

OCEAN FISHERIES MANAGEMENT

THE FAO PROGRAMME

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"L'ère des terrains vagues, des territoires libres, des lieux qui ne sont à personne, donc l'ère de la libre expansion est close... Le temps du monde fini commence." Paul Valery (1945).

ABSTRACT

This paper traces the evolution of ocean fisheries and their management on a worldwide basis, showing how the FAO programme related or contributed to the evolution. After various phases of rapid development separated by relative stagnation, ocean fisheries production is now oscillating close to the level considered as maximum for traditional resources (100 million tons). In the process of development, numerous stocks have been reduced, some of them quite drastically, underlining the growing need for management including policy, planning, data collection, research, laws, enforcement and regional cooperation. The mandate of FAO, the structure of its Fisheries Department and its programme since its creation reflect these needs. The broad lines of FAO's today programme were already established in 1945 and its focus evolved within the international context: the early days of post-war reconstruction (1946-58), the period of expansion of research and fisheries (1958-72), the establishment of a new economic order of the oceans (1973-83), the transition towards global concerns (1984-92) and the future challenge for global sustainability (1993-2000). In conclusion, the paper presents a perspective view of the process indicating the various axes along which the world fishery system and the FAO programme have evolved during 45 years and the key issues to be faced before the end of this century.

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LIST OF ABBREVIATIONS USED IN THE TEXT

| | | |
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| ACMRR | : | Advisory Committee on Marine Resources Research |
| ASFIS | : | Aquatic Sciences and Fisheries Information Systems |
| CECAF | : | Committee for the Eastern Central Atlantic Fisheries |
| CWP | : | Coordinating Working Party for Fishery Statistics in the Atlantic. |
| CCAMLR | : | Commission for the Conservation of Antarctic Marine Living Resources |
| COFI | : | FAO Committee on Fisheries |
| CPPS | : | Comision Permanente del Pacifico Sur |
| DANIDA | : | Danish International Development Agency |
| EEZ | : | Exclusive Economic Zone |
| FAO | : | Food and Agriculture Organization of the UN |
| FFA | : | Forum Fisheries Agency |
| GATT | : | General Agreement on Tariffs and Trade |
| GFCM | : | General Fisheries Council for the Mediterranean |
| I-ATTC | : | Inter-American Tropical Tuna Commission |
| ICCAT | : | International Commission for the Conservation of Atlantic Tunas |
| ICES | : | International Council for the Exploration of the Sea |
| ICNAF | : | International Commission for Northwest Atlantic Fisheries |
| IOC | : | Intergovernmental Oceanographic Commission (Unesco) |
| IOFC | : | Indian Ocean Fisheries Commission |
| IOTC | : | Indian Ocean Tuna Commission |
| IPFC | : | Indo-Pacific Fisheries Commission |
| IWC | : | International Whaling Commission |
| NAFO | : | North Atlantic Fisheries Organization |
| NASCO | : | North Atlantic Salmon Conservation Organization |
| NGO | : | Non-Governmental Organization |
| NORAD | : | Norwegian Agency for Development Cooperation |
| OECD | : | Organization for Economic Cooperation and Development |
| OLDEPESCA | : | Organización Latino-Americana por el Desarrollo de la Pesca |
| UNCED | : | UN Conference on Environment and Development |
| UNCLOS | : | UN Convention on the Law of the Sea |
| UNESCO | : | UN Educational, Scientific and Cultural Organization |
| UNDP | : | United Nations Development Programme |
| UNEP | : | United Nations Environment Programme |
| UNCHS | : | UN Centre for Human Settlement: Habitat |
| SOFA | : | State of Food and Agriculture |
| WECAFC | : | Western Central Atlantic Fisheries Committee |
| WCED | : | World Conference on Environment and Development. |

1. INTRODUCTION

Sea fisheries developed slowly until the beginning of the century. Reported marine production increased rapidly between the two world wars and after, passing from 18 to 28 million t between 1948 and 1958. It increased faster in the following decade reaching 59 million t in 1970 as a result of expansion of the large-scale fishing fleets from Western and Eastern Europe, Japan, USA, Cuba, Thailand and the Republic of Korea and as newly independent developing countries established their national fisheries sectors. During the seventies fisheries growth declined, reaching only 68 million t by 1982. A number of stocks of small coastal pelagic species collapsed during this period (including the Peruvian anchoveta) while whale stocks and Antarctic resources continued to be depleted. Since 1982, fisheries growth again accelerated, reaching 86 million t in 1989, a value close to the world potential estimated by FAO at about 100 million t [1] (Fig. 1).

Fish provide about 40% of the protein intake to about two-thirds of the world population. Demand for food fish continues to rise at the rate of 2% per year indicating a possible deficit of 20 million t or more by the end of the century. Conflicts are growing for a progressively scarcer resource.

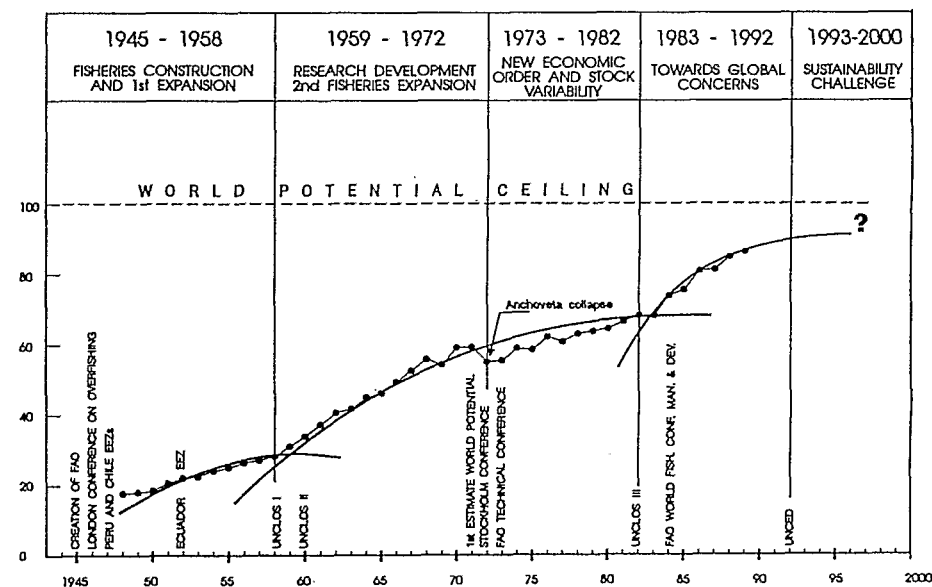


Figure 1. World reported marine catches and aquaculture ($\times 10^6$ t) and selected international events

Since the early seventies, awareness of environmental issues has created additional dimensions to the challenge of fisheries management. The coastal areas have been "saturated" by competing industries and urban development particularly in enclosed and semi-enclosed seas and island countries. This resulted in environmental degradation by factors largely external to the fishing industry that affected the quality of sea food and the productivity of mangroves, sea-grass beds, estuaries, lagoons and shallow bays which are essential for sustainable fisheries development. Coastal aquaculture has shown potential for increased production but met with environmental problems and it has to compete for feeds, fingerlings, space and water resources with other uses of the coastal zone [2, 3]. Strong opinions have been voiced against non-sustainable development strategies. Drastic changes occurred in world resources allocation through the UN Convention on the Law of the Sea (UNCLOS). Decolonization and EEZ processes have increased responsibilities for national administrations, together with the demand for food, development, management and research. Socio-economic and environmental forces have become increasingly recognized. Involvement of politicians, media and the public in management has increased. These rapid changes have created opportunities for improvement of fisheries, but also a climate of scientific and administrative uncertainty. This uncertainty is further aggravated by the unknowns related to the expected climate change, the consequences of which are far from clear.

This paper draws a perspective view of world fisheries, their management and the related FAO programme and does not attempt to give a full account of other important aspects of FAO work related to technology, community development, trade, aquaculture, etc. This difficult task required that fairly general statements be made on a situation which, because of its geographical diversity, defies generalization. It requires subjective decomposition of a complex non-linear historical process and selection of key elements in the 45 years' programme of FAO and the selection made in this paper, which here reflects the personal interpretation of the writer. The following sections will describe: (a) the structure of the FAO Fisheries Department in relation to the mandate of FAO and the requirements for fisheries management, and (b) the evolution of the FAO programme for fisheries management in relation to the evolution of the international context of fisheries.

2. THE FAO FISHERIES DEPARTMENT

The FAO Mandate

On 16 October 1945, 8 days before the creation of the United Nations itself, FAO was founded as the first of a new generation of international organizations. For the first time, nations joined together to raise levels of production and distribution of food and agricultural products. The preamble to the FAO Constitution specifies that the ultimate aim is to raise nutritional levels and standards of living, and to improve the condition of rural populations. The Constitution of the Organization determines that, in order to achieve this, the Organization should "promote and...recommend national and international action with respect to conservation of natural resources and the adoption of improved methods of agricultural production". The specific mandate on fisheries was further defined by the Technical Committee on Fisheries on 13 April 1945, which established the main lines of the programme that FAO developed in the following decades: fishery data collection, research, training, development management and regional cooperation (see section 3.1).

