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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

FIRST CONSULTATION ON THE FISHERIES INDUSTRY

Gdansk, Poland, 1 – 5 June 1987

Distr.
LIMITED

ID/WG.467/4
30 April 1987

ENGLISH

WORLD FISHERIES SITUATION AND OUTLOOK*

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the FAO Secretariat

* This information paper, prepared by FAO, was first submitted to the Seventeenth Session of its Committee on Fisheries (Rome, 18-22 May 1987).

V.87-84818

Summary

This paper contains a review of the current situation in the world's fisheries, covering production and trade. It also provides an assessment of trends for the future to the year 2000, including the state of resources, demand and supply projections and suggests some implications for development policy.

THE FISHERIES TODAY

Fish Production

1. World fish production in 1985 totalled some 85 million tons, an increase of 2.2 percent above that of the preceding year. This, following an increase of almost 7.5 percent in 1984, represents the eighth consecutive year of growth in terms of physical output.

2. These increases result, almost entirely, from increases in catches of shoaling pelagics which are notoriously subject to fluctuations in abundance. The recent (1984-85) surge in production is attributable to increased catches in the Southeast Pacific (west coast of South America). Elsewhere, for the most part, production has been either relatively stable or marginal increases in some areas have been offset by marginal declines in others.

3. The explosive growth in world fish production during the two decades after 1950 ceased in the early seventies (Table 1). Underlying the early expansion in fish production was the growth in the world economy, restricted largely to the developed countries in the fifties but extending to developing countries in the sixties, based mainly on increased income levels and, consequently, on expansion of demand for food products of the fisheries. Concomitantly, an increase in the demand for fish meal (and thus for shoaling pelagics) stemmed from a shift to intensive raising of livestock in North America and Western Europe, which entailed feeding with nutritionally balanced rations.

Table 1
World fish production, by origin, 1950-85
(million tons)

Year	Marine	Freshwater	Total
1950	17.6	3.2	20.8
1960	32.8	6.6	39.4
1970	59.5	6.1	65.6
1975	59.2	7.2	66.4
1980	64.5	7.6	72.1
1985	74.8	10.1	84.9

4. Expansion of the world's fish harvest, in response to the growth in demand, was assisted by two technological innovations of this period, viz. (a) the introduction of synthetic fibres in the manufacture of nets and (b) the introduction of freezing at sea. These innovations, in association respectively with mechanical net hauling and stern trawling (both introduced more or less simultaneously) as well as electronic aids, permitted widespread use of large nets and a dramatic increase in the size, versatility and operational range of fishing craft. Purse seining had an important role in the development of the pelagic fisheries of Northern Europe, of the South American anchoveta fishery and of some tuna fisheries, while freezing at sea facilitated the maintenance of Japan's foremost position in the commercial fisheries and the spectacular expansion of the distant-water fisheries of Eastern European countries in the sixties and seventies.

5. The species composition of international fish production has changed significantly during the past 25 years. The catch of Atlantic cod, for example, has been declining since the late sixties; Alaska pollack has become the dominant demersal species landed. Among pelagic species, the Japanese pilchard (the stock of which collapsed in 1940) now sustains a major fishery, the stock(s) of Atlantic herring declined and then recovered and that of the Southeast Pacific anchoveta collapsed and was replaced (at least in part) by a pilchard stock. The worldwide tuna fisheries have continued to expand but output from the shrimp fisheries, which almost doubled between 1970 and 1980, has slackened.

6. The bulk of supply from the shrimp fisheries and an important share of that from the tuna and cephalopod fisheries originates in developing countries. Expansion in shrimp fisheries has been largely due to technological transfers which would have been ineffective had there not been available the entrepreneurial initiative and skill in developing countries to exploit the new technologies.

7. Information on fishing "effort", i.e., investment and employment, in the fisheries of the world, is quite fragmentary. There is a presumption, however, that it has been increasing (at a greater rate, probably, than the harvest) throughout the developed and developing worlds, but direct evidence is lacking. Data on other investment in the fisheries sector are not available with the exception of data provided on investment by foreign aid agencies in the fisheries of developing countries, reported in Fisheries Circular No.755 (Revision 2), available at this Consultation.

