	منظمة الأغذية والزراعة للأمم المتحدة	COFI/91/3 February 1991
	联合国粮食及农业组织	
	FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS	
	ORGANISATION DES NATIONS UNIES POUR L'ALIMENTATION ET L'AGRICULTURE	
	ORGANIZACION DE LAS NACIONES UNIDAS PARA LA AGRICULTURA Y LA ALIMENTACION	

Item 4.2 of the  
Provisional agenda

COMMITTEE ON FISHERIES

Nineteenth Session

Rome, 8-12 April 1991

**ENVIRONMENT AND SUSTAINABILITY IN FISHERIES**

Summary

This paper examines the two important issues of sustainable development and environmental conservation with respect to fisheries. It first describes the characteristics and present state of aquatic living resources and their environment. It then examines the various technical issues relevant to the sustainable use of fishery resources and the protection of the aquatic environment. It finally proposes actions which the Committee is invited to consider for support.

**INTRODUCTION**

1. The 1984 FAO World Fisheries Conference endorsed a Strategy for Fisheries Management and Development and approved five associated Programmes of Action which now serve as an international framework for fishery management and development. The Strategy includes a number of broad principles and guidelines for the sustainable use of fishery resources and protection of aquatic habitats from pollution and other forms of environmental degradation, including those originating from fisheries, especially aquaculture. The Conference also adopted a special Resolution calling for international action to protect fishery resources of developing countries from pollution.

2. The following definition of sustainable development was used by the Council when, at its 94th Session, it discussed FAO's policies, programmes, budget and activities aimed at contributing to sustainable development: "the management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the

attainment and continued satisfaction of human needs for present and future generations. Such sustainable development conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable".

3. At its Eighteenth Session (April 1989), the Committee on Fisheries reviewed the prospects for capture fisheries and aquaculture in the next 25 years and the role of FAO and expressed its serious concern about the growing risks from environmental degradation to the proper management and sustainable development of fisheries. It urged FAO to give higher priority to the monitoring and prevention of environmental degradation in the context of fisheries, including aquaculture, and to promote international collaboration to protect the aquatic environment, as one of the key factors that should be fully integrated into the Programmes of Action. The Committee also encouraged FAO to give more attention to the impact of natural environmental fluctuations and climate changes on fisheries.

4. The Twenty-fifth Session of the FAO Conference, in November 1989, examined the major trends and policies in food and agriculture, and considered that insufficient attention to the environmental impact of certain agricultural practices had led to extensive environmental damage. Its Resolution 3/89 (FAO Activities Related to Sustainable Development) underlines FAO's role as a centre of excellence within the UN System in several sub-sectors related to environment and sustainable development and requested the Organization to contribute actively in furthering international agreements on biological/genetic diversity, tropical forestry, fisheries and other environmental matters. The Conference decided that the Organization should intensify its inter-disciplinary work to ensure the integration of environmental considerations into all relevant FAO activities; give higher priority to the prevention of environmental degradation affecting agriculture, fisheries and forestry; strengthen its cooperation with other organizations of the UN System in these fields; and collaborate fully in the preparations for the 1992 United Nations Conference on Environment and Development (UNCED).

5. FAO is participating actively in the preparation of the report of the UNCED Secretariat to the UNCED Preparatory Commission and has taken the lead in preparing reports on coastal area development and enclosed seas as well as on living marine resources. The main issues contained in these reports are included in this document for consideration by the Committee.

#### **THE ENVIRONMENT OF FISHERY RESOURCES**

6. The abundance and availability of fishery resources is governed by a variety of environmental factors which include temperature, salinity, nutrient levels, meteorological conditions, current and flow rates and their short and long-term

natural variations. Nutrient levels are generally limited in the oceanic environment outside upwelling areas, and nitrates and phosphates are mostly supplied through on-shelf turbulence, river outflow and via the atmosphere. Long-term changes at small levels can allow for species adaptation; short-term changes result in species disappearance or expansion.

7. Existing practices for monitoring the aquatic environment are not sufficient to separate the effects of environmental degradation from natural oscillations and climate change. The following sections, however, describe the present state of the aquatic environment and the effects of climate changes, man-induced environmental degradation, as well as fishing.

#### The state of the aquatic environment

8. Over 85 percent of the growth in world population since 1950 has occurred in developing countries. This growth has coincided with efforts to raise living standards and has created stress on the financial, physical and human resources of developing countries. It has often exacerbated poverty and triggered migration to littoral areas. This has led to overfishing and, partly through the introduction of inappropriate technology, contributed to the degradation of the environment.

9. Lakes and rivers are altered by human activities, nearly always with negative consequences for fisheries. Water quality has become a major concern to aquaculture. Freshwater fisheries are adversely affected by lowering lake levels, drainage of wetlands, water extraction, siltation, construction of dams and regulation of rivers for navigation and flood prevention. Measures to protect large lakes and rivers are urgently required.

10. In the degradation of the inland aquatic environment, most of the world's rivers have been modified and isolated from their floodplains and associated wetlands, and most lakes are eutrophicated or polluted. Because fisheries are apparently an insignificant component of the multi-use of land and water resources, development priorities have often been given to other sectors and the fishery administrator is rarely in full control of the resource to be managed. All too often, management at this level is aimed at mitigating the effects caused by other users of the aquatic system.

11. Particularly sensitive to human activities have been the Caspian Sea, the Aral Sea, the North American Great Lakes and the African Great Lakes. Climate changes have caused Sahelian droughts which have affected Lake Chad.

12. Semi-enclosed seas are very favourable environments for human development and are particularly important from the fishery standpoint. Their susceptibility to the adverse effects of development, and their capacity to dampen these effects depend

mainly on the degree of "enclosure" and exchange of water masses with the neighbouring oceans.

13. Coastal ecosystems, such as estuaries, marshes, shallow bays and wetlands, mangroves, coral reefs and sea-grass beds, play a major role in the life cycle of many economically important fish species by providing breeding, nursery and feeding grounds; about 95 percent of the world marine production originates from coastal ecosystems. Their accelerated degradation by land reclamation, drainage, coastal construction and many other competing uses threatens marine fisheries.