Structure of the Department

A functional fisheries management system, at national, regional or international level, requires a number of elements: (1) An information system to collect reliable, standardized data on the fisheries (catch, by-catch, fishing effort, costs, revenues), the processing sector, the markets, etc. (2) A research capacity to provide information on resources and fisheries, to develop internationally agreed methods and criteria, monitor impacts on and from fisheries, propose management options, monitor their performance, provide intelligence in fisheries negotiations. (3) A decision-making system to set development policies and objectives, decide on allocation and other scientifically-based management measures, ensure participation of industry and people in the decision process. (4) An enforcement system to ensure compliance of industry and defence of public interests, with adequate laws and efficient system for monitoring, control and surveillance (one of the major deficiencies in international fishery management systems).

The FAO Fisheries Division was one of the Organization's first technical divisions to be established in 1946. By 1947, the Fisheries Division was divided into 3 branches: Biology, Technology and Economics. In 1965, the Fisheries Division was upgraded to a Fisheries Department with a Fisheries Resources and Exploitation Division and a Fisheries Economics and Products Division, recognizing the expanding role of fisheries in the economic and social development of the member countries. In 1970, the Department was rearranged with a Fishery Resources Division, a Fishery Economics and Institutions Division, a Fishery Industries Division and an Operations Service, reflecting the importance taken by the regional fisheries bodies and the Field Programme. In 1972, year of the UN Conference on the Human Environment (Stockholm), the Fishery Resources Division became the Fishery Resources and Environment Division. From 1973 to 1979, the Fishery Economics and Institutions Division evolved, strengthening its capacity to service regional fisheries bodies and to provide policy advice, accompanying the worldwide revolution which was underway with the UN Convention on the Law of the Sea (UNCLOS). In 1979, it became a Fishery Policy and Planning Division with two Services dealing respectively with policy and planning and with international collaboration. By 1980 the Fisheries Department had reached its present structure as briefly described below.

The Fishery Information, Data and Statistics Service (FIDI) develops international statistical standards and produces annual statistical yearbooks and computerized databases. It advises on data collection, storage and processing, and provides training in statistics. It supervises the FAO Fisheries Branch Library and is a major partner of the worldwide Aquatic Sciences and Fisheries Information System (ASFIS) which stores and disseminates bibliographical information.

The Fishery Resources and Environment Division (FIR) provides worldwide reviews of the state of stocks. It develops, adapts and transfers methodologies and software to developing countries and carries out an important training programme in stock assessment, bio-economics and fisheries science in general. It produces written and computerized material for species identification. About 50% of its activities are in direct support of the work of the FAO and non-FAO regional fishery bodies dealing with fisheries management. It is also involved in environmental aspects of fisheries and is responsible for research and development in mariculture and coastal aquaculture.

The Fishery Industries Division (FII) provides advice and assistance on all aspects of fish capture technology and the handling, processing, marketing and distribution of fish products with a focus on small-scale fisheries. Its activities relate to waste reduction, transfer and adaptation of gears, upgrading of national fishery industries and technology services, development of underutilized resources, training, integrated development, energy optimization, "responsible" or sustainable fishing and nutrition. The Division runs a world network of marketing information services (GLOBEFISH) and coordinates a Project for Cooperative Use of Research Vessels.

The Fishery Policy and Planning Division (FIP) addresses the major economic, social and institutional issues in fisheries management and development, providing support to the national fisheries policy development process and to regional fishery bodies. It analyses national fishery sectors and worldwide trends in production, trade and consumption. It contributes to improvement of national legal and institutional management frameworks, including monitoring, control and surveillance. It deals with investment and fisheries development, particularly for small-scale fisheries, develops socio-economic databases and country fishery profiles. It also provides training in fisheries socio-economics, bio-economics and management.

The Operations Service (FIO) is responsible for the management of the numerous FAO projects which are funded from extra-budgetary sources and constitutes the FAO Field Programme, the active and practical part of the FAO programme of work in the member countries.

The FAO regional fishery bodies (CECAF, WECAF, GFCM, IOFC and IPFC) provide fora for international cooperation, exchange of data and information, and regionally agreed advice on resources. They provide advice to governments on fisheries matters as well as recommendations to FAO on its programme of work. All the technical divisions of the Fisheries Department contribute to their functioning on a regular basis while providing ad hoc assistance to non-FAO fishery bodies.

The Advisory Committee on Marine Resources Research (ACMRR), composed of high level experts from outside FAO, advises the Director General of FAO and the IOC on the conduct of management-oriented research and on priorities for the FAO programme. Since its creation, in 1961, it has been deeply involved in the evolution of the FAO programme.

The Committee on Fisheries, created in 1966, is the main inter-governmental body of FAO in fisheries. It meets every two years to examine the major issues and to advise on FAO's programme of work in fisheries. This body has followed very closely the development of all international events (such as UNCLOS, EEZ development, high seas and driftnet fisheries). Issues related to fish trade are specifically dealt with through a Sub-Committee on Fish Trade, established in 1985.

The FAO Conference is the supreme governing and deliberative body of FAO and decides on the programme of the organization and its budget. It examines, therefore, the fisheries programme every biennium and establishes its orientations. It has also been regularly involved in major reviews of fisheries issues.

3. THE FAO PROGRAMME

The role of FAO in fisheries development and management has evolved during the Organization's 46 years of existence accompanying or anticipating the changes in the world fisheries context. The process, described in the following sections, has been subjectively divided in time periods corresponding to particular phases of evolution of the international fisheries context and of the FAO programme.

3.1 RECONSTRUCTION AND DEVELOPMENT: 1945-58

This period starts just after the second world war with the creation of FAO (in 1945) and the post-war reconstruction. It ends with the first Conference on the Law of the Sea (Geneva, 1958) and the adoption of a Convention on Fishing and Conservation of the Living Resources of the High Seas, a first and not very successful step towards progressive establishment of a new regime of jurisdiction.

The international context

The world population was about 2 000 million. Europe's industries had been devastated by the 1939-1945 war and the priority for FAO was on agricultural development. The northern hemisphere had been locally overfished before and between the two world wars. Apart from very coastal resources in some Asian areas, the tropical fishery resources were lightly exploited by small-scale fisheries and offered potential for expansion. During the period, marine fish production increased from 17.7 million t in 1948 to 28.4 million t in 1958 reaching, at the end of the period, just above 25% of the world potential estimated at about 100 million t, many years later, by FAO [1].

The limitation of marine living resources was fully recognized and the problem of overfishing was obvious in the northern hemisphere and even in New Zealand. Overfishing of traditional bottom fish (e.g., plaice) was stressed, in 1946, by the London International Overfishing Conference [4] and by the International Convention for the Regulation of Whaling. The problem of political constraints upon management of freely accessible resources was directly addressed and carefully formulated at the London Conference but the lack of political agreement on the allocation of resources prevented any real progress in the following years. The Hokkaido sardine stock decreased drastically during the fifties to nearly disappear in the sixties. The North Sea and Atlanto-Scandian herring resources collapsed in the late fifties. During the same period, the dwindling California pilchard accelerated its downward trend towards its collapse in the sixties. In North America, J.A. Crutchfield and H. Scott Gordon (1959) underlined the economic aspects of fisheries management and the problems of common property resources laying the basis for the development and application of fisheries economics.

In industrialized countries, the response to overfishing of traditional grounds was: local management (unfortunately avoiding to address the central issues of effort limitation and allocation), technological improvements (aggravating the situation in the long term), and expansion towards new grounds (triggering a conservative response from coastal countries). The International Commission for the Northwest Atlantic Fisheries (ICNAF) was created in 1949. Management advice was biologically-based and aimed at preventing fish being caught

too young and to protect spawners by regulation of mesh sizes, closed areas, closed seasons and fish size at landing. Benefits from these measures were progressively nullified by the uncontrolled growth of fishing effort. Early suggestions to limit global fishing effort levels met with political opposition starting decades of conquest and wasteful competition. Distant-water fishing expanded (from Europe, USA, Japan) supported by technological innovation, developing factory ships, methods of conservation, fish-finding devices and fishing gears, ploughing new grounds for new resources.

The early reaction to the presence of foreign fleets occurred in Chile and Peru, which claimed a 200-mile territorial sea jurisdiction in 1947. The concept of a 200-mile extended jurisdiction was embedded in the Santiago Declaration (1952), signed by Chile, Peru and Ecuador and which established the Comisión permanente del Pacífico Sur (CPPS). The growing concern about the state of resources and the disagreement between the main fishing powers and coastal countries on the sharing of rights and responsibilities on these resources, lead to a gradual increase of pressure for the establishment of a different international order for fisheries. After a decade of heated debate, the first UN Convention on the Law of the Sea (UNCLOS I, Geneva, 1958) adopted a Convention on Fishing and Conservation of the Living Resources of the High Seas which has not been signed by some of the most important high seas fishing nations.

