles differ widely in size, population and economic development. Sri Lanka with an area of only 66 000 sq km is the smallest while Indonesia, covering 1 919 000 sq km is the largest. Indonesia also has the largest population (151 million in 1981) and the largest economy (GNP in 1980 of over $61 billion). Malaysia has the smallest population (13.85 million) and Sri Lanka the smallest GNP ($4 billion in 1980)[3].

These eight countries have been divided into groups of four on the basis of economic factors as well as geographic location. The four ASEAN countries included in the survey are all "middle income" developing countries, with each of them having average per capita incomes of over $400 annually in 1980. Population densities in these four countries are generally below 90 persons per sq km, except for the Philippines (165 persons per sq km).

[1]Indonesia, Malaysia, Philippines and Thailand in the ASEAN region; Bangladesh, Burma, Pakistan and Sri Lanka in South Asia.
[2]FAO estimates total world nominal fish catches in 1980 of 72.2 million mt; total fish landings from the eight countries in 1980 was 7.8 million mt.
[3]See Table 1 for a comparison of general economic data for these eight countries.

Table 1
General Economic Data on Eight Selected Countries

	Area 000 sq km)	Population mid-1981 (millions)	Population Density, mid-1981 (persons/sq km)	Population Growth Rate 1972-81 (%)	Total GNP, 1980 ($ billions)	*Per Capita* GNP, 1980 ($)
ASEAN REGION	3 091	262.21	85	—	149.1	—
Indonesia	1 919	151.03	79	2.5	61.47	420
Malaysia	330	13.85	42	2.2	22.30	1 660
Philippines	300	49.53	165	2.7	34.19	710
Thailand	542	47.80	88	2.5	31.14	670
SOUTH ASIA	1 692	223.77	132	—	45.77	—
Bangladesh	144	89.9	624	2.3	11.17	120
Burma	678	35.10	52	2.4	5.88	180
Pakistan	804	83.78	104	3.0	24.75	300
Sri Lanka	66	14.99	228	1.7	3.97	270
TOTAL	4 783	485.98	102	—	194.87	—

Source: *Key Indicators of Developing Countries of ADB*, April 1982

The four South Asian countries covered here are poorer than the ASEAN group; average per capita incomes range from only $120 in Bangladesh to $300 in Pakistan. Population densities are generally higher in South Asia, except for Burma (which has only 52 persons per sq km).

The ASEAN economies have generally been more private sector and export oriented than those in South Asia, and their economic growth rates over the past decade have been somewhat higher than for the South Asian countries. The agriculture sector's role in the economies of all eight countries is important, but it generally contributes a higher proportion of Gross Domestic Product (GDP) in South Asia than in the ASEAN area.

Per capita incomes are reported to be growing at significant rates in all eight countries. These increases in income, combined with annual population growth rates of 1.7 to 3.0 percent, have led to rapid increases in domestic demand for food, and there is every indication that food demand, particularly for fish and other animal protein, will continue to grow rapidly over the next decade.

Resources

Marine fisheries resources

All eight of the countries surveyed have rich marine fishery resources, but the extent of these resources and the present levels of exploitation differ markedly. As shown in Table 2,

Table 2
Marine Fisheries Resources of Eight Selected Countries

	Length of Coastline (km)	Shelf Area to 200 m depth (sq km)	Estimated Total MSY* (000 mt)	Total Marine Fish Landings in 1980 (000 mt)
ASEAN REGION	60 294	1 683 000	7 089	5 018
Indonesia	36 834	775 000	3 307	1 395
Malaysia	3 400	418 000	882	725
Philippines	17 460	185 000	1 700	1 250
Thailand	2 600	305 000	1 200	1 648
SOUTH ASIA	6 370	373 000	1 814	1 001
Bangladesh	700	40 000	350	125
Burma	2 800	250 000	700	468
Pakistan	885	55 000	514	233
Sri Lanka	1 770	28 000	250	175
TOTAL	66 664	2 056 000	8 903	6 019

*Generally taken as the low side of the range of estimates of MSY

Note: See Volume 9 for sources of data

the four ASEAN countries all have continental shelf areas of 185 000 sq km or more with Indonesia's shelf area being the largest at 775 000 sq km. Only Burma among the South Asian countries has a shelf area over 60 000 sq km. The extent of shelf area is an important factor in the marine resource potential of each country.