14. The exploitation of natural resources and habitats is a function of human population size and development: the trends toward accelerating urbanization, more powerful technology, greater affluence and faster transport are expected to continue throughout the world. Fisheries are, in fact, generally not the culprit but rather the victim of environmental degradation. Controlling coastal development and protecting habitats will require changes in planning, often involving painful social and political choices.

#### Climate changes

15. The amplitude and pace of the anticipated global climate changes are still not clear, and it is therefore difficult to forecast their effects on fisheries and aquaculture. Large changes in total marine fish production are not expected, although particular stocks will be affected. Changes in rainfall patterns and river runoff, as well as sea-level rise, will affect life in coastal wetlands, estuaries, lagoons, mangroves and other important coastal nursery areas. Land erosion may increase, leading to coastal siltation, reduction of the marine photic zone and further degradation of coral reefs and sea-grass beds. Coastal aquaculture will also be deeply affected, especially in Asia from where most of the world's marine and brackishwater aquaculture production now comes. The cost of moving and rebuilding coastal aquaculture infrastructures and re-siting seaweed and mollusc productions cannot be calculated at present but would be enormous.

16. Tropical upwelling zones, which produce large amounts of fish resources, might shift polewards by 200 to 700 km and increase in strength. The year-to-year variability of the resources they support may increase; however, the increased plankton productivity may reduce oxygen levels and lead to anoxic situations.

17. Changes in the strength and frequency of floods are likely to affect inland fisheries, which are currently an important source of protein for the rural communities of sub-Saharan Africa and sub-tropical parts of Latin America; such problems could potentially be worsened by flood control and irrigation programmes. Aquaculture is less likely to be affected by flood

control and irrigation schemes but could be adversely affected by drought. Higher temperatures may be lethal for some species in some areas and would alter oxygen solubility, thus affecting water quality, survival rates and yields.

18. Financial consequences are hard to predict and it is difficult to convince governments and institutional donors to commit funds until better forecasts are available. Premature, ill-informed decisions could be costly and dangerous but there is also a risk in taking no action at all. It is therefore important to reduce the present level of uncertainty.

#### Effects of environmental degradation

19. Chemical pollution, even at low levels, may influence fish production in numerous ways: reduction of stocks by mass mortalities; gradual decline, or changes in species composition, of fish populations or entire ecosystems; increased occurrence of diseases, deterioration of the food quality of fish; lowered growth rates. The seas and land-locked water bodies receive a significant proportion of pollutant chemicals via the atmosphere, so that effects distant from the source cannot be discounted.

20. Nutrient-rich wastes boost primary production in otherwise nutrient-poor seas. They may even enhance fishery resources, although they tend to favour production of small pelagic fish of low economic value. Such wastes may, however, lead to eutrophication, subsequent oxygen depletion and anoxic conditions in deeper layers of lakes and stratified seas, such as the Black and Yellow Seas, with subsequent declines in catch. Blooms of toxic phytoplankton species, arising from the disposal of nutrients into the sea, may lead to red tides and paralytic shellfish poisoning, necessitating the temporary prohibition of the sale of affected fish products. Over-fertilization can cause fouling and clogging of nets and traps used in aquaculture; aquaculture itself is often a source of over-fertilization of the water. Defining a "favourable" level of aquatic enrichment, from the fishery resource standpoint, is, however, very difficult. Nutrient-rich wastes to inland seas impose a high risk to fisheries.

21. Soil erosion due to the removal of plant cover (e.g., deforestation) in watersheds increases sediment loading of rivers and direct freshwater runoff to coastal seas. Water temperature changes are also a consequence which can cause changes in species composition. The former particularly affects anadromous species, such as salmon, and estuarine organisms, such as oysters, coral reefs and aquatic vegetation; increased freshwater run-off to coastal seas may also affect aquatic vegetation therein as well as changing spawning habitat through salinity alterations.

22. Extraction of sand and gravel from the seabed affects many benthic species and damages spawning grounds of other species. Trenches, pits and mounds due to dredging pose problems to

fishermen using bottom gear. Effects are, however, limited in time and space and can be reduced by careful planning and attention to operational procedures.

23. The mining of coral for building material in tropical countries not only destroys a relatively productive ecosystem supporting small-scale fisheries but also deprives the coastline of a natural wave-protection barrier.

24. Reclamation for water-front housing and the construction of marinas in pristine coastal areas are another form of environmental degradation affecting fishery resources.

25. The uncontrolled cutting of mangroves and the clearing of mangrove swamps for various purposes including coastal shrimp farming will destroy the nursery grounds of a number of commercially important marine species and adversely affect those living resources inhabiting the ecosystem. Shorelines will be devoid of natural protection from winds and waves.

26. Whilst freshwater resources are already generally heavily exploited, intervention in the hydrological regime of streams, rivers and floodplains also adversely affects these resources. River management will therefore have to include the consideration of engineering solutions such as the connexion of channels and floodplains in order to ensure the availability of nursery and feeding grounds for the young.

#### Effects of fishing

27. Fishing affects the marine environment by, for instance, destroying benthic organisms or sea-grass beds by intensive dredging or trawling. Illegal techniques such as the use of dynamite or chemicals to capture reef fish also damage the habitat. Whereas these are often the consequence of a lack of fisheries management to ensure adequate catch rates to the fleets they could, however, be handled through legislation, with at-sea enforcement, and by fishermen's education as to the longer-term negative consequences.

28. Fishing modifies the targeted and non-targeted fish stocks, their structure, species composition and reproduction. Moderate levels of exploitation remove old, slow-growing individuals and reduce the abundance of large predators thereby increasing the productivity of the remaining stocks and the sustainable yields. High levels of exploitation reduce large, slow-growing species to "commercial extinction". Although very few, if any, cases of biological extinction by fishing alone have been documented, uncontrolled fishing can have serious ecological consequences, such as the destruction of coral reefs or sea-grass beds.

29. Environmental capacity and "acceptable" levels of impact should ideally be established in advance; any human activity may irreversibly change some components of the marine environment.