The work of FAO

The first report submitted to FAO by its Technical Committee on 13 April 1945, indicated that many resources in the northern hemisphere (producing 93% of the world catch) had been overfished but that most of the southern hemisphere resources remained underutilized, producing 7% of the world catch. Near-extinction of some whale species was mentioned as well as wastage through by-catch, particularly in trawl shrimp fisheries. It emphasized the need for exploratory research and the fact that "knowledge of facts fundamental to sound management of high-seas fisheries was still fragmentary". It showed the potential for expansion while stressing the requirement for immediate management measures, drawing attention to the fact that existing fishery bodies had only advisory functions and no regulatory powers [5]. The Technical Committee recommended, *inter alia*: (a) The establishment of a system to collect and disseminate fishery data and scientific publications; (b) The development of scientific, sociological, technological and economic research of fisheries and fishery products for "maximum sustained production without endangering future supplies"; (c) The improvement of education in fishery matters and sciences; (d) The conservation of fishery resources through better cooperative research and management, in particular through the establishment of Regional Councils. These first recommendations as well as others related to fisheries development have represented the backbone of the entire FAO programme on fisheries for nearly half a century.

The first report of FAO on the State of Food and Agriculture (SOFA), in 1948, focused on the central issue of post-war food shortage, viewing fisheries as a supplement to deficient agricultural production and addressing technological problems such as storage and distribution of fish. The problems of over-capacity of the fishing industry were acknowledged in this and many of the earliest SOFA reports together with the issue of allocation and access rights and were to appear as recurrent items for the following decades. With the decrease of the North Sea herring and the collapse of the Californian sardine, the 1956 SOFA report

stresses the need for collaborative research underlining the potential role of fishery science in management, taking ICES and ICNAF as models. As early as 1956, a round table organized by FAO, dealt with economics in fisheries, their optimal utilization and control. The great need for advice and coordination on fisheries development policy and planning, training and technology transfer for increased production had led to the establishment of the two first regional fisheries bodies of FAO in the Indo-Pacific area (IPFC, 1948) and the Mediterranean and Black Seas (GFCM, 1949).

Headed by Dr D.B. Finn, from Canada (1946-1964), the FAO Fisheries Division's programme focused on fishery development issues until the end of the fifties, dealing with nutrition, industrial development, fish processing and conservation, fisheries mechanization, fishermen organization. Standards for internationally comparable statistics to be used by fishery commissions were developed through the work of the Coordinating Working Party on Atlantic Fishery Statistics (CWP), established in 1956. These are still used today on a worldwide basis. A part of the programme was devoted to national resources assessment (e.g. in Libya and Chile, 1952; Iran, 1957; Venezuela, 1958) as a basis for development. Related training programmes focused on fish biology (Turkey, 1954; Thailand, 1955). FAO contributed also, very early, to the process of evolution of national jurisdiction. It hosted an International Technical Conference on the Conservation of the Living Resources of the Sea in Rome (1955) to address issues such as: fisheries conservation objectives, data requirements, management measures and international issues. This meeting agreed on the need for scientific evidence on which to base management, putting the burden of proof on the managers. Resources allocation was not considered in the list of applicable management measures, but some coastal States raised the issue of the special interest they had in the resources adjacent to their coasts and, hence, the special rights and responsibilities they should be given. The possibility of excluding new entrants from a fully exploited fishery was also discussed. The meeting could not agree and the issue was left open for the years to come.

3.2 RESEARCH AND FISHERIES EXPANSION: 1959-72

This period starts with the beginning of an important international effort to discover resources on a worldwide basis and with the UNCLOS II meeting (1960). It ends with the World Conference on Human Environment in Stockholm, in 1972.

International context

During this period, catches rose from about 30 to about 60 million t. The world population was approaching 3 000 million and the demographic boom had started, increasing the demand for food. The decolonization process accelerated further the demand for development assistance, technology transfer and training, for countries with important resources to be developed. The need for international cooperation was felt very strongly. For the first time, two developing countries, Peru and China appeared among the first four fish producers of the world. The North Sea remained severely affected by overfishing.

The central issues of common property resources management and access rights were addressed again, by A. Scott and F.T. Christy, in 1966 but countries remained obviously incapable of taking the required and politically difficult measures. The UN Convention on

Fishing and Conservation of the Living Resources of the High Seas (adopted in 1958) came into force only in 1966. This Convention, as well as UNCLOS II (Geneva, 1960), failed to agree on the breadth of the national jurisdiction and therefore on the definition of the high seas area and on a new allocation of wealth between nations.

Throughout all the sixties and in the early seventies, long-distance fishing from developed (Europe, Japan, USA) and developing nations (Cuba, Republic of Korea, Ghana, Thailand) undertook a second phase of expansion beyond their borders into neighbouring areas and farther away, to Northwest and Southwest Africa and in the tropical ocean in an attempt to offset decrease in landings from national grounds. Expansion was supported by subsidy schemes, a policy which, during the following decades, built up a huge overcapacity. The technological development had consequences on developing countries' subsistence fisheries which were given access to synthetic fibres and engines, increasing fishing power while their traditional grounds became progressively invaded by modern vessels. Developing countries such as Peru, Chile, Morocco, Senegal, Cote d'Ivoire, Ghana and Angola developed an industrial fishery sector. Valuable shrimp fisheries developed in Asia and the Near-East (India, Kuwait, Pakistan) paving the way for one of the major sources of foreign exchange earnings and overfishing (and by-catch waste) in the tropics. Modernization, investment and demographic explosion led, in two decades, to very severe overfishing of coastal developing areas. The end of this period was marked by a series of fishery resources collapses... including in areas where the first 200-mile zone jurisdiction had been established (Peruvian anchoveta).

During the seventies, interest for marine mammals began to spread beyond the groups of industries, managers and scientists involved with them traditionally, and public concern for the obvious mismanagement of large whales started growing rapidly. In 1972, the World Conference on Human Environment dealt with environmental aspects of natural resources management. In recommending a 10-year moratorium on commercial whaling it initiated a debate, still going on today, on the scientific evidence necessary for any management decision and on the legitimacy of "emotional" and "political" (i.e., non-scientific) arguments in such decisions. It also started an era during which the voices of "non-fishery users" would try to obtain progressively more weight in fishery management. Towards the end of this period, the Stockholm Conference, in 1972, defined the rights of mankind to a healthy environment. It stressed both the right for men to modify environment for its development and the dangers behind the huge capacity developed to do so. It underlined the international inequity in wealth distribution. Its principles addressed issues which are central to fisheries management: resources limitation, environmental degradation, demography, planning and management, institutions, science and technology, education, research, international liability, international cooperation and equity.

The work of FAO

The Fisheries Department contributed to the FAO response to the population boom and consequent demand for development assistance. Focus was on producing more while optimizing the use of the available resources. The Field Programme kept a very strong emphasis on nutritional aspects, fish capture and utilization, freezing techniques, decision-making in the fishing industry, fishing boat design, fishing gear design and fish behaviour. Work began also on economic aspects of fishing regulations (1961), and research vessel

design (1966-69). FAO, advised by its Advisory Committee on Marine Resources Research (ACMRR), initiated a long-term programme in support of fisheries development and management [6,7]. Attention was given to the development of national fishery statistical systems able to produce the detailed data required for estimating stock abundance and for management. Manuals of sampling methods were published [8].

The sixties were the time for active discovery and assessment of world potential of fisheries resources through international resources surveys in poorly known areas. The coasts of Africa were covered by the Guinean Trawling Survey (GTS) and the US Bureau of Fisheries tuna survey in the early sixties. The Bay of Bengal area was surveyed in 1962 and the Atlantic coast of Latin America in 1964-65. Symposia were organized to discuss the results of these surveys in East Africa (1960), West Africa (1966, 1968, 1970), Indian Ocean (1967), Caribbean (1968). Additional resources surveys were undertaken at national level to test development possibilities (e.g., Tunisia, 1962; Chile, 1963-69; Brazil, 1961-76; Peru, 1967-71). In West Africa, a series of "Sardinella Projects" were undertaken to develop small pelagic resources in Senegal, Sierra Leone, Côte d'Ivoire and Congo from the late sixties to the mid-seventies. The large UNDP/FAO Indian Ocean Resources Development Programme started in 1971, with a strong resources assessment component and development aims. It led to a series of national and regional projects in the following two decades. It is interesting to note that most of the fishery research facilities existing today in developing countries were created or greatly enhanced through these FAO regional and national projects.

Intense scientific cooperation developed in fishery bodies leading to the transfer, in the tropical developing world, of the knowledge available and of the management concern of the northern hemisphere through international working groups organized at the initiative of ACMRR [7]. International conferences were organized on important tropical resources such as tunas [9] and shrimps [10]. To support its training programme FAO started, at the end of the fifties, the preparation of manuals for basic fishery science [11], trawl surveys [12, 13], acoustic methods [14], population dynamics and stock assessment [15-18].