Utilization of the catch

8. Since 1970, the total increase in world catches, about 20 million tons, has been used for direct human consumption. Reduction to fish meal and oil, which reached a peak of 40 percent of total catches in 1970, has declined to about 30 percent (Table 2). For the period 1950 to 1985, the proportion frozen has increased from about 10 percent to almost 25 percent and the proportion canned from 10 percent to somewhat less than 15 percent. These changes took place for the most part during the early part of the period; there has been little change during the last 10 years. The proportion of production cured has remained relatively constant throughout the period at 15 percent.

Table 2
World fish production, by end-use, 1950-85
(million tons)

Year	Food	Feed	Total
1950	17.8	3.0	20.8
1955	23.9	4.6	28.5
1960	30.8	8.6	39.4
1965	36.3	16.3	52.6
1970	39.1	26.5	65.6
1975	46.0	20.4	66.4
1980	52.9	19.2	72.1
1985	59.6	25.3	84.9

Fish trade

9. Expansion of the international trade in fish products has paralleled the growth in world production over the past 25 years, the quantity traded having grown from 4.5 million tons in 1960 to 12.5 million tons in 1985. Converted from product weight to live weight, the latter figure represents approximately one-third of total catch - and this ratio has been quite stable throughout the period. The value of the fish trade increased steadily from $US 1 300 million in 1960 to $US 16 900 million in 1985, a threefold increase in real terms.

10. As currently structured, three trade flows may be distinguished, namely (a) from developing to developed countries (consisting in the main of relatively high-valued products), (b) from developed to developing countries (chiefly low-valued products) and (c) between developed countries. Trade in fish products among developing countries is on a minor scale. Three-quarters of all imports in value terms are divided about equally among Japan, the USA and the EEC (about one-third in the last case being supplied by intra-community trade). Japan's share of the global fish trade is trending upward, that of the EEC has declined, although it has shown an increase in 1985, and that of the USA remains stable.

11. The fish trade is characterized by extreme heterogeneity of product form and by market specializations. Generalization as to trends and developments, therefore, tends to be subject to qualification and uncertainty. The trade composition has shifted substantially since 1960. In terms of value (to the nearest five percent),the share of fresh and frozen finfish products has increased from 25 percent to 35 percent of the total and that of fresh and frozen crustacean products from 15 percent to 35 percent, while the share of canned fishery products has dropped from 25 percent to 15 percent and that of cured fishery products from 15 percent to five percent.

12. In recent years, developing countries have become net exporters of fishery products, accounting for almost 45 percent of total exports in 1985 as compared with about one-third ten years earlier. Over the same period, their surplus in foreign exchange earnings from the fish trade increased from $US 1 800 million to $US 5 000 million.

13. Tariffs, it appears, may no longer be a major obstacle to development of the fish trade. More significant barriers are (a) bilateral agreements and quantitative restrictions on imports, (b) foreign-exchange constraints, (c) import licensing, prior-deposit and surcharge requirements and (d) regulations relating to packaging, labelling and product-quality standards. These considerations were discussed in the First Session of the Sub-Committee on Fish Trade.

14. A further phenomenon of the past decade or longer is the upward trend of fish prices in real terms, i.e., at a faster rate than prices in general: by an average of 6.5 percent annually in Japan, for example, and similar rates are observable elsewhere in both developed and developing countries. This trend reflects contraction of overall supply, that of preferred species in particular, in relation to rising demand. It has provided the basis in recent years for growth in aquaculture production of certain freshwater and marine (anadromous and demersal) finfish as well as crustaceans and molluscs.

15. The rising trend in the real price of fish products is in fact one of the two most significant developments in the fisheries during the later years of the period under review, the other one being the extension of fishery management jurisdiction by coastal States.

Exclusive Economic Zones (EEZs) and Trade

16. Prior to the extension of jurisdictions, the total value of the distant-water fishing harvest approximated $US 7 300 million (1978 prices). Excluding oceanic pelagics, however, two-thirds of this harvest was taken off the coasts of developed countries and most of the remaining third off Northwest Africa, leaving little more than five percent for developing countries elsewhere. Besides gaining twice the amount of fishery resources, the developed countries possessed an industrial organization and infrastructure that enabled them readily to expand their harvest, and trade in the products, of those resources.