The concept of "acceptable impacts" as associated with the concept of sustainability implies that reversibility is ensured. Such a principle is already provided for in the Convention for the Conservation of Antarctic Marine Living Resources.

30. In recent years, concern has been directed particularly toward involuntary and incidental capture or entanglement of marine mammals, birds and turtles by operative as well as lost/discarded fishing gear. Improved gear design and fishing practices could reduce incidental captures to the minimum. However, trawling, driftnetting and seining, for example, even when carried out with improved gear in a responsible fashion, may involve the capture of non-targeted species. These types of gear cannot readily be substituted, and application of unduly restrictive norms may bring many forms of fishing, whether large-scale or artisanal, to an end.

31. In cases of high uncertainty about critical areas or species, in particular, and to avoid potentially irreversible damages to a resource, precautionary approaches have been advocated to make development conditional upon scientific proof of its harmlessness. This is largely a consequence of past and present abuses resulting from the lack of action or weak fishery administration, and is seen as a safeguard for the future. The uncontrolled widespread application of such principles may however conflict with certain food security considerations and development requirements.

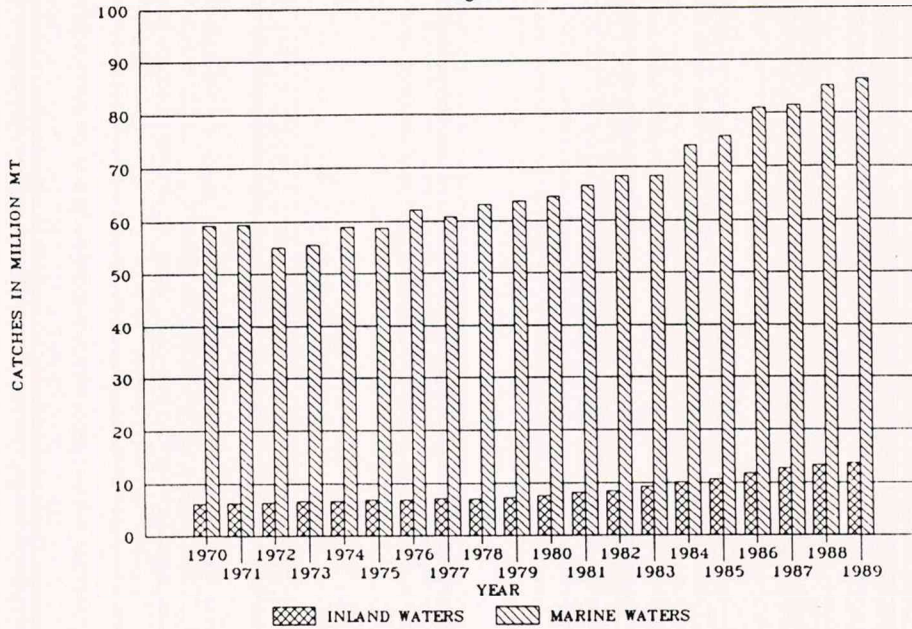
## **THE FISHERIES**

### Coastal fisheries

32. Most of the world's fish production comes from the marine areas, as shown in Figure 1 (see also COFI/90/Inf.4 and 5). Of the marine catch, which is close to the maximum production obtainable by capture fisheries on traditional species, some 90 percent is estimated to be from coastal areas. These areas are the most important from socio-economic as well as food security standpoints. Environmental degradation and excessive fishing pressure has resulted in many of the coastal areas being in a poor condition, particularly in heavily populated areas. Artisanal fisheries are important to rural communities. These are threatened with dwindling resource bases and conflicts with more mobile fishing gears.

### MARINE + INLAND CATCHES IN 1970-1989

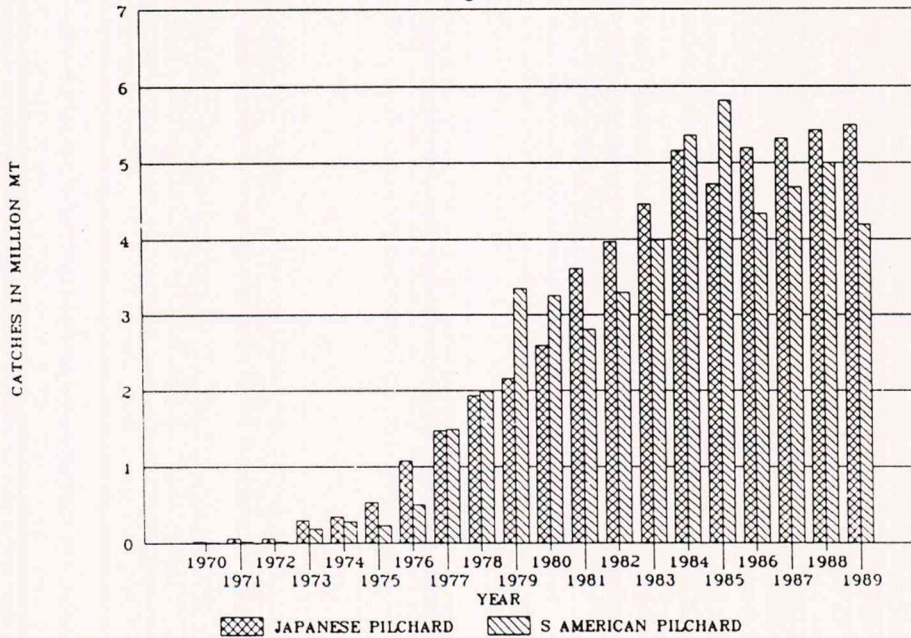
Figure 1



33. Increases in marine catches are the result of different events such as the discovery of new resources, the introduction of new fishing technologies, changes as a result of the Law of the Sea and major environmental changes (the collapse of the Peruvian anchovy). The apparent steady increase in aggregated catches does not reveal a large number of situations of severe overfishing of certain species, declines in the condition of productive areas and climate-driven oscillation as presented as examples below.