The mid-sixties represent a turning point. Under the leadership of R.I. Jackson (from the USA) at the head of the Fisheries Department and H. Kasahara, J.A. Gulland and S.J. Holt in the Fishery Resources and Exploitation Division, the programme started focusing sharply and specifically on technical aspects of fisheries management. The lead was taken in tropical resources assessments methodology, international regulatory standards, management measures and international cooperation mechanisms, promoting the analysis of interactions between fisheries biology and economics. The FAO Committee on Fisheries was created and, at its first meeting in 1966, focused on international fisheries management, and the role of regional fisheries bodies. In 1967, the Report on the State of Food and Agriculture [19] included a special chapter on fisheries management and a manual on regulation of fishing effort was published [20]. The Field Programme, however, constrained by countries' demands and donors' priorities, remained focused on resources assessments and fisheries development. It was not until the late sixties, however, that limitation of catches became a generalized source of concern for FAO and non-FAO fishery bodies. With the pretext that regulating directly the fishing effort was technically difficult, regulation by means of total allowable catches (TACs) and quotas was generalized, failing to reduce economic waste or conflicts arising from the inadequacy of access rights. Much of the philosophy of the seventies and eighties on fisheries management and the role of research and of the

fisheries commissions can be found in a synthesis published in 1968 by J.A. Gulland and J.E. Carroz [21] which included economic considerations and attempts to deal with allocation issues and extraction of economic rents, including in the high seas.

The network of FAO regional fisheries bodies was enhanced by the creation of new ones in Latin America (CARPAS, in 1961), West Africa (CECAF, in 1967), Indian Ocean (IOFC, in 1967) and the Caribbean (WECAF, in 1973). FAO contributed also to the creation of non-FAO bodies such as ICCAT, for the Atlantic tunas (in 1966) and Southeast Atlantic resources (ICSEAF, in 1969).

FAO started a "World Watch" on the status of stocks. It undertook the first evaluations of tropical tuna stocks, before the creation of ICCAT [22] and of West African resources [7]. At the beginning of the seventies, marine fisheries production had reached about 60 million t. FAO predicted that many fisheries were not sustainable and that production levels could not be maintained without tapping underutilized resources. The collapse of the Peruvian anchoveta (in 1972), partly due to overfishing and partly to "natural climatic variability" appeared as a sinister confirmation that the time of expansion was over and that the era of variability and uncertainty had begun.

As a contribution to the process of negotiation of new rights and obligations on fisheries resources and to the geographic delimitation of these rights, FAO elaborated, in 1971, the first version of the Atlas of the Living Resources of the Seas which was finalized 10 years later [23]. At the beginning of the seventies, the first steps towards the establishment of a cooperative Aquatic Sciences and Fisheries Information System (ASFIS) were made in cooperation with Unesco. In the following years ASFIS became the most important system of bibliographic information on ocean environment and fisheries.

In 1970 the Department started the FAO Species Identification and Data Programme for Fishery Purposes involving a growing number of scientific collaborators (7 in 1970 to about 80 currently) to improve the taxonomy of the new resources and the fishery statistics through better identification. This programme also provides ecological and biological information on the species.

In 1972, COFI requested an independent review of the status of marine mammals stocks and a special ACMRR Working Party was established. Guided by Dr S.J. Holt, the Working Party produced a voluminous report, presented at the Scientific Consultation on the Conservation and Management of Marine Mammals (Bergen, 1976), and which represents a remarkable compilation of the available knowledge. It confirmed the poor state of many stocks, the limitations of the data and the resulting uncertainty and the urgency of management measures.

In the seventies, FAO strengthened its programme on pollution in relation to fisheries and resources. The protection of the productive environment is part of the management of marine resources and concern has always been present in the FAO programme. For instance, as early as 1970, FAO organized a Technical Conference on Marine Pollution and its Effects on Living Resources and on Fishing as well as a Seminar on methods of detection, measurement and monitoring of pollutants in the marine environment. It sponsored the establishment of the Group of Experts on Scientific Aspects of Marine Pollution (GESAMP),

in 1969, in collaboration with many other UN Agencies. One of the main first tasks of GESAMP was to advise the Stockholm Conference in 1972 on marine pollution issues.

3.3. THE NEW ECONOMIC ORDER: 1973-82

This period starts with the FAO Technical Conference on Fishery Management and Development (Vancouver, February 1973) and the beginning of a new decade of negotiation in preparation for UNCLOS III (December 1973). It ends with the adoption of UNCLOS III in 1982.

International context

During this period, fisheries production increased from about 60 to about 68 million t and the status of stocks improved in a few areas and worsened in most. At the beginning of the period, the world production levelled off while oil prices rose and conditions of access stiffened. Fisheries expansion slowed down markedly but fisheries withstood the shock, thanks to steadily rising fish prices. In the second half of the seventies the use of "fishing licences" systems generalized as a large number of countries claimed a 200-mile Exclusive Economic Zone.

In the eighties, catches again rose fast due to: (a) natural fluctuations of abundance of low-value species such as Peruvian anchoveta, Chilean jack mackerel, Japanese and Latin American pilchards; (b) intensified fishing on Alaska pollock; (c) a third phase of expansion of long-range fleets into the Indian Ocean, the South Pacific and the Southwest Atlantic in search of high-value species (e.g., tunas, shrimps and cephalopods). This rise in production conceals the overfishing of most valuable demersal resources such as cod, hakes, haddock, whiting, octopus, groupers, sea breams, Pacific Ocean perch, Chinese yellow croaker, large shrimps, etc., and the ecological changes of fishery systems with replacement of large, long-lived species by smaller short-lived ones (in the Gulf of Thailand, in the North Sea, off West Africa).

In December 1973, the UNCLOS III process started. The draft provisions started being progressively implemented by coastal countries in claiming their EEZs (especially between 1976 and 1979) and in their international relations in fisheries. Shelf areas which remain open to free access, e.g., off Western Sahara, Namibia, and in the Southwest Atlantic became favourite fishing grounds for foreign fleets. Straddling stocks were put under severe pressure. New high-seas resources were tapped in the seventies: small tropical tunas, oceanic sharks, high-seas horse mackerels (off Chile), Antarctic krill, oceanic squids.

At the end of 1982 the UN Convention on the Law of the Sea was opened for signature, in Montego Bay, Jamaica, marking the formal beginning of a new era, in a process of extension of national jurisdiction which had started decades before. In the meantime, UNCLOS draft provisions had progressively become current fisheries practice in relations between States. In 1982 also, the 10-year moratorium on whaling recommended by the 1972 Stockholm Conference was finally adopted by the International Whaling Commission after 10 years of bitter political debate, scientific polarization and mismanagement. It took a few more years (until 1988) for it to be effectively implemented.

The work of FAO

In its path towards the "New Economic Order", the Fisheries Department was guided by F.E. Popper, from Canada (1972-1976), H.C. Watzinger from Norway (1977-1978) and K.C. Lucas (1978-1981).

With the "explosive" process of creation of EEZs in the mid-seventies, the demand for assistance by coastal countries increased drastically. Stocks had to be assessed by EEZ instead of by region, despite incomplete definition of maritime boundaries. The process of development of national capacities in research and management required an acceleration of the training to increase participation of local experts to working groups. The requirements for assistance by FAO/HQ to the Field Programme increased drastically as a few large regional, medium-term projects were progressively replaced by a much greater number of national, short-term projects. This increased further the pressure on the already thinly-spread FAO capacity, particularly in the information and assessment divisions. The issue was raised by ACMRR in 1968 and stressed in 1971. The situation became worse with time as the workload increased faster than available means.

During the seventies, FAO contributed to the UNCLOS III negotiations by preparing a number of technical documents for the negotiators providing objective documentation and highlighting issues. Dr J.E. Carroz, one of the very few persons having attended all sessions of UNCLOS I, II and III, played a leading role in this matter.

In 1973, FAO convened in Vancouver (Canada) the Technical Conference on Fishery Management and Development [24]. This Conference followed the Stockholm Conference on Human Environment and, although not explicitly related to it, addressed many of the same key issues. The Conference recognized: (1) The resource limitation and the fact that, despite limited management success, most of the major stocks had reached the lowest levels ever recorded. (2) The great over-capitalization in fisheries, the fact that government subsidies often resulted in economic waste, and the conflict between management, development and technological change, (3) The need for a better scientific basis for management, for integration of biological sciences with economy [25] and for better regional cooperation, (4) The problem of free access to resources and the fact that it did not allow to limit exploitation rates to levels that would meet economic or resource conservation criteria, (5) The competition of long-distance fleets with national ones and the potential role of joint-venture agreements, (6) The environmental degradation and its greater impact on fisheries than fishing itself, (7) The need for new management approaches (precautionary, anticipatory, experimental and multispecies management) proposing to frame the concepts of fishery management into the broader one of ocean management. However, because of the proximity of the third UNCLOS meeting (the autumn of the same year) the fundamental legal and jurisdictional matters were carefully avoided, purposely missing the opportunity to discuss objectively the technical, biological, social and economic implications of a central political issue.