While estimates of overall average maximum sustainable yields (MSY) of each country's marine waters are imprecise, surveys have been carried out in each of the eight countries and approximations have been made of potential annual yields of marine fish. The estimated MSY's range from 250 000 to 500 000 mt annually for Sri Lanka, Bangladesh and Pakistan to 1.2 to 3.3 million mt for Thailand, Philippines and Indonesia. Generally, total marine fish landings in each country have in recent years remained well below the estimated MSY's. The exception is Thailand where catches in excess of its MSY have been recorded for much of the last decade. Highlights of each country's marine resource position are presented below.

Indonesia

Marine fish landings in 1980 of 1.4 million mt were less than half the estimated MSY of 3.3 million mt. Nevertheless, shrimp and other inshore fish stocks along the coasts of North Java and East Sumatra have apparently been overfished and the government has banned trawling in these areas. This trawling ban will be imposed nationwide as of 1 January 1983.

Malaysia

While Malaysia's total marine landings of 725 000 mt in 1980 were below the estimated MSY of 882 000 mt, there is strong evidence that Malaysia's best fishing grounds, along the west coast of Peninsular Malaysia, are heavily overfished. Inshore stocks on the east coast of Peninsular Malaysia are also heavily fished and landings there in 1980 were down from 1979. This may also reflect the pressure on fish stocks by Thai and other foreign vessels operating in Malaysian waters.

Both Sarawak and Sabah appear to have good potential for expanded catches although many of the prime shrimp grounds in these states may already be fully exploited.

Philippines

Coastal fishing grounds in the Philippines are heavily fished by both commercial and artisanal fishermen, and many of the best fishing areas are now being over-exploited. Until recently, offshore and deepsea fish stocks, including tuna, were underfished. But by 1981, the rapid expansion of the "payao" based tuna fleet had begun to threaten local stocks of skipjack.

Thailand

Thailand's marine resources are clearly the most heavily fished in Asia. Catches of both demersal and pelagic fish from the Gulf of Thailand and the Andaman Sea have exceeded their estimated MSY for a number of years and fish landings from these areas have declined significantly since 1977. As a result of sharply falling catch rates in Thai waters, an increasingly large proportion of the Thai fleet has been forced to operate in the waters of neighbouring countries including Malaysia, Burma, Vietnam and others.

Bangladesh

Marine fisheries production in Bangladesh of only 125 000 mt in 1980 is far below the estimated MSY of 350 000 mt. Both nearshore and offshore stocks are underfished and there is, therefore, excellent potential for increased fish landings.

Burma

Like Bangladesh, Burma has rich fishing grounds that offer the potential for substantially increased landings. According to the most recent resource survey, Burma should be able to increase its average annual marine fish landings by about 250 000 mt or more above the 1980 level of 468 000 mt.

Pakistan

With a shelf area of 55 000 sq km, Pakistan has marine resources with the potential of yielding about 514 000 mt annually, about twice the current production level. There is good potential for expanded landings of demersal finfish and small pelagics, but shrimp stocks appear to be overfished at present.

Sri Lanka

Because of its relatively narrow continental shelf, Sri Lanka's marine resource potential, estimated at 250 000 mt annually, is the smallest among the countries surveyed. While shrimp stocks are probably being overfished, there is scope for an increase in finfish landings by about 75 000 mt annually over the present level of 175 000 mt.

Inland fisheries and aquaculture resources

Except in Bangladesh, inland fisheries and aquaculture play a secondary role in each of the countries surveyed. However, the potential for major expansion of fish production from aquaculture is now fully recognized in all countries surveyed. Although data is not available for every country on the area of existing bodies of water, or on the amount of land suitable for pond construction and fish culture, it is clear that every one of these countries has the physical potential for a rapid growth in aquaculture production. Various species of carp and tilapia have the best potential in freshwater areas of South Asia, while these species as well as milkfish and catfish offer excellent prospects in Southeast Asia. In brackishwater areas, pond culture of shrimp can yield high investment returns in all the countries surveyed.