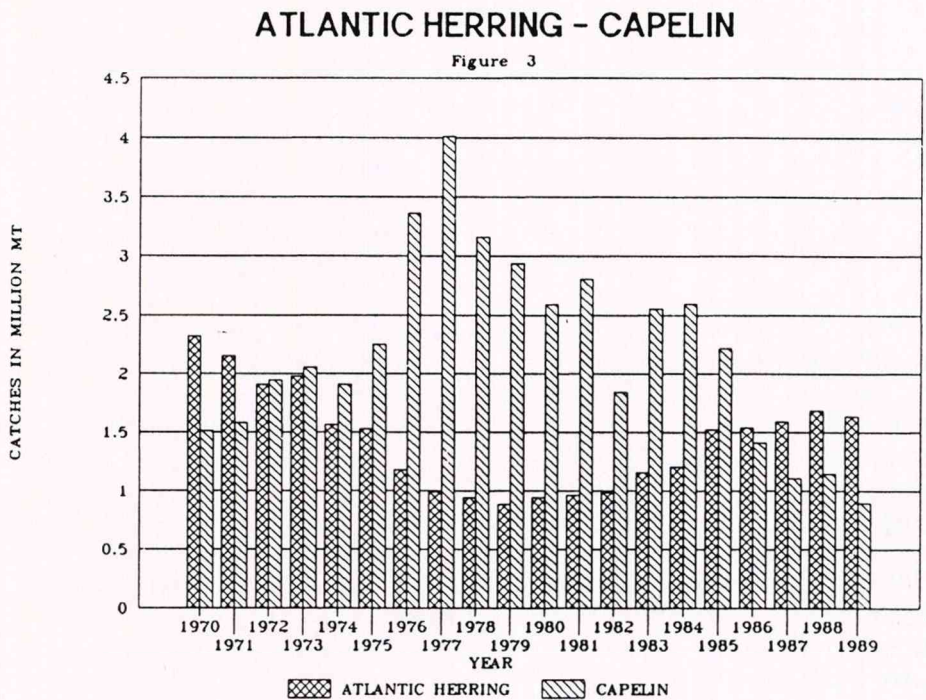
### JAPANESE AND SOUTH AMERICAN PILCHARD

Figure 2





34. Figure 2 shows dramatic increases in catches resulting largely, if not only, from natural climatic oscillations. The increase in catches of the Japanese pilchard is related to the change in the Kuroshio current. The increase in the catch of the South American pilchard is related to the climatic event 'El Niño' and to overfishing of the Peruvian anchoveta, which was apparently replaced by this species commencing in 1973.



35. Figure 3 shows changes in catches of Atlantic herring and capelin. The decreases in capelin catches result from overfishing. The recovery of herring catches result from a closure to fishing, as well as natural recovery due to favourable environmental conditions.

36. Selected examples above are only to demonstrate the changes in yield of certain species from a combination of environmental and fishing conditions. Extreme fluctuations have significant impacts on the fleets and industries concerned. A goal for

improved sustainability in coastal fisheries should therefore be directed at reducing variability in stocks through improved control of exploitation rates as well as improving predictions of environmental change on fisheries.

37. Since the abundance of species is linked to larval survival, very often in shallow waters, the preservation of critical spawning and nursery areas in the immediate inshore areas can be expected to improve stock abundance and reduce variability. It is urgent that critical habitats be properly identified and protected.

#### High-seas fisheries

38. Most high-seas resources have a phase of their life-cycle inside 200-mile limits (EEZs). About 400 species can be considered entirely or partially oceanic, and a few of them have been exploited. Some tuna species are overfished and many of the large whale species have been overfished, depleted or are on the verge of extinction. Several Antarctic fish species have been overfished. The biological information and statistical time series available are usually poor except perhaps for large tunas and some whales. The conservation of those species being exploited is a matter of serious international concern.

39. The management and/or conservation of some high-seas fisheries is presently covered by international conventions and by fishery commissions functioning usually on the basis of consensus amongst the contracting parties or member countries and also cover coastal areas.

40. Although most of the fishery commissions do not have binding authority in basic conservation matters, several have been successful in applying economic pressure to achieve some conservation objectives. Most of the commissions do not, however, have such leverage and others lack the basic data required to identify conservation needs. The task involves not just oceanic stocks but also the interaction between EEZs and the high seas.

41. Few of the species exploited beyond 200-mile limits are properly covered by fishery management bodies. Even when they are, as for tuna or whales, there are major problems of monitoring and control. In addition, high-seas fisheries often take place on transboundary stocks, which migrate into EEZs for part of their lives, creating particular problems of data collection and stock assessment. Recent innovations in gear technology have allowed for an increase in fishing effort on the high seas, as a result of a necessity for long-range fleets, excluded from EEZs, to find alternative resources. Concern has recently been expressed over the lack of cohesion in the network of fishery commissions in dealing with inter-ocean and intra-ocean problems.

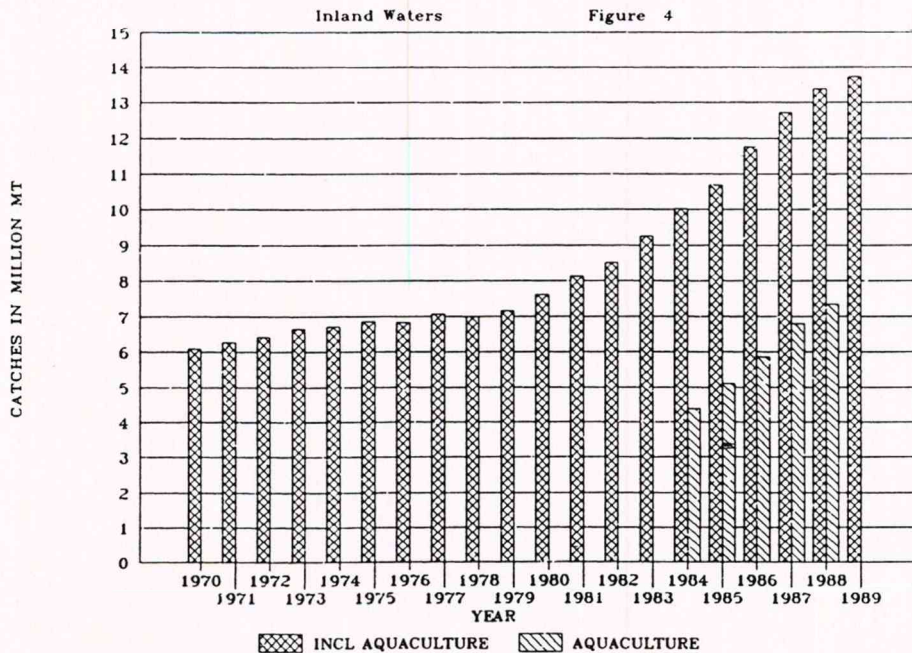
42. Distant-water fishing vessels fish outside the jurisdiction of their respective flag states, and although reporting procedures are required by many distant-water fishing nations, as a condition of fishing, these are difficult to enforce. This problem also includes the recording of unbiased fishery data on by-catch of protected species. The need for a common data base for high-seas fisheries has become progressively more evident, most recently with respect to the issue of large-scale pelagic driftnet fisheries, as reported in document COFI/91/5.