The wisdom developed in Vancouver spread through fisheries bodies working groups and deliberations, national fisheries departments and the international and FAO literature. During the seventies, the FAO Advisory Committee on Marine Resources Research (ACMRR) addressed regularly the question of development of national information systems

and research capacity. Modern issues, such as the multiple use of the oceans and impact on fisheries and the problem of incidental catches of unwanted species was already addressed by ACMRR in 1975. In 1979, the Twentieth FAO Conference adopted a Comprehensive Action Programme of technical assistance for the development and management of fisheries in EEZs. The "EEZ Programme", funded by Norway, became, for more than a decade, the main mechanism of assistance to developing countries in their efforts to master their resources. The Fishery Policy and Planning Division (FIP) was created the same year to coordinate this effort and made responsible for fishery policy and planning as well as for managing the regional fishery bodies, underlining FAO strategy to channel advice through these bodies.

The work of the regional fishery bodies in management was strengthened by: (a) developing or enhancing the terms of reference related to management and (b) establishing sub-regional committees with management competence. IOFC established in 1972 a Committee for the Gulfs (between Iran and the Arabian peninsula) and, in 1980, two Committees for the Southwest Indian Ocean and the Bay of Bengal. During the same year, WECAF established a Committee for the Lesser Antilles and IPFC a Committee for the South China Sea. In addition, GFCM decided to structure its technical work on resources assessments in five sub-regional technical consultations for the Western, Central and Eastern Mediterranean, the Adriatic and the Black Sea. The fact that, during the same period (in 1977) an Advisory Committee on Fisheries Management (ACFM) was created by the venerable ICES to streamline the management advice process shows that FAO's action was timely.

During the seventies, regional resources surveys continued to play an important role. The Indian Ocean Resources Development Programme developed its activities until the late seventies. The FAO/UNDP/NORAD Global Programme for Survey and Identification of World Marine Fish Resources put at the direct disposal of FAO the most modern resources survey technology with the research vessel DR FRIDTJOF NANSEN. It started operating in the Arabian Sea, in 1975, and is still operating in 1992 off Africa. The demand for national surveys increased with the establishment of EEZs (e.g., in Indonesia with the JETINDOFISH Project in 1979-82; in India (with the R/V RASTRELLIGER during most of the seventies).

In 1980, before the formal adoption of UNCLOS (in 1982), the Report on the State of Food and Agriculture [26] included a comprehensive review of fisheries management under the new regime for the oceans. This review recognized that freedom of fishing had virtually been abolished by the States' claims of 200-mile EEZs and urging States to take this opportunity to improve fisheries management. The report also underlined areas which remain unresolved (which were to emerge again at UNCED, in 1992): the determination of maritime boundaries (and the underlying distribution of wealth), the degree of coastal nations authority over their EEZ (including the concepts of "optimum yield" and "surplus") and the management of shared, straddling and highly migratory resources. The report stressed the need for adjustments regarding access of foreign fishing, development of coastal countries fishing and management capacities, and shared stocks. In order to meet the demand for information on the importance of fleets a special effort has been made, by FAO, since 1975, to collect statistics on national fleets. The response, through the seventies and eighties, was not satisfactory and much remains to be done. Manuals were produced to support the training

effort [27, 28].

Recognizing the biological and economic deficiencies of the concept of Maximum Sustainable Yield (and of Total Allowable Catches determined on this basis), FAO experts recommended, in 1973, to aim at slightly lower fishing levels ($F_{0.1}$), based on the concept of marginal yield. Although this level was arbitrarily defined in biological terms, it would have improved resource stability and was less objectionable than MSY from an economic point of view [29]. The concept was largely adopted and led to other management targets with similar properties ($F_{2/3MSY}$). FAO stressed again, 25 years after its 1956 round table on fisheries economics, that both concepts, taken singly, failed to satisfy properly the criteria for the economic and social optimization of fisheries [30].

The theoretical aspects of multispecies management were addressed by FAO with difficulty because the understanding of the scientific community remained insufficient for any practical application in the tropics. The difficult issue of by-catch in shrimp fisheries was addressed at the Consultation on shrimp by-catch (Umuiden, Netherlands, 1973). The fluctuations of species abundance were recognized as well as the opportunistic nature of multispecies fisheries [31, 32] and the practical aspects of multispecies management were addressed, in particular for Southeast Asian fisheries [33]. In an effort to clarify issues and to transmit the wisdom, a series of Fisheries Technical Papers and articles in leading scientific journals were produced relating to fisheries management, economics and development, with emphasis on direct effort controls, resources allocation and small-scale fisheries [30, 34-40] as well as legal aspects of extended jurisdiction [41]. Development and management plans were elaborated for Namibia [42]. Gulland calculated that sounder fisheries management would produce a net profit of US\$ 500 million in the North Sea and US\$ 1 000 million in the whole of the Northeastern Atlantic [43].

The FAO Species Identification and Data Programme generated a very large number of Species Synopses, in collaboration with CSIRO (Australia), INP (Mexico) and NMFS (USA). FAO produced Identification Sheets for the Mediterranean, Black Sea, Eastern Indian Ocean, Western Central Pacific, Western Central Atlantic and Eastern Central Atlantic and started a new series of Field Guides and Species Catalogues.

Manuals for stock assessment were updated and completed to better reflect tropical characteristics. Recognizing the problem posed by the scarcity of biological data in tropical developing countries, FAO cooperated with ICLARM in the development and diffusion of methods adapted to data-limited situations and, in particular, on length frequency analysis [35, 44, 45]. Training courses were organized, either on an *ad hoc* basis [46] or through dedicated medium-term programmes supported by extra-budgetary resources such as the FAO/DANIDA Project for Training in Fish Stock Assessment and Fishery Research Planning which started in 1982 and is still operational in 1992.

The initial efforts of FAO to provide a "World Watch" on fisheries resources [1], was followed by a series of regional reviews, during the seventies and eighties: Southeast Atlantic [47, 48], Southern Ocean [49], mesopelagic fish [50], Western Central Atlantic [51], Mediterranean [52, 53], Eastern Central Atlantic [54, 55]. The results led to an updated world compilation [56].

FAO increased its involvement with environmental issues, sponsoring the organization of meetings in 1974, 1975 and 1976. In 1974, the General Fisheries Council for the Mediterranean (GFCM) organized an intergovernmental consultation which produced the guidelines on which the 1976 Barcelona Convention was established for the protection of the marine environment.

The impact of natural medium-term climatic fluctuations was also rapidly recognized, especially in relation with the oscillations of abundance of small pelagic resources. A first meeting was organized on El Niño in Ecuador (Guayaquil, 1974) but the turning point was represented by the Expert Consultation organized by FAO in Costa Rica (San José, 1983) where the impact of environmental oscillations on recruitment and abundance was strongly stressed [57]. Paradoxically, it is when developing coastal industries become concerned about stability of the supply that research "rediscovers" the problems of variability and uncertainty. In November 1982, the Twelfth Session of IOC decided to begin the IOC-FAO international cooperative programme on Ocean Science in Relation to Living Resources (OSLR) in November 1982 to investigate the relation between recruitment, stock size and environment.

The FAO efforts to raise awareness, develop management-oriented science and promote management action were supported by its two scientific advisory bodies, ACMRR and SCORRAD, which dealt with such issues as marine mammals, the scientific basis for management [58-64], pollution, methods for surveying fish abundance and aquaculture.

3.4. TOWARDS GLOBAL CONCERNS: 1983-92

This period starts with the technical preparations of the FAO World Conference on Fishery Management and Development (Rome, 1984). It ends with the preparations for the UN Conference on Environment and Development (UNCED). An important role is played during this period by the World Commission on Environment and Development ("Brundtland Commission", 1984-87).

International context

During this period, the marine catches increased from 68 to about 85 million t. It was essentially a period of transition. Developed countries tried new management measures such as limited entry or individual transferable quotas (ITQs). Developing countries continued experimenting with the management of their newly acquired resources and the difficulty of related responsibilities, realizing that claiming an EEZ was certainly not sufficient to avoid overfishing and that controlling nationals was no easier than controlling foreigners.

The process of signature and ratification of UNCLOS proceeded slowly. By November 1991, 159 countries had signed, but only 51 had ratified it; 9 ratifications short of the requirement for UNCLOS to come into force. It is agreed, however, that several of its provisions concerning fisheries have already become international customary law. Straddling stocks continued to be put under severe pressure leading to reactions from coastal countries attempting to extend further offshore their effective control.

Inadequacies in the management of international fisheries, recognized by scientists since the mid-sixties, were quite regularly referred to. Third-world fisheries development

policies were criticized for their negative impacts on small-scale fishermen, national debt and environment. Management deficiencies in coastal fisheries have been less well documented but are evident, both in developed and developing countries, in industrial as well as small-scale fisheries, generating social unrest, conflict, illegal fishing practices (use of explosives or poison) and extensive use of governmental subsidies to compensate for economic inefficiencies.

Major international management issues created intense political and technical activity, shaking the foundations of traditional management mechanisms.

In 1989 in the South Pacific a movement started to prohibit all large-scale pelagic driftnet fishing. The UN General Assembly resolution 44/225¹ addressed the issue after regional fisheries management bodies of the North and South Pacific had failed to reach consensus on an issue with obvious economic and social implications (competition for high-seas resources) and aggravated by serious environmental concerns. Despite the initial lack of scientific data (and possibly because of such a lack) on long-term impacts of the fishing method, a non-conventional political process started, supported by the media, an alerted public opinion and by environmental lobbies, which may lead to the outright ban of the gear by the General Assembly of the UN in mid-1992.