17. For the distant-water fishing countries, the effects of EEZ establishment included (a) a reduction in fleet size and a rationalization of craft mix and deployment, (b) a search for alternative resources and fishing grounds on the high seas and within EEZs and (c) negotiation of fishing agreements with coastal States. The result for some of these countries is a reduction in harvests and/or a switch to the harvesting of lower-valued species.

18. The impact of coastal State extensions of jurisdiction (EEZs) in the later seventies, which was expected to bring about a major realignment of the international fish trade, has been masked by the 30 percent increase in overall production during the subsequent period. It had been expected that countries previously with large foreign fleets operating off their coasts would benefit most from the establishment of EEZs, the areas identified being the Northeast Pacific and Northwest Atlantic (for developed countries) and the Southwest, East Central and Southeast Atlantic (for developing countries). Some of the countries involved have increased their exports. Several countries which have lost access to fishing grounds have also increased their exports.

PROSPECTS TO THE END OF THE CENTURY

Demand

19. The demand for fish products in the aggregate depends on three factors, viz., population, income and price, the latter incorporating a number of factors such as consumer preferences. Of these, population is the most important since, with stable prices, it normally accounts for about two-thirds of change in total demand.

20. World population is expected to continue increasing, at a declining rate, through the year 2000, when it is estimated it will reach 6 100 million. At 1980 levels of consumption (50 million tons) and assuming no change in relative prices of fish to other food products, that number of people would require an additional 20 million tons of fish, i.e., a total of about 70 million tons simply to maintain present levels of consumption. Added to this total there is likely to be a requirement for at least 20 million tons for reduction to fish meal, bringing the total requirement to 90 million tons. It should be noted, however, that consumption has already increased by about 7 million tons in the period between 1980 and 1985 (Table 2).

21. In this respect, account has to be taken of the divergent growth trends in various regions. The developing countries already contain almost 75 percent of the world's population and, by the year 2000, this will have increased to 80 percent. It is in these countries that the impact of population growth on the demand for fish is the greatest. In Asia, for example, where there are a number of countries in which fish represents half or more of animal protein supplies, an extra five million tons per year would be required by the end of the century to maintain present levels of consumption. Fish also is important in the African diet, especially in the western half of the continent.

22. Projections of income change, being subject to special uncertainty, are more hazardous than are those of demographic trends. The effect of a relatively modest increase in income would be to raise per caput consumption by one kilogramme in each decade in the developing countries and by slightly more in the developed ones. As a result, total world demand for fish as food would be raised by a further 10 million tons, i.e., over and above what would be required to maintain constant per caput consumption in the face of increasing population. This would imply assuming no change in the use of fish for fish meal, a prospective total demand for fish by the year 2000 exceeding 100 million tons, on the basis of stable relative prices.

Supply

23. The slowdown in fish production after 1970 reflects the encounter, at that time, of fishing industries around the world with a resource barrier to further rapid expansion. Although, with the surge of the past two years, annual production overall has increased by 30 percent since 1970, it appears unlikely that this can be sustained. On the evidence presently available production in 1986 is not expected to have exceeded that of 1985 significantly, if at all. Lower landings are reported for demersal fish in the Northwest Pacific and for pelagics in the Southeast Pacific, for example, and those from major fisheries of the Northwest and Northeast Atlantic are controlled by quotas.

24. Almost all important stocks of demersal species are either fully exploited or overfished. Many of the stocks of more highly-valued species are depleted. Reef stocks and those of estuarine/littoral zones are under especial threat, from illegal fishing and environmental pollution. Year-class (recruitment) variation may have a marked effect on catches and there is evidence that some species may be subject to long-run changes in abundance due to climatological or other factors.

25. There is little prospect, therefore, of increasing the catch of demersal species. It is necessary to distinguish between landings and catch, however, since quantities of these species are taken, e.g., in shrimping operations, and discarded, and this is likely to continue until incentives are provided for landing and marketing these fish. Scattered stocks exist elsewhere but, in general, the cost of harvesting them would not be justified at present by the revenue obtainable from the derived products.