43. FAO is not presently able to report globally on high-seas catches. Data provided to the Organization are by statistical fishing area, as agreed by the Coordinating Working Party on Atlantic Fisheries Statistics, and differentiation is not made by distance from the coast.

### Inland fisheries

44. About 13 percent of the world catch of aquatic resources comes from inland waters, half of which is produced from fresh-water aquaculture, as shown in Figure 4 starting from 1984. Previous to this date no separation in data was provided between inland catches and aquaculture and it is assumed that most of the increases in total production shown in the figure over the last ten years are due to aquaculture production. Any trends for inland catches alone therefore cannot be determined and the effects of environmental degradation are not identifiable.

WORLD CATCHES FOR THE PERIOD 1970-1989



45. Most fisheries are small-scale subsistence or commercial fisheries. They exploit lakes, rivers, reservoirs and flood-plains in competition with other human activities. Nearly all

major enclosed water bodies are now seriously affected by human activities. The habitats of many wild inland fishery resources are being severely damaged by intensive agriculture, river control and urban development. These resources have also been drastically affected by climate changes, especially by droughts in sub-Saharan Africa. The intensification of fisheries management practices by stocking and fertilizing inland water systems, on the other hand, has increased the available production.

46. As major controls on inland water environment are exercised by non-fishery users, fishery managers must participate to a much greater extent than at present in the planning of the integrated use of river basins. The FAO programme on inland fisheries has included basic studies on river fisheries ecology as well as a series of training courses on planning for resource managers, aimed at defining the impacts on fisheries of decisions on the allocation of use of aquatic resources.

47. There is considerable room for improvement in the management of inland fish stocks. Present management practices, in general, are all too frequently not founded on the best scientific advice available. Multi-species fisheries, of the type most common in inland waters, permit a considerable flexibility in formulating fishery strategies, although the general tendency has been toward laissez-faire policies which have led to the general degradation of stocks almost everywhere. Furthermore, current understanding of the behaviour of multi-species assemblages subject to fishing pressure is not always adequate for the formulation of legislation based on scientific analysis, nor does it allow prediction of the resilience of such assemblages and the reversibility of trends when management strategies change.

48. An increasing trend in inland fishery areas is toward some degree of environmental engineering in order to provide the necessary breeding and nursery grounds for resident stocks and fish passes for migrant species. Where these solutions fail, the introduction of non-native species better adapted to the needs of the altered environment, or sustained stocking with native species which could not otherwise reproduce, are common. The impacts of such practices on the stocks already in the water-body are poorly understood, as is the cost effectiveness of massive programmes of this type.

#### Aquaculture

49. About 10 percent of global fish production comes from aquaculture, approximately 7 million t from freshwater aquaculture and 5 million t from mariculture. At present growth rates, production by the end of the century should be almost doubled. In areas of high production, environmental problems are already apparent and will affect further growth in the sector. To avoid this, planning should cover areas such as environment, social interests, economic policies (credit, incentives) in a cross-sectorial manner.

50. Aquaculture development has followed two separate paths: that of rural, extensive aquaculture, practised mainly in developing countries, and that of commercial and intensive aquaculture practised in both developed and developing countries. The first type is traditional and more likely to be influenced by the environment than to affect it. The second type is more likely to produce undesirable environmental consequences. The rapid expansion of industrial aquaculture in developing countries could have significant consequences for the environment.

51. Only a few developing countries have enacted legislation supporting or even dealing with aquaculture. So far, the setting-up of aquaculture enterprises is often being constrained by regulations on land tenure, water use and public health. Additionally, increasing awareness of the need for environmental safeguards is promoting legislative measures to prevent and control pollution. A restatement of the pertinent legislation is often necessary, particularly in developing countries, and will have to consider the law in related fields that affects aquaculture (i.e., land tenure, access and use of water and coastal areas, etc.).

52. It is important to note that the present number of species raised in aquaculture is relatively limited: carps, tilapia, salmon, trout, catfish, milkfish, amberjack and shrimps. Recognizing that only a few species are presently cultured, concern should be given to maintaining wild species diversity until more is known about a considerable number of other species.

#### **FISHERIES MANAGEMENT AND SUSTAINABLE DEVELOPMENT**

53. The definition of sustainable development, as provided in paragraph 2, is generally adequate for fishery purposes since it implies increasing the global societal benefits derived from aquatic resources without increasing the rate of exploitation or rate of use, and therefore without decreasing a resource or stock beyond some optimal and sustainable level. In view of the increasing contamination of the coastal environment and its potential impact on public health there is a clear need for governments to pay more attention to monitoring environmental quality and the safety of fishery products. Any product found to be contaminated must be rejected for human consumption and the areas closed to fishing until shown to be safe.

54. Fisheries produce 16 percent of the total animal protein available in the world. This contribution of fish to protein supply is approximately the same as for beef or pork. It is the diversity of fish species that is important, since it provides consumers with a wide range in both taste and price. Maintaining the biological diversity is important therefore for environmental and market reasons.