Fisheries contribution to the economy

The fisheries sector's contribution to the economy of each country is summarized in Table 3. The sector's share of GDP ranges from only 0.6 percent in Pakistan to over 4 percent in the Philippines, Bangladesh and Burma. According to government statistics, over 4.7 million fishermen and fishfarmers were employed in 1980, with the highest fishery

sector employment being in Indonesia (2.0 million), Bangladesh (1.1 million) and the Philippines (0.8 million). Because of the highly commercialized nature of the Thai fishing industry, it employed only 90 000 marine fishermen to catch over 1.6 million mt of fish in 1980.

Table 3
Fisheries Contribution to the Economies of Eight Selected Asian Countries*

	Fisheries Share of GDP (%)	Number of Fishermen (000)	Trade Balance Fish Exports-Imports ($ millions)
ASEAN REGION	—	3 047	594
Indonesia	1.8	2 027	205
Malaysia	3.0	130	N.A.
Philippines	4.4	800	89
Thailand	1.7	90	300
SOUTH ASIA	—	1 679	118
Bangladesh	4.2	1 058	44
Burma	5.0	362	12
Pakistan	0.6	191	50
Sri Lanka**	3.0	68	12
TOTAL	—	4 726	712

* Data for 1980 unless otherwise stated
** 1981

Each one of the countries surveyed had a positive trade balance in fish products (measured in values of imports and exports)[1]. Thailand, Indonesia and the Philippines all have sizeable fish export industries while importing relatively small amounts of fish.

Current production levels

The eight countries surveyed produced over 7.8 million mt of fish in 1980, 10.8 percent of total nominal world catches of 72.2 million mt. As shown in Table 4, Indonesia, Thailand and the Philippines each produced over 1.6 million mt in 1980. Malaysia, Bangladesh and Burma reported landings of between 600 000 and 800 000 mt, while Pakistan and Sri Lanka each produced less than 300 000 mt of fish in 1980.

Total fish landings have been growing for most countries except Thailand, where production declined sharply after 1977. Pakistan's 1980 landings were also significantly below 1979 levels and production in Bangladesh has been almost stable in recent years. Landings have grown most rapidly in Sri Lanka, Indonesia, the Philippines and Burma.

Of the total 1980 production from these countries of 7.8 million mt, about 77 percent was from marine fisheries, and 23 percent from inland fisheries and aquaculture. Only in Bangladesh was marine fisheries production less than inland fisheries; in that country inland fisheries and aquaculture production reached 525 000 mt, over 80 percent of total fish landings.

[1]No country wide trade data for Malaysia was available.

Table 4
Fish Production in Eight Selected Countries, 1980

	Marine Fish Production (000 mt)	Inland Fisheries & Aquaculture Production (000 mt)	Total Production** (000 mt)
ASEAN REGION	5 018	1 032	6 050
Indonesia	1 395	457	1 852
Malaysia	725	10	735
Philippines	1 250	421	1 671
Thailand	1 648	144	1 792
SOUTH ASIA	1 001	756	1 757
Bangladesh*	125	525	650
Burma*	468	156	624
Pakistan	233	46	279
Sri Lanka	175	29	204
TOTAL	6 019	1 788	7 807

* Data for fiscal year 1980/81
* Excludes trash fish discarded at sea
Source: Government estimates; see profiles in Volume 9

Because of the resource constraints noted earlier, the growth of marine fish production from the ASEAN region is likely to be slower in the 1980's than it was in the previous decade. However, these countries have excellent potential for rapid increases in aquaculture production and this may allow them to compensate for lower growth rates of marine fish landings. Meanwhile, the four South Asian countries have the potential for continued growth of both marine and aquaculture production.

Domestic fish markets

Domestic fish consumption

Fish is the main source of animal protein in all of the countries surveyed except Pakistan. Available data suggests that fish provides 50-80 percent of the animal protein consumption in these countries (except Pakistan) and that fish is especially important in the diets of middle and lower-income groups.