In the Eastern Central Pacific tuna fisheries the conflict continued due to interaction of the fishery with dolphins. Despite many years of effective management through I-ATTC and a drastic reduction of the dolphin death toll (from 700 000-850 000 /year in the early seventies to 90 000-100 000 in the late eighties) the USA, under the pressure of environmental and political lobbying, resorted to unilateral commercial embargoes on tuna imports to force faster and greater corrective action by the tuna fishing nations. GATT opposed the procedure in 1991 but it is expected that it may have to give more importance to environmental management considerations in the future.

In 1991, it has been proposed, also, to list the bluefin tuna in Appendix II of the Convention on International Trade in Endangered Species of wild fauna and flora (CITES) despite the fact that such species still provide 30 000 t/year in the North Atlantic.

The creation of EEZs, the development of national production in the developing world, the replacement of foreign fleets by joint ventures and the obligation made to foreign fleets to land their catch locally contributed to a great increase in international fish trade at a faster rate than for most agricultural products. Between 1980 and 1987 trade from developing countries increased by 75% in volume and 100% in value increasing the contribution of fisheries to countries hard currency incomes. This evolution did not contribute to the limitations of fishing efforts. The world competition for access to markets intensified and concern started being voiced about trade barriers raised, apparently for the sake of improving ecological conservation or seafood quality standards.

¹This resolution recommends that all nations agree to a moratorium on all large scale driftnet fishing unless "effective conservation and management measures be taken, based on statistically sound analysis... to prevent unacceptable impacts of such fishing practices... and to ensure the conservation of marine living resources."

Following the steps of the Stockholm Conference, the World Commission on Environment and Development worked from 1984 to 1987 [65], paving the way for the UN Conference on Environment and Development (UNCED) in 1992.

The work of FAO

The Fisheries Department was headed by Mr. A. Labon from Poland (1983-1985) and by Dr J.E. Carroz from Switzerland (1985-1992).

In 1982-83, a special effort was devoted to the technical preparations for the FAO World Conference on Fisheries Management and Development and a series of meetings were arranged to consider the problems of overfishing and catch and effort regulations [66, 67], development strategies [68], natural variability of stocks and its impact on development and management [57] and conditions of access to EEZ resources [69].

The FAO World Conference on Fisheries Management and Development (Rome, 1984, a decade after the FAO Technical Conference on Fisheries (Vancouver, 1973)) brought together the major issues and ideas related to fisheries management and development. The technical issues were not new, but the formal political recognition of their causes and possible solutions was a significant achievement. The Conference endorsed a strategy and recommended five Programmes of Action that FAO has been executing since then and which all countries found still relevant in 1991. The first and most important of these programmes was related to fisheries management.

Two years after UNCLOS, the Conference confirmed the end of an era. It became clear that the debate on access to resources was over. Freedom of fishing had been suppressed in a 200-mile belt of oceans around the continents. Coastal States had been given definite sovereign rights on the resources within that belt and attempts to limit or qualify those rights by stressing related obligations were unsuccessful. It also signalled the beginning of a new economic battle between the new "resources owners" (mainly developing nations and a few industrialized ones) looking for markets and the "market owners" (mainly developed nations) looking for renewed access to resources for their fleets.

As a consequence, international fish trade (in which FAO had been increasingly involved since the late seventies) has become highly competitive and, on occasion, measures are introduced on the presumption of environmental² or consumer³ protection arguments, which are actually serving as non-tariff barriers and lead to a series of international conflicts. Following a recommendation of the 1984 Conference to establish a multilateral framework for consultations on trade and a decision by COFI, in 1985, FAO established a Sub-Committee on Fish Trade under the FAO Committee on Fisheries (COFI). This body was recognized, in 1991, as an international commodity body by the Common Funds of Commodities (CFC) established by GATT.

²As in the case of large-scale driftnet fishing, the tuna-dolphin problem in the Eastern Central Pacific, and the shrimp-turtle problem in the Gulf of Mexico.

³As in the case of shrimp imports bans from developing countries

Following on recommendations from the Conference, FAO strengthened its work in economic and social aspects of fisheries. WECAF (in 1989) and GFCM (in 1990) established a special Working Party to discuss the needs for socio-economic data and analysis. SCORRAD's terms of reference were narrowed to focus exclusively on management-oriented research and this body will address the needs and available approaches in fisheries bio-economics in 1993. Similarly the 1993 IPFC Symposium will focus on socio-economic aspects of small-scale fisheries management.

Taking stock of the problems and phenomena observed since the early seventies, FAO produced a series of publications related to the "post-EEZ" situation, clarifying such issues as the so-called "surplus" [70], the role of fishermen's organization in management [71] and analysing changes in national fisheries policies [72]. It reviewed the problems raised by the management of major world fisheries [33, 73-77] including the driftnet issue [78-81], the relationship between fishery research and management [82] stressing again the inadequacy of present management systems [83] nearly 20 years after a similar diagnosis at the Vancouver Conference [24]. The Fishery Industries Division drew up guidelines for the marking and identification of fishing vessels which have received worldwide acceptance and is developing guidelines for the marking of fishing gear. Both efforts contribute to the solution of the problem of control of fishing efforts and of foreign fleets in EEZs and, potentially, in the high seas.

The situation of the world resources continued to be reviewed, region by region, every two years, for presentation to the FAO Committee on Fisheries [84]. A special analysis was undertaken for the Falklands-Malvinas area in the Southwest Atlantic [85]. The poor state of many high seas fisheries, including in the Antarctic, was stressed and the problems behind their mismanagement were highlighted [86]. A new programme has been started aiming at the development of a world Geographic Information System on oceans, their fisheries, resources and environments as a basis for management of coastal zones and high seas.

The FAO Species Identification and Data Programme continued its intense activity, supported by strong demand and extra-budgetary funding. During this period it produced 11 Species Catalogues (starting 10 more), 10 Field Guides, and Identification Sheets for the Southern Ocean, Mediterranean and Black Sea (second edition) and the Eastern Central Pacific.

The regional fisheries bodies suffered from insufficient technical support due to a lack of interest of traditional donors, including UNDP, in supporting regional mechanisms in the absence of clear national commitment to take over the long-term responsibility of their funding. Within its limited capacity, FAO continued to provide scientific support to these bodies and to many non-FAO fishery bodies around the world. It also provided technical support, in the form of regional projects to some of them (FFA, OLDEPESCA). In 1990-91 it assisted in the preparation of the Convention on Fisheries Cooperation Among African States Bordering the Atlantic Ocean and is providing technical support to its Secretariat.

Between 1989 and 1991, FAO contributed greatly to the International Study on Fishery Research Needs (SIFR) organized in collaboration with UNDP, the World Bank, EEC and 17 other donors. The diagnostic part of the Study concluded that institutional

deficiencies related to resource and space allocation and fishing rights were among the major causes for inadequate fisheries management [87, 88], echoing, with more evidence at hand, the conclusions drawn in 1945 by the First FAO Technical Committee on Fisheries.

The FAO Field Programme contributed significantly despite the reduction of donor support in West Africa and South China Sea areas. The FAO/UNDP/NORAD global project provided assistance for the assessment and monitoring of resources, using the R/V DR FRIDTJOF NANSEN around Africa and in Central America. However, financial support for resources surveys was generally very limited and the emphasis was on stock assessment based on fisheries data. The Indo-Pacific Tuna Management and Development Programme (IPTP), based in Colombo, provided strong support in data collection, stock assessment and management advice on tuna fisheries in the Indian Ocean, laying the basis for the future Indian Ocean Tuna Commission. The Southwest Indian Ocean Programme (SWIOP) helped East African countries assess their resources and develop appropriate management schemes. The Bay of Bengal Programme (BOBP) tackled the problems of management of coastal fisheries with emphasis on artisanal fisheries and bio-economics.

The effort to provide stock assessment methods and critical analysis of their performance continued [82, 89-92]. With the fast development of inexpensive personal computers, FAO developed stock assessment software giving to developing countries some of the computing and modelling capacity which, until recently, had been the privilege of developed countries' laboratories [93-95], taking this opportunity to introduce bio-economic modelling as a basis for analysing interactions between fisheries sectors [96-98].

The FAO/DANIDA Project for Training in Fish Stock Assessment and Fishery Research Planning, which started in 1982, continued to programme training at regional level, offering assistance in training courses organized nationally. With the support of this project and in collaboration with ICLARM, an integrated software for tropical stock assessment was produced (FAO-ICLARM Stock Assessment Tools, FISAT). In parallel, efforts were made to return the basic ecological issues [99] to the foreground of fishery science.

The early interest of FAO in fisheries-related pollution problems was demonstrated by the activities of ACMRR, the cooperation with IOC and UNEP - particularly through the WACAF project, in West Africa - and its sponsoring of and cooperation with the Group of Experts for Scientific Advice on Marine Pollution (GESAMP). The Organization sponsored meetings on pollution in 1984 and 1986. Some activities of the Fishery Industries Division were devoted to the problem of onshore pollution by fishing ports and fish processing industries.