### Sustainability as Management Criteria

55. Fisheries have been regulated in various ways for centuries and as fleets increased in mobility, international collaboration became necessary to try to ensure the sustainability of the yields from commonly exploited stocks. The 1882 Convention for Regulating the Police of the Fisheries in the North Sea outside Territorial Seas, primarily directed at driftnet fishing, is one of the earliest examples. Some fishery conventions are species-specific, such as those covering whales, Pacific and Atlantic salmon, tunas, and Pacific halibut. Others cover geographical areas; there are a number of fishery bodies for the Atlantic Ocean, the Pacific and the Indian Ocean, and one each for the Baltic, the Mediterranean and Black Sea. Six of these regional fishery bodies are under FAO's responsibility.

56. The concept of sustainability has always been the basis of fisheries management. It includes the sustainability of the biological resource, its value and the social benefits deriving from fisheries. It also implies an assumption of reversibility. Resources will inevitably be affected by exploitation in terms of abundance, spawning biomass, species composition, etc. The need to conserve options for future generations implies that modifications be reversible within some practical time-frame.

57. As already noted above, fishery resources are too often exploited in a non-sustainable manner despite the legal frameworks that exist and the regional institutional mechanisms established within them. Greater awareness must be created of the penalties arising from mismanagement, or the lack of management, of fisheries, and, in the light of the Third World debt and economic restructuring, the governmental role in fishery management is crucial. The implicit value of fishery resources, often called "rent", is presently being dissipated by excess fishing capacity through lack of management.

58. The removal of open-access conditions to fisheries, the payment of user fees, etc. and the negotiation of maximum allowable effort levels and allocation schemes could all contribute to the greater sustainability of fisheries.

59. Where resources are overfished, it is because the rate of exploitation is too high. The continuing increase in the real price of fish, as a result of strong demand against limits to the supply of fish, is encouraging the rate of exploitation at too high a level. User fees or environmental taxes would help to offset the effect of rising prices and may provide sufficient funds for developing countries to implement effective fishery management regimes.

60. The regulation of fishing effort is, in many instances, insufficient to ensure sustainable resource utilization. Recruitment, mortality and growth of a fish stock are also affected by

the impacts of other users of the aquatic habitat; they potentially include all up-stream economic activities such as industry and agriculture as well as fishing. One of the major problems in acting efficiently relates to the dispersion of responsibilities among many national and international institutions having competence in various aspects of resource and environment use.

61. As a priority, fishery resources and aquatic habitats that are not yet degraded need to be brought under effective management regimes. Rehabilitation of resources is a more costly way of achieving sustainable development patterns than timely preventive action. Care needs to be taken not to aggravate over-use through rehabilitation measures (such as artificial reefs) unless they are accompanied by adequate management systems.

62. Fishery management requires multi-disciplinary expertise on a range of subjects, such as fishery resource assessment; bio-economic and socio-economic analysis; management techniques; fishing technology; monitoring, control and surveillance methods; and fisheries legislation. Some governments have made considerable efforts to acquire and strengthen their national expertise in these fields through training, study tours and scholarships for young scientists and administrators. FAO has assisted governments in these efforts and has organized national and regional training courses in these fields.

#### Responsible fishing

63. Another practical aspect of the sustainability issue is in the application of more selective fishing gear and methods. Bycatches of non-marketable, undersized or non-targeted species (birds, turtles, mammals) are not wanted by the fishermen, but fishing gear and methods are not sufficiently selective, and fishermen dump what cannot be sold. For instance, the discard from shrimp trawling alone is probably in excess of 5 million t annually.

64. Most countries have minimum standards for mesh sizes in fishing nets and minimum sizes for targeted species; most international conventions seek to regulate mesh size and the deployment of fishing gear so as to control the sizes caught but few refer specifically to gear selectivity for species.

65. Some States have already introduced legislation controlling certain fishing methods and making escape devices obligatory in certain types of fishing gear. This has not always had the desired effect and has led to conflict between the fishermen, administrators and the public.

66. A particular current problem is the poor selectivity of the monofilament nets used in the large drifting gillnet fisheries which are different from inshore gillnets employed in artisanal fisheries. Incidental catches of non-targeted species caught in these large nets can be high, including not only small tunas and

other fish but also marine mammals and birds. The need to ensure that fishing gear is designed in such a way that the targeted species is caught preferentially, with only minor catches of other species, poses a challenge to fishery technologists.

#### Variability and "sustainability"

67. In the aquatic environment, sustainability does not mean constancy. Since the seventies, short-term variations in marine resources, due to fishing and natural fluctuations, are now recognized as important for assessment and management. The interaction between species (through predation) and fishing effort is also an important factor.

68. Under heavy fishing pressure, species dominance changes toward short-lived, small, pelagic species, thereby modifying the resource base and options available for development.

69. Variations in fish stocks due to natural climate fluctuations are important in upwelling areas which contain very abundant pelagic resources and contribute about 50 percent of the world catch. Their over-exploitation leads to increased variability and risk of collapse, as illustrated by the Peruvian anchovy and the Namibian sardine. These variations are, however, a source of uncertainty and cost to fishery management authorities and industry. They must be reduced, if possible, or better predicted, which requires combining environmental analysis with stock assessment.

#### The biodiversity issue

70. Since the beginning of this century, the transfer of aquatic species around the globe, either through deliberate introduction by man or by accident, has increased. This has resulted in changes to the faunal composition in certain waters. The effects of the introductions include: immediate ecological impacts at the community level through changes in competition and predation; changes in the nature of the environment itself through the behaviour of certain organisms; possible genetic degradation of indigenous stocks. The co-introduction of pathogenic organisms has often adversely affected native and introduced species alike; the introduction of diseases has proved a particularly serious problem for aquaculture, especially in developing countries where infrastructure is insufficient to support the necessary quarantine and veterinarian services.

71. The conservation of biodiversity of aquatic organisms poses problems at two main levels. In wild stocks, the loss of species, and more especially local races, through bad fishing practices, environmental change or species introduction (including escapes of cultured species into open waters), is a real and persistent danger. In cultured species, the need to develop new strains and conserve favourable ones is increasing.



72. Fisheries and aquaculture have, to a certain extent, lagged behind other sectors of agriculture and forestry in the exploitation of genetics and biotechnology for management and development. However, the effects of present fishing and management practices on wild fish stocks and the advantages of genetic manipulation to aquaculture are becoming more apparent.