Per capita fish consumption levels vary widely among the countries surveyed, from only 1.5 kg in Pakistan to over 40 kg in Malaysia (see Table 5). The high average levels of consumption in Malaysia and the Philippines (27.3 kg) are the result of high income levels and plentiful fish supplies. Average consumption levels of edible fish products have increased significantly over the past decade in Indonesia, Malaysia, Philippines and Burma. The fish consumption level has increased marginally in Pakistan and has fluctuated widely in Sri Lanka; in Thailand and Bangladesh, average fish consumption has definitely declined.

Table 5
Per Capita Fish Consumption
in Eight Selected Countries, 1980

	kg — whole fish equivalent	1970-1980 Trend
ASEAN REGION		
Indonesia	11.8	up
Malaysia*	43.0	up
Philippines	27.3	up
Thailand	17.4	down
SOUTH ASIA		
Bangladesh	7.1	down
Burma	18.1	up
Pakistan	1.5	up
Sri Lanka	14.6	up
Weighted Average	12.6	up

*Peninsular Malaysia only
Note: See Volume 9 for sources of data

Fish price levels

Average prices of fish have generally remained below those of meat and chicken, but the price differential has narrowed in most of the surveyed countries over the past decade. Real fish prices have risen sharply in most countries in response to rapid growth in both domestic and foreign demand for fish products, and this trend appears likely to continue over the next decade. One of the consequences of expanded fish product exports has been the sharp increase in domestic prices of shrimp, lobster and other high-valued exportable fish items. These high prices have clearly benefitted domestic producers in these eight countries, but they have also placed these commodities beyond the reach of most domestic consumers.

Future domestic market outlook

Because of the likelihood of high rates of growth of both population and income over the next decade, the demand for fish products in these eight countries is expected to continue to grow rapidly. While the availability of meat, chicken and other protein foods will have a major impact on the rate of increase in demand for fish, there is little likelihood that domestic consumers in these countries will make a major shift in preferences away from fish unless it becomes very scarce.

As shown in Table 6, domestic demand for edible fish is estimated to grow at an annual rate of 3 to 6 percent in these countries over the coming decade. By 1990, aggregate edible fish demand in these eight countries will reach 9.2 million mt, an increase of 3.2 million mt (53 percent) over the 1980 consumption level of 6.0 million mt. For the eight countries as a whole, *per capita* fish demand is projected to grow from an average of about 12.6 kg in 1980 to about 15.6 kg in 1990[1], an increase of 24 percent in 10 years.

Table 6
Future Demand for Edible Fish
Products in Eight Selectd Countries, 1990

(000 mt, whole fish equivalent)

	Projected Annual Growth Rate of Demand (%)	Projected Demand, 1990	Incremental Demand over 1980
ASEAN REGION	—	6 816	2 394
Indonesia	4.8	2 780	1 034
Malaysia	4.2	845	285
Philippines	3.1	1 776	467
Thailand	5.8	1 415	608
SOUTH ASIA	—	2 387	800
Bangladesh	4.3	972	337
Burma	4.0	913	296
Pakistan	3.7	180	55
Sri Lanka**	4.8	322	112
TOTAL	—	9 203	3 194

Note: See Volume 9 for sources of estimates

To meet the projected level of demand will require incremental annual supplies of 3.2 million mt of edible fish by 1990. As most of these countries will be unable to afford to increase fish imports[2] or reduce their fish exports, this incremental supply must come from domestic production. This will require an average increase of edible fish production of 4.4 percent annually, and achieving this growth rate may require new investment of $5-10 billion in fishing vessels, shore facilities, aquaculture farms and facilities. It will require a shift of emphasis in marine fisheries away from the heavily fished coastal areas toward under-exploited fish stocks further offshore and/or in more remote locations. It will also demand a major new focus on aquaculture, emphasizing both increased productivity of existing ponds and facilities as well as expansion of culture to new areas.

The anticipated increases in real fish prices worldwide will be a strong incentive to increase fish production in Asia, and it appears unlikely that domestic consumers in Asia can avoid some increases in the relative prices of fish in the coming years. But if production growth can be generated through rapidly increasing investment in fish production facilities, these prices rises can be moderated and *per capita* fish consumption levels can continue to grow.

[1]Assuming an average annual population growth rate of 2.2 percent for the entire group of countries.
[2]Malaysia may be an exception as its high income levels will probably lead to significantly higher fish imports.

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