26. There seems to be a better possibility of increasing the harvest of small (shoaling) pelagic species. Stocks of such species are subject to periods of high and low abundance, extending over decades. Prediction of potential availability is complicated further by evidence that when the abundance of one species is low that of other species may increase. Additional harvesting may be feasible, however, by more intensive exploitation in some areas and improved fishery management (regulation of fishing effort) in others.

27. Crustacean species generally are heavily exploited and many if not most stocks are depleted. Some local increases in catches may be expected, e.g., from stocks of the smaller crabs. Most stocks of shrimp in potentially productive areas already are being exploited and no major increase in the harvest of capture fisheries can be foreseen. These fisheries generally have reached a stage of economic overfishing.

28. Very few untapped resources of conventional species remain anywhere. Resources of the slope in tropical seas tend to be sparse and the cost of their exploitation relatively high. Squids and other cephalopods are lightly exploited in some parts of the world but are regarded as conventional foods in few countries. The harvest of common squid has been increasing, as a result of better targetting and (possibly) of depletion of predator species stocks.

29. Freshwater fisheries provide some 10 percent of the world production of aquatic organisms and, since the total harvest is used for human consumption and includes highly-valued species, the contribution to the value of production probably is higher than that. This production is capable of some increase, particularly from flood-plain fisheries in Latin America and Africa. These fisheries, however, are vulnerable to natural phenomena such as drought and to interference for purposes of irrigation, power generation and the like which almost inevitably reduce their productivity. The loss is seldom offset by increases in production from the reservoirs provided.

30. The production of marine and freshwater aquaculture (finfish, crustaceans and molluscs) is 5.5 million tons (1984). Finfish production represents 65 percent of this total with about 50 percent produced in China. In addition, 2.7 million tons of seaweeds and aquatic plants are cultivated.

31. Among unconventional marine resources, those that might support fisheries in the future include mesopelagic species and krill. The latter already supports a fishery but there are economic constraints to the development of mass production and marketing. Mesopelagic species are widely distributed throughout the oceans and are found locally in considerable abundance. For the foreseeable future, because of the nature and size of these fish, they would have to be used for fish-meal production and, at present, incentives for commercial investment for this purpose are lacking.

Demand/supply implications

32. As already noted earlier in the paper, the total demand for fish by the year 2000, assuming no changes in relative prices or in the use of fish for fish meal, might well exceed 100 million tons.

33. It has been estimated that an increase in supply of that magnitude based on potential catches of more or less conventional species, is theoretically feasible (Table 3). It is stressed, however, that only a part of such an increase would be realizable through more extensive or intensive fishing effort -- and that may have been largely achieved already. About a half of the projected increase in supply could be obtained only through better fishery management and ultilization of resources.

Table 3
Fish for food: projected demand and supply
(million tons)

Increase in demand 1980 - 2000		Estimated potential for increased production (1985)	
Location	Quantity	Category	Quantity
Developing countries	+ 22.5	Demersal	1.0 - 8.0
		Shoaling pelagic	3.0 -10.0
Developed countries	+ 5.9	Other marine	4.0 - 6.0
Total	+ 28.4	Freshwater and aquaculture	5.0 -10.0
		Total	13.0 -34.0

34. The rough estimates of potential increased production provided in Table 3 are subject to considerable uncertainty and there are substantial gaps in the data. It is significant, however, that in a number of instances catches of demersal species are in excess of, or close to, estimates of potential yield. Prediction of potential availability in shoaling small pelagic species is especially complicated because such species are subject to periods of high and low abundance extending over decades. It would seem most likely, however, that the estimated potential for increased production lies within the range indicated in the table.

35. The inevitable rise in the price for preferred species, and modern marketing methods, may bring about a shift to other species but the process probably would be long. For decades, the world fisheries scene has been characterized by strong demand for expensive products of fully-exploited species while abundant, low-priced fish of high quality have been difficult to market. The latter description fits most of the shoaling pelagic species, some two-thirds of the world catch of which is used at present for the production of fish meal. This is the group of species, however, that, in spite of their unreliability, has the largest potential for increased harvesting.