73. FAO has collaborated with the International Council for the Exploration of the Sea (ICES) in the preparation of a "Code of Practice for Consideration of Transfers and Introductions of Marine and Freshwater Organisms"; its provisions have already been adopted by the European Inland Fisheries Advisory Commission (EIFAC) and the Commission for Inland Fisheries of Latin America (COPESCAL), and are being considered by the Committee for Inland Fisheries of Africa (CIFA) and the Indo-Pacific Fisheries Commission (IPFC).

#### The need for research

74. The management and development of resources should be based on the best scientific evidence available. At national, regional and international levels, information and research on the resources, the fisheries, and the human communities concerned are required.

75. Uncertainty is high in the aquatic environment and its cost to development is substantial. Research must be applied to reducing the uncertainty facing decision-makers.

76. There is an urgent need for fishery research, including that concerning the environment to be more closely linked to development programmes. To date, the demand for research has often only come after problems, such as stock depletion, environmental degradation and contamination, have become apparent. Coastal-zone management from a fishery manager's perspective requires inputs from research on fisheries and environment. Document COFI/91/7 provides a fuller discussion on the needs for fisheries research.

#### SAFETY OF AQUATIC PRODUCTS

77. Consumption of fishery products is on the rise in developed countries because of the perceived health benefits, while developing countries are struggling to maintain their food supply. Simultaneously, consumers are becoming increasingly aware about intrinsic quality, and more stringent regulations are being introduced by governments, increasing the cost of testing and making it more difficult for developing countries to comply. Residues of environmental processes, discarded into the environment and subsequently concentrated into the food web, such as heavy metals, PCBs and dioxins, have had the most dramatic impact. There are, however, growing problems with the contamination of the inland and coastal environment, and subsequently,

aquatic products, with pathogenic bacteria and viruses contained in sewage and uncontrolled domestic and industrial discharges from urban agglomerations. Nutrients from the same sources also encourage the blooms of toxic dinoflagellates which cause the red tides that are an increasing problem both for capture and culture fisheries. In areas of oil exploitation and spills as well as in the vicinity of heavy naval traffic, nets are frequently clogged by crude oil and tar lumps, and catches often have to be discarded because of tainting.

78. Through the joint Codex alimentarius Commission, FAO cooperates with the World Health Organization to protect the health of consumers, promote trade and the coordination of international food standards. In addition, developing country governments have been provided with assistance to develop the infrastructure for handling and processing the catches from small-scale fisheries to ensure that they meet international quality standards.

#### **SUMMARY AND CONCLUSIONS**

79. The 1984 FAO World Fisheries Conference established the policy basis for sustainable development of fisheries in greater detail, proposing a Strategy and five Programmes of Action. Reports on their implementation have regularly been presented to the Committee (see also documents COFI/91/2 and COFI/91/9). Despite the efforts, fisheries management still needs considerable improvement and further action is required to tackle environment-related fisheries problems. National development plans in sectors which interact with fisheries should be reviewed in order to sustain the production of fish.

80. The following proposals are therefore intended to strengthen and complement the Strategy of the World Fisheries Conference. The main long-term goal is to improve national capacity to deal with the complex issues related to sustainable development of fisheries and its implications in terms of environmental management.

81. Although the large majority of fisheries resources is not threatened by extinction, immediate action is required at several levels (the fishing communities, the national policy and planning departments, the regional fisheries organizations, the international agencies) to stop present trends towards degradation of resources and habitats, rehabilitate them and promote the conditions for fisheries in watersheds/coastal zones and in the high seas.

82. The lines of action proposed for the Committee's consideration are: to raise general awareness, to improve information systems, to increase rights and responsibilities of the fishing communities, to integrate better the national mechanism for decision-making, to better coordinate the action of the

international organizations, to improve legal and institutional frameworks, to make full use of the United Nations Convention on the Law of the Sea (UNCLOS).

#### Research needs

83. Increased efforts in research are required, at national level, aiming at establishing resources inventories, assessing economic values, degrees of exploitation and present status; defining "acceptable" rates of use, levels of departure from pristine conditions, and reversibility criteria; analysing trade offs between environmental degradation from development and rehabilitation; studying the potential damage to aquaculture from intensive coastal and inland aquaculture. As already mentioned in paragraph 78, this matter is discussed in detail in document COFI/91/7.

#### Biodiversity and biotechnology

84. The FAO/ICES "Code of Practice for Consideration of Transfers and Introductions of Marine and Freshwater Organisms" should be more widely adopted and better enforced to avoid further spread of diseases and undesirable introductions in coastal areas. Guidelines for stocking should be prepared for coastal aquaculture.

85. Better integration of fisheries institutions with the plant and animal husbandry sectors is needed in developing and applying conventions for the conservation of genetic resources and for the control in the application of biotechnology.

86. The FAO Fisheries Species Data-Base and Identification Programme would continue to produce world catalogues and regional identification sheets and field guides as a basis of monitoring changes in species diversity. Emphasis would be put on training and on development of data bases to be used by developing countries.

87. Biotechnology, as applied to fisheries and aquaculture, is still in its infancy relative to agriculture, and there is therefore a need to carefully follow developments in this field, its implications for fisheries management and any possible risks to aquatic ecosystems.

#### Environmental awareness

88. Efforts should be made at all levels to highlight issues related to sustainable development, food security and related environmental issues. In particular, the issues related to multiple and potentially conflictual use of coastal areas and watersheds and the resulting environmental problems should be introduced in fisheries training and education programmes, for fishery scientists, managers, extension workers and fishermen's communities, associations and cooperatives. Areas of particular relevance are watersheds, mangroves, deltas, lagoons, intertidal

and other coastal critical habitats. Those issues should be brought to the attention of FAO regional fishery bodies and other fishery bodies. Continued emphasis should be given to quality assurance and safety of fish as food.

#### Environment and resources rehabilitation

89. Major efforts are needed to stop environmental degradation and to reduce and mitigate effects from other users on fisheries, inland, in the coastal areas and in enclosed and semi-enclosed seas. Land-base sources of pollution should be better controlled and dumping of non-biodegradable wastes (including discarding of fishing gear) into seas, rivers and lakes should be reduced.