Since 1989 FAO's concern for environment, management and sustainable development has been integrated, prompted by the preparatory process to the UN Conference on Environment and Development [2, 3]. FAO started strengthening its environment-related programme looking at impacts of pollution particularly on enclosed and semi-enclosed seas [100, 101] and giving priority to an inter-departmental programme on Integrated Coastal Zone Management involving the Departments of Fisheries, Forestry and Agriculture.

The 1992 Report on the State of Food and Agriculture [83] indicates that, during the preceding decade, redistribution of wealth resulting from UNCLOS had proceeded as

expected with gains for some coastal countries with large marine resources and losses in a few other countries with important long distance fleets, which resisted the EEZ shock far better than expected. In the EEZs, progress in fisheries management has been unexpectedly slow with domestic fisheries inefficiently managed because of reluctance on the part of the States to establish property and exclusive user rights. The losses through mismanagement (see below) are aggravated by inestimable losses through coastal environment degradation, especially in the coastal zone where sectors are often in conflict for scarce resources and small-scale fisheries are the most adversely affected.

4. THE SUSTAINABILITY CHALLENGE: 1993-2000

The new management context

In the EEZs, important social and economic benefits are potentially available to coastal countries provided they take appropriate steps during the coming decade [83]. During the last four decades, science and management theory were ahead of management practice and lagging behind uncontrolled sectoral development (too little was done and too late). With the slowing-down of investment in fisheries development there could have been an opportunity for science and management to "catch up" when, after half a century of wild competition, the problem of excessive effort was formally and widely recognized. Many countries have started experimenting with effort limitation and resource allocation schemes. Japan has reduced its large fleets. Eastern Europe may have to do so. EEC has finally accepted the idea of effort reductions and initiated steps to reduce the huge fleet capacity by 40%. The World Bank has become reluctant to finance further development and seems to have finally accepted to support fleet reduction schemes.

However, the question of overexploitation that was posed in 1946 for North Sea fisheries, in the sixties for the whole North Atlantic and in the eighties for the world ocean fisheries resources, is now posed for the entire ocean ecosystem. Sectoral interactions and non-consumptive uses have to be taken into account, as well as environmental degradation, raising the problem of resources allocation but at higher, inter-sectoral level, complicating the institutional issue and the tasks of scientists and managers.

Buying now the future benefits

In the long term, there is no conflict between biological and economic concepts of sustainability or between conservation and economic efficiency. In the short term, however, these concepts are in conflict. The global loss of revenues (through dissipated rent) has been roughly estimated by the FAO Fisheries Department to reach the order of magnitude of US\$15 000-30 000 million per year. The cost of correcting present-day deficiencies has been calculated to be in the order of US\$7 000-14 000 million per year for the next 10-20 years. These overly gross figures only pretend to indicate that the cost of fisheries rehabilitation could be covered by the rents which will result from improved management and which could be captured by appropriate systems of user fees. The problem is that the fishing industry, in its presently poor economic state, is not in a position to initiate the reconversion process. The intervention of development banks and States is necessary to pay, today, the cost of future benefits.

The by-catch syndrome

The problem of incidental catches was already mentioned in 1945 by the FAO Technical Committee on Fisheries and has recurrently been examined as a "waste" problem. It emerges now also as a threat to endangered species and has become apparent in at least three cases: the driftnet fishery, the tuna purse-seine fishery in the Eastern Central Pacific and in the shrimp trawling fishery. In addition, trawling is under criticism for the changes it provokes in the environment.

As anticipated by FAO in 1989, the driftnet conflict in the high seas is having repercussions on coastal gillnet fisheries including small-scale ones. The FAO report [81] illustrated the wider implications of the selectivity problem, in gillnet fisheries, and the biological as well as socio-economic dimensions of the problem. The arguments used for justifying the large-scale driftnet ban have been since then used to ban coastal gillnets in California (in 1991, even before any formal ban on the high seas) and attempts are ongoing to ban them from coastal waters of other States.

As gillnets have always been considered to be very selective compared with other gears, there is room for great concern for the fisheries as a whole and for the availability of food from the sea if overly stringent parameters are imposed to fisheries without explicit consideration of equity and development issues. Efforts must therefore be made to integrate economic and social constraints with environmental requirements, developing standards for "acceptable" levels of impact satisfying both the environmental and development conditions.

The information gap

National statistical systems are deficient, particularly for artisanal fisheries where simple data on catch and effort by species as well as socio-economic data are almost non-existent. Countries and donors seem to underestimate the importance of the data and do not give to data collection and monitoring the priority it deserves. Regarding the data required for stock assessment and fisheries analysis, the last decade has shown the limit of "quick and dirty" methods and there seems no sufficiently reliable alternative to a comprehensive data collection system.

The information on high seas fisheries is scanty. Its availability could be improved easily with the technology available, and FAO has started to modify its statistical system for the purpose. Control of its quality, however, would require costly schemes. The problem of by-catch is crucial, especially for endangered species. The data required to analyse interactions between fisheries and other sectors in the coastal zone are very far from complete. The need to consider the available information on a geographical basis leads to the necessity to develop digitized mapping capacity and Geographical Information Systems worldwide.

High seas management and "creeping jurisdiction"

High-seas management is a new important challenge despite the fact that high seas are presently exploited essentially by developed countries and produce a small part of the world catch. Most high seas resources have their source in the coastal areas of the EEZs where the

reproduction, nursery and feeding areas often are. Many high seas stocks such as whales, sharks, some tunas, Antarctic resources, are overfished [86]. The status of many others such as most small cetaceans, pomfrets, squids is unknown. Straddling stocks, extending beyond national jurisdiction, into the high seas open access system need urgent international management in the Northwest Atlantic (Grand Banks), in the Bering Sea (Doughnut Hole), in the Patagonian Shelf and off Chile. A fairly similar problem exists in the Mediterranean where national jurisdiction is generally limited to 12 miles while valuable resources extend beyond (in particular off Tunisia and Libya).

This situation leads to attempts by coastal States to gain "creeping jurisdiction" beyond that recently granted under UNCLOS. This is apparent in the attempt to use national trade embargoes as international management tools, in the terms of the tuna fishing agreements between South Pacific States and USA, and in the proposal to the Argentinean Parliament to extend the coastal State jurisdiction beyond 200 miles. It is also apparent in the UNCED process where some countries have proposed (a) to give more recognition to the special interest of the coastal countries in straddling or highly migratory stocks (b) the need to take these interests into account when managing the straddling stocks and (c) the need to increase liability of violators of regional agreements whether or not they are party to it.

FAO will organize, in 1992, an Expert Consultation and a Governmental Consultation on the issue, to lay the basis for a set of guidelines or a code of conduct for responsible fishing. The issues relate to (a) the insufficient attention given by fishery bodies to the high seas areas and resources under their jurisdiction; (b) the lack of integration of their work at ocean level; (c) the special interests and potential responsibility of the coastal State on high seas resources, especially straddling stocks; (d) the enforcement of international agreements; (e) the weakness of international research programmes on the high seas.

Coastal integrated management and environmental degradation

Coastal zone integrated management is the important challenge for fisheries and seafood production as well as for coastal industries and human settlements. It is estimated by UNCHS (Habitat) that, by the year 2000, 60% of the urban population (1.800 million people) will be living less than 50 km from shore and many more in settlements along rivers carrying pollution to the sea; and this does not take into account rural settlements in coastal areas. In addition, it is estimated that 80% of the present marine pollution comes from the land, sometimes far away and affects people who live on and from the coastal sea (in some enclosed seas, fish are so loaded with pollutants that they should no longer be considered edible). In many areas, coastal rehabilitation is required, calling for ecological engineering and therapeutic ecology [102]. In oligotrophic marine areas, however, organic enrichment may have positive effects on production [100, 101].

FAO has undertaken the production of sectoral guidelines for environmentally sound ("responsible") coastal fisheries and intensive coastal aquaculture, promoting integrated planning and management of primary industries in the coastal zones and strengthening its cooperation with other UN agencies and NGOs. It has also undertaken to analyse the impact of major river flows and their anthropogenic modifications on the coastal areas.

Non-fishery users and public opinion

It has taken time for biologists and fisheries managers with a biological background to realize that one does not manage resources but rather their exploitation by people, and that any attempt to exclude or forget people and the distribution of resources among them in the management "equation" leads to failure. The concept of "resources management" was therefore replaced by that of "fisheries management" to indicate that action was required on the economic sector. The problem of management of marine living resources must now be broadened to include the point of view of the non-fisheries users⁴ with an appropriate "weighting factor" to meet the undefined equity criteria while satisfying both development and environmental requirements.

The last years have shown a few cases where decisions have been imposed on fishermen, from outside the fishery sector, perhaps with insufficient consideration of socio-economic consequences and explicit recognition of the wealth transfers implied. The need to consider global impacts and the increased voice of the environmental groups lead to a return to the concept of "resources management" with the risk of forgetting that action is required at sectoral level.