36. In theory, the principal incentive for a shift in demand from one species to another would be provided by a rise in the price of the species in inelastic (fully exploited) supply, and there is some evidence that what is predictable in theory is being borne out in practice: certain "trash fish" species are becoming marketable. More significant is the evidence from a number of countries not only of a sharp increase in the price of "luxury" species but of fish in general, i.e. in the price of fish as compared with the prices of meat and other forms of animal protein, and the trend is not confined to countries of high income.

SOME IMPLICATIONS OF PRESENT TRENDS

Fishery management

37. The above outlook for the world's fisheries raises issues of policy that concern politicians, administrators, entrepreneurs and other decision-makers concerned with the fisheries sector. The fifties and sixties, in most parts of the world, were a period of rapid growth, brought about by fleet expansion and the use of innovative technologies. As resource stocks became fully exploited and then overfished, however, there emerged an interest in problems of fishery management, although not yet a generalized conviction that action in this field was widely necessary.

38. By the seventies, there were few resource stocks left to which fishing effort could be transferred and,in the middle years of the decade, increased fuel costs rendered many fishery ventures unprofitable, temporarily or permanently. More recently, rising prices for fish in real terms has compensated, at least partially, for cost increases. If this process were to continue, however, as seems probable, the task of fishery-management authorities might be made more difficult to accomplish, as price increases attract more fishing effort despite declining yields.

39. With establishment of EEZs, some problems of fishery management have been simplified - others, e.g., those relating to trans-boundary matters, may have been exacerbated. Moreover, coastal State control does not of itself ensure effective management of fisheries, even of those based on stocks occurring exclusively within national zones. Adminstrators, as well as political leaders (with whom the ultimate decisions rest) and donors often prefer an expansionist policy; the benefits of such a policy being perceived as immediate and tangible whereas those of good management often are long-term and hypothetical. As in the past, pressures of this kind may continue to frustrate a rational approach to fishery management.

40. Management must be concerned with the overall economic performance of the fisheries. To this end, government intervention in fisheries must also include measures that reduce fishing costs, improve revenues and satisfy social objectives. For example, the use of fossil fuels in fishing can represent 90 percent of the cost of production and measures can be taken to lower these costs. Many existing fishing vessels were built during the era of low-cost fuel and now require modification to be fuel-efficient, such as fitting with nozzles and compatible propellers, which could result in a 15 percent fuel saving. Considerable efforts have been put into producing fuel-saving engines by manufacturers but re-engining with more fuel-efficient machines would not be sufficient by itself, particularly in fisheries where over-powering has been the trend. In such cases administrations will have to set upper limits for installed horsepower if cost reductions on fuel are to be obtained. In the same way, considerable savings can be achieved by reducing the search time required for finding productive shoals of fish. The use of fish aggregating devices, spotter aircraft and satellite-generated imagery are in use today and can be expected to have a wider application by the end of the century. Other areas for consideration by governments are the targetting of fisheries on animals where prices are significantly higher, viz., the management of the Australian northern prawn fishery and the Saudi Arabian prawn fishery.

41. Social considerations often require conscious allocation of limited fish resources to particular groups of fishermen which is most commonly achieved by legislating protective areas for the use by specified fishing gears or fishermen. In addition, a number of countries regulate gear either by length of net or head-rope, as a means of equalizing the fishing opportunity of fishermen. It is particularly important to protect and enhance small-scale or artisanal fisheries, which produce over 20 million tons of

fish a year, almost all of which is used for direct human consumption. These fisheries are characterized by high labour involvement (some 10 million small-scale and some 5 million part-time fishermen), low capital investment (as many as 3 million small-scale fishing boats), low levels of mechanization and often the use of passive fishing methods.

42. In addition, environmental degradation will become increasingly a serious problem in maintaining important fishery resources in coastal waters. More effort will be required to adopt measures to enhance productivity, such as stricter monitoring and prevention of environmental degradation, pollution, protection of nursery grounds and juvenile fish, stocking of appropriate species in suitable areas and strategic placement of artificial reefs.

Aquaculture

43. It has been evident for several years that the price trend has especially important implications for the development of aquaculture. Output from this source, which at present accounts for about 10 percent of total fishery production, may increase at an average annual rate of 5.5 percent and thus be doubled by the end of the century. It should be noted, however, that the distribution of production among the four main species groups (finfish, crustaceans, molluscs and seaweeds) and the five geographic regions (Asia, North America, South America, Europe/Near East and Africa) probably would change significantly.