#### Climate changes

90. Climate change impacts on inland and coastal habitats, people's and resource uses must be assessed and contingency plans to mitigate those impacts, at national and regional levels should be prepared. Particular attention should be given to coastal plains and deltas and to island countries. Increased understanding is needed on climate changes on aquatic ecosystems and on possible impacts on fisheries.

#### Fishermen's involvement

91. Fishermen's participation is a pre-condition to substantial improvement of both fisheries management and environmental protection. Improving their participation and increasing their responsibility implies that adequate property or user rights be defined, allocating space and resources explicitly. The concepts of people's participation and resources allocation, in particular within the framework of coastal areas integrated management should be promoted. Fishermen's associations and cooperatives would be very efficient vehicles for information.

#### Information systems

92. Efforts are needed in many directions to reduce risks in fisheries development and to improve the capacity to react to negative events. Improvement of information systems is a prerequisite and should concern the environment, the resources, the fisheries and the market.

93. There is a need to improve monitoring systems for environmental degradation. A global information system identifying critical fisheries habitats areas and monitoring gains and losses to fish productivity would be useful. Monitoring of heavy metals in seafood is crucial to ensure long-term integrity of food supplies. Monitoring of catastrophic events such as dinoflagellates blooms or viruses and bacterial epidemics are also essential in heavily developed areas. National capacity to monitor and analyse environmental data and to react to early

warnings, through adequate systems of regulations and enforcement, should be improved.

94. Geographic Information Systems (GIS) are required, at national and regional levels, to compile an inventory to use the data already available in a better way, to improve the cost-effectiveness of new data collection, and to facilitate the analysis required for intelligent integrated development and management. Member countries should be assisted with extra-budgetary funding in developing GIS for the management of high-seas fisheries and coastal areas.

95. National fishery statistical systems need improvement and support. Countries should make efforts to improve the logistics of data collection and there is a need to provide technical assistance to modernize (computerize) the data processing systems with extra-budgetary funding to acquire the necessary equipment.

96. High-seas fisheries data are presently not adequate. States whose nationals fish in the high seas should improve their reporting to regional fisheries bodies and to the Organization. The statistical data collection should be adapted to distinguish between high seas and EEZ fisheries (see also document COFI/91/5).

#### Integration and coordination

97. At national level, inter-ministerial coordination should be established to deal with conflicts for the uses of the aquatic resources, taking due account of the need to ensure global sustainability and alleviate environmental constraints. Policies and mechanisms are needed to integrate fisheries protection into the pattern of resource use at the river basin and coastal areas level, encouraging an integrated management and development approach. Field activities should be developed as far as possible in support of national efforts toward integrated coastal areas management. Aquaculture should be included in rural planning.

98. At regional level, the work of regional fishery bodies in handling environmental matters of importance to fisheries should be reinforced. In particular, issues related to selective fishing, appropriate technology and critical habitat conservation from land-based sources of pollution should receive more attention.

99. At international level, collaboration between international specialized organizations is needed to develop a holistic understanding of the oceans and their resources. Experience has shown however, that a regional approach and sectoral specialization is required in order to be able to act efficiently. Collaboration on matters relating to data collection, research and training

programmes for integrated development and management should be sought with other organizations working in these fields.

#### Legal frameworks

100. The United Nations Convention on the Law of the Sea (UNCLOS) provides a framework for the conservation and management of living resources and for the protection and preservation of the marine environment. It is clear that further progress could still be made for the full implementation of the relevant provisions of the Convention, especially with regard to high-seas fisheries. Further work is needed in order to maintain or restore populations of harvested species at levels which can produce a sustainable yield as qualified by relevant environmental and economic factors, and taking into account international standards. FAO has an important role to play in assisting member countries and international organizations in such a process.

101. There is a need for a legal framework for the control of aquaculture development. FAO could assist member countries and international organizations in the development and implementation of principles or guidelines in order to control the environmental impact of aquaculture and to limit the spread of diseases in cultured and wild populations. A legal framework is also needed to protect critical habitat areas.

#### Responsible fishing

102. Action is required to improve long-term efficiency of fisheries and reduce waste. Too many resources are overfished with severe biological and economic consequences. Efforts should continue and increase to reduce fishing intensities in inland waters and in the sea to sustainable levels that are economically viable, ecologically sound and socially acceptable. Particular attention should be given to ecological consequences in inland fisheries systems and in the high seas.

103. The use of subsidies should be limited to remedial or initial development measures. Imposition of resource and environmental fees should be considered to counteract the pressures of excess demand and provide financial support needed by the fisheries commissions and national administrations responsible for coastal areas use management. Such concepts could be built into the Organization's training programme and workshops on fisheries management.

104. Management of multispecies assemblages must be improved taking into account the need for conservation of biodiversity. Gear selectivity should be improved, especially for the concerns with incidental mortality of non-targeted species such as marine mammals or endangered species such as turtles. Attention should be given to the problem of appropriate fishing techniques, particularly on the high seas.

105. Certain fishing practices require management action to either restrict the number of vessels using gears which damage the environment, restrict effectively the area of operation of such gears or encourage such vessels to change to more selective gears. In particular, the Secretariat would assist with guidelines for the marking of fishing vessels and fishing gear, to improve enforcement, facilitate navigation, reduce conflicts and help reduce loss or at-sea discarding of gear (see also document COFI/91/6).

#### **SUGGESTED ACTION BY THE COMMITTEE**

106. The Committee is invited to review the document, especially the Summary and Conclusions in paragraphs 79 to 105, with a view to guiding the Organization in the preparation of its 1992-93 Programme of Work and its Medium-Term Plan. In particular, the Committee may wish to consider:

- the requirements for better high-seas fisheries data (paragraphs 42, 94, 96)
- the integrated development of coastal areas (paragraphs 88, 89, 97)
- the development of geographical information systems (paragraphs 94, 95)
- the need for guidelines on responsible fishing (paragraphs 63-66, 102-105)
- the role which FAO regional fishery bodies and other regional fishery bodies can have in implementing the issues referred to above.