44. The farming of shrimps and prawns, given the capital-intensity required, is not expected to contribute significantly to global production. The intensive rearing of shrimp has not been commercially justifiable to date. Production increases over the next decade may be achieved through expansion of extensive culture (currently a fast-growing industry), which, however, requires substantial areas of land. In any event, aquacultural production of shrimp, although important, is likely to remain a minor component of total production by the end of the century.

45. A greater contribution to the expansion of overall aquacultural production must come from the culture of finfish species. Major gains in quantity may be obtained from culture-based fisheries, i.e., extensive aquaculture systems, fishery enhancement in reservoirs, lakes and even the open seas. Semi-intensive and intensive systems in land-based and coastal farms are becoming attractive. For example, the US production of finfish from aquaculture has increased more than twofold from 1980 to 1984, while salmon culture in cages is increasing in a similarly dramatic way (Canada, Norway, UK).

46. In almost all countries with a favourable natural environment for aquaculture, the initial requirement is for organization,i.e., an agency (governmental, parastatal or private) to convince enterpreneurs (farmers, etc.) of the benefits of aquacultural enterprise, to organize the supply of inputs (particularly seed supply) and to assist with the marketing of products. When the commercial feasibility of a technology is demonstrated, the main requirement is for an extension service which, in most countries, implies a need for training.

47. Encouragement of small farmers/aquaculturists, if successful, could make a significant nutritional impact in the rural areas of low-income countries. The development of commercial aquaculture, on the other hand, is likely to be largely involved with luxury species or those that fetch a price sufficiently high to permit recovery of the not inconsiderable cost of inputs.

48. Much of the application of technology is likely to be undertaken by large firms with the financial resources to support innovative product introduction, but there would continue to be a need for research by universities and State agencies (a) to advance technology, e.g. extension to new species, disease control, etc. and (b) to supply technologists for the staff of commercial enterprises.

Improved utilization

49. Improvements in utilization practices could make a significant contribution to increasing the supply of fish to meet the demand anticipated in the year 2000. Three main areas merit priority attention: rescuing discards from trawling, reduction in post-harvest losses, and better utilization of small pelagic species.

50. An estimated quantity of between 5 and 16 million tons of fish per year is caught and discarded at sea by trawlers, principally engaged in shrimping. Perhaps between 20 and 70 percent represents marketable species and sizes, depending on the fishing area. Ensuring that discards are landed for human consumption is essentially an economic and logistical problem; where increased demand opens up a market for previously unacceptable species, the problem largely disappears. Some governments have taken the step of linking joint-venture licensing to participation in schemes to land discards as a contribution to national food supplies.

51. It is difficult to estimate the post-harvest losses which result from lack of facilities to preserve fish or from lack of training; however, they probably amount to about 10 percent of food fish supplies. To reduce these losses will require investment in better infrastructure for landing, storage and distribution and trained staff to operate it.

52. The third area - better utilization of small pelagic species - has a greater potential but is perhaps more speculative. As noted previously, only about one-third of world catches of these species is used for direct human consumption, the balance going to fish meal and oil. In addition, there is a further unexploited potential of up to 10 million tons. These species can be made into a wide range of highly acceptable products, including frozen, canned, smoked, salted and dried. Economies of scale are necessary to reduce production costs, but requirements for full exploitation will include technological research, consumer promotion and investment in facilities. There is a possibility for spectacular changes as these species contain the highest concentrations of the n -3 marine lipids which have been shown to be effective in preventing coronary heart disease. As an example, the perceived health benefits of fish are expected to double per caput consumption in the USA.

53. Two possible scenarios for the future of small pelagic fish utilization emerge depending on whether consumers prefer to take their fish oil in capsules or in the natural state, as part of the fish. The former route will encourage the use of fish for industrial purposes, with high oil prices perhaps making fish meal a by-product of the meal and oil industry. The alternative, direct consumption of fish, will require investment in handling and processing facilities. Although this will result in increased availability, the prices must necessarily be sufficient to cover the increased production costs.

54. These trends will also have an impact on fish meal production and prices. In the absence of other demand factors, demand for fish meal in animal feed is likely to decline as other protein sources (soy) become increasingly competitive. The possibility of an increased demand from aquaculture, either as meal or as industrial species in wet feed, will probably balance out the likely decrease in animal feed requirements. In the light of these uncertainties, it would probably be wise to assume that fish meal and oil production will continue to represent about 25 percent of world catches.

CONCLUSIONS

55. The projected increase in demand for direct human consumption of an additional 30 million tons by the year 2000 might therefore be answered by better fisheries management (10 million tons), possible increases from aquaculture (about 5 to 10 million tons), and improved utilization of resources (15 to 20 million tons). Delays in improving management and therefore alleviating supply constraints can be expected to increase prices which in turn will improve the viability of aquacultural production.

56. For capture fisheries, with the natural resources under mounting pressure, the need for management is becoming acute if production is to be enhanced, let alone maintained, to the year 2000. Without management fisheries development becomes increasingly difficult to sustain. Indeed, once fishery resources become fully exploited, catches fall and the potential wealth of an over-exploited fishery is dissipated in higher than necessary costs. In resolving this issue both technical assistance and capital investment under concessionary terms have important roles.

57. Within the context of technical assistance in support of fisheries management, a need of many developing countries is for a greater support of research on tropical fisheries; included under this heading is the provision of statistical services. In general, the quality of such services has been deteriorating over a long period.

58. Governments and donors may wish also to give further consideration to the ways in which capital aid may be directed towards alleviation of the problems of conflict, over-capacity and dissipation of economic rents which will facilitate the progression of the fishing sectors to a more orderly and sustainable industry. Governments without access to funds for compensating fishermen for losses incurred from management measures will continue to be unable to achieve significant changes in the conduct of fishing. In the inshore areas of most tropical fisheries, the consequences of a fisheries closure has extreme economic implications on the livelihood of artisanal fishermen. More attention is required to the need for matching fishing effort to the sustainable yield from the resources, whereby direct control over fishing effort can relieve fishing pressure, improve incomes to fishermen as well as providing them with important collateral for credit acquisition.

59. Just as the extension of fisheries jurisdictions to 200 miles nationalized fisheries that were previously under free and open access, national fisheries will also require division into areas for exclusive use by specified fishing gears or fishermen if conflicts are to be avoided and the national consequences of "open" access overcome. The enforcement of these areas will require a greater "at sea" physical presence than has been the case so far and, indeed, the concept of fisheries protection vessels should be viewed from the same perspective as that of fences for agricultural lands.

60. While the production levels from capture fisheries can be improved through management within the time period under study, so the costs of production can be reduced by immediate attention given to energy-saving methods directed at engine-efficiency horsepower limits, and reductions in search time for productive shoals of fish. Particular attention is required for improving the living standards of small-scale fishermen in recognition of their important contribution to sustained supplies of fish for direct human consumption.

61. Without sufficient government infrastructures to undertake fisheries management, the fisheries sector will fail to reach its potential. In the past, it has not been a priority of many governments to improve the capability of their fishery institutions significantly faster than those of other sectors. Governments, however, may wish to consider the dangers to their fisheries in not undertaking as quickly as possible the strengthening of their fishery institutions to enable them to undertake the complex tasks of fisheries management.

62. The development of aquaculture will require long-term government assistance for the promotion of adaptive technologies, marketing programmes and credit services. Recent documentation on aquaculture states that the future growth of the industry and its successful establishment as a viable enterprise throughout the world depend principally on the continued effective application of financial assistance and private investment, rather than on such other factors as advances in technology.

63. A significant contribution to increased supplies could also result from making better use of what is already caught. Ensuring that the present discards from trawl fisheries are landed for human consumption, investing in facilities to reduce post-harvest losses and fully utilizing the small pelagic species as food could all have an impact. However, the contribution from all the above sources to the increased food fish demand in the year 2000 will only be possible if governments address the needs now.

64. The failure to meet these challenges will result in lower income groups, that are now dependent to a greater or lesser extent on fish in their diets, no longer being able to secure adequate protein supplies from this source.