During the Vancouver Conference (1973), it was already mentioned that, in the case of competition between commercial fishermen and other sectors economically difficult to evaluate (in that specific case, sport fishermen) "decisions were apt to be based on emotional and political grounds" [24, page 2097]. This happened in fact in the California gillnet fishery in 1991.

Public opinion already had, in the past, decisive influence on management of whales and seals and in some countries a special status is being advocated for almost all cetaceans. In both cases, as in the more recent driftnet fishing case, a few developed countries were involved and economic interests were modest. Public opinion has also been used recently in the tuna-dolphin issue in the Eastern Central Pacific and in the shrimp-turtle issue in the Gulf of Mexico. In these cases, developing countries are involved and the socio-economic consequences for all concerned are very significant. Finally, public opinion is now used, at national level, to attempt to deprive commercial fishermen from their rights of access to sea resources, through mechanisms (political arenas, media) in which equity and scientific neutrality may be lost. The process by which public opinion has been mobilized (advertisement campaigns and catastrophic images - sometimes genuine, sometimes forged) is far from the concept of "best scientific evidence" existing in the texts creating ICES in 1902 and required in UNCLOS in 1982. This situation developed partially because of the lack of scientific consensus and the politicization of research fora.

The questions are: How to maintain a balance? How to continue to extract from the sea the required food, employment opportunities, and revenues while demonstrating to the public that the industry is "under control" and that non-fisheries users' needs can be satisfied provided "acceptable levels of impacts" are agreed? State control seems to be absolutely

⁴ A broad category including other industrial sectors affecting the marine living resources as well as the public and the environmental protection institutions.

necessary as well as modern systems with property rights, users' rights and fees. Participation of non-fishery users in fisheries management is necessary [86] as well as greater involvement of fishermen associations in the coastal zone management.

Management in an uncertain context

In front of the increasing complexity of management, the disturbing fact must be faced that both science and management theory will be soon (and are already, in some areas) lagging behind management needs, lacking global understanding, models and practical references to address issues such as high seas or coastal integrated management.

When data are scarce and understanding of the ecosystem is limited, the range of uncertainty of any scientific advice is wide and so is the range of statistically equivalent management options. These options may have drastically different political implications and the uncertainty may be exploited by pressure groups or nations with different objectives, selecting within the range the most favourable option. This tends to lead to "polarization" (and has done so in the case of marine mammals) into extreme, unreconcilable positions if "tragic scenarios" are objectively possible within the range and there is no compromise on acceptable levels of impacts. In the case of the Florida gillnet fishing, for instance, newspapers indicate that the aim is: "stopping commercial exploitation".

There is no easy solution to this problem. It lies in integrated management of all interests in the framework of a modern system of allocation of rights against payment. It requires better science to (a) reduce the range of uncertainty as far as economically possible; (b) to evaluate the confidence intervals of the assessments and advice in the best possible way and (c) to develop models to test the impacts of the uncertainty on management strategies and develop precautionary approaches.

Precautionary approaches and the burden of proof

The precautionary principle is a consequence of uncertainty and has been developed in relation to pollution prevention. It requires States to take corrective action even in the absence of sufficient scientific evidence to prove causal links between a suspected factor and the adverse effects observed or even before any effect is observed at all. Its formulation, for fisheries, is not yet formalized but in general requires that the development of any new fisheries, or expansion of existing fisheries, should only be authorized after a rigorous multidisciplinary environmental impact assessment that includes the potential effect on target and non-target species. It places on those willing to introduce a new technology the onus to demonstrate that it does not have an unacceptable impact. This principle has been used in various Conventions since 1987, by UNEP in 1989, in the UN Resolution 44/225 on large-scale driftnetting [103], in many of the actions taken against this fishing technique (including the EEC decision on driftnet fishing, October 1991), in the regulation of inshore experimental trawling in California (1991) and in the UNCED negotiations.

This principle changes fundamentally the relationship between science and decision-making in fisheries, reverting the "burden of proof" on industry. It is also assumed that such principle would not allow policy-makers to hide behind real or pretended uncertainties to avoid difficult decisions. It represents potentially a useful tool for anticipatory management

but its effective implementation raises serious socio-economic concerns and technical difficulties, in particular in complex marine ecosystems. Considering the limited knowledge available on the biology and dynamics of such ecosystems, it would be, in most cases, difficult to forecast the long term impact on the ecosystem with sufficient accuracy and credibility unless pilot projects are implemented. In the absence of agreement on acceptable levels of uncertainty and impacts, on which the principle does not provide any guidance, it is of little practical value and unlikely to gain general acceptance.

Precautionary approaches to fisheries management have long been advocated even though they have rarely been applied in practice. It has always been recommended, for instance, to take early management measures in order to avoid crisis and higher costs in the future. This included such principles as (a) step-wise development with monitoring of impacts as opposed to massive development; (b) *a priori* effort limitations instead of laissez-faire investment strategies; (c) design of institutional or financial "expansion brakes" to avoid "explosive" development; (d) request for prior authorization before ordering construction of new vessels; (e) precautionary quotas for species without proper assessment; (f) recommendations for multispecies management; (g) recommendations for "experimental management" to test systems response; (h) recommendations of development targets below the Maximum Sustainable Yield (MSY); (i) modelling systems response across the whole uncertainty range; (j) prior agreement on cautious management thresholds (e.g. minimum spawning biomass) at which management action is taken automatically to avoid dangerous lags in decision-making.

More work will be necessary to clarify the principles for application of precautionary approaches and to define acceptable level of impacts with criteria for "acceptability", based on such elements as resources sustainability, vital reproduction thresholds, reversibility, etc.

The allocation and the institutional issue

No matter what spatial or functional basis is taken for management of marine living resources (the coastal zone and its watershed, the EEZ, the sub-region occupied by a shared stock, the large marine ecosystem, the ocean or the earth), the absolute requirements for ensuring long-term sustainability include the establishment of some form of property rights and the delegation of user rights, against some form of payment, through an institution whose geographical competence matches the geographical distribution of the resources and which considers the interests of all the users concerned on an equitable basis. This is easy to write but difficult to do.

The implication for coastal and EEZ resources is inter-sectoral integration, integrated sectoral planning and development and explicit mechanisms for resources allocation and conflict resolution. The implication of the allocation issue in the high seas is that there should be one integrated mechanism for sharing resources among users, managing all uses and collecting user fees [21].

Considering the difficulties, a practical approach, with increasing levels of difficulty, would be to:

- ⊙ Integrate all concerns in the coastal areas, providing a mechanism for inter-

sectoral negotiations for resources under State control and ownership using the Integrated Coastal Zone Management concept.

- ⊙ Integrate fisheries concerns at regional level (where most fleet and fish migrations occur) using regional fisheries bodies.
- ⊙ Strengthen relationships between regional FAO and non-FAO fishery bodies and environmental regional bodies and mechanisms (e.g. Regional Seas Programmes).
- ⊙ Develop cooperation, exchange information and analyse interactions between regional fisheries bodies, fisheries and resources, on an ocean-wide basis. The FAO Committee on Fisheries has the mandate to play this role.
- ⊙ Develop cooperation, negotiation and compatibility between all sectors and group interests, on an ocean-wide basis.

The global climate change

Global warming and sea-level rise will certainly affect fisheries to an unknown extent. The changes may not be drastic. Global resources potential is unlikely to change. Resources distribution may change, especially in upwelling areas. Coastal environments critical for fisheries might be affected particularly in low-lying areas. Without a better prediction of the likely direction and amplitude of the changes, on a local and seasonal basis, the predictions precision and usefulness will remain very limited.

With the present knowledge, forecasts would be little more than qualitative guesses. The uncertainty will remain very high for many years and the cost of applying precautionary principles might be overwhelming. The prime responsibility of fishery science is to ensure that algorithms and models are developed to predict resources changes resulting from environmental changes and to be used as soon as environmental predictions have improved.

5. CONCLUSIONS

The FAO resources are too limited to claim a central role in the evolution of world fisheries since 1945 but, as shown in this paper, the Organization takes pride in having made vital contributions in a number of fields related to development and management even though some of the contradictions, inherent to the historical process and to the macro-economic and political context in which fisheries have developed, could not be avoided.

In the early days of FAO (1945-1958), developed countries were concerned by post-war reconstruction of production capacity and a few developing ones realized that oceans offered opportunities if access rights were changed. In the sixties (1959-1972) world fishery resources were discovered, assessed and technology was developed to catch and process them. More developing countries realized the potential offered by EEZs and joined in the quest. In the seventies (1973-1982), most developing coastal countries fought for a greater share of ocean resources while developing their national fishing capacity, most often beyond necessary levels. In the eighties (1983-1992), proud of having won new exclusive rights, they

learned more quickly than their developed predecessors, that managing the new wealth was very difficult and the expected "blue gold" turned into a social and economic nightmare, debts and environmental quake.

The whole ocean is now in the situation where the North Sea countries were in 1945, and in 1992 there is nowhere else to go to fish. In the meantime, developed countries have tested management approaches but failing to deal with the allocation issue explicitly, many of them made little progress. As a consequence, most countries are now in the same type of situation, richer countries having a more expensive restructuring programme to go through. The process of resources appropriation has started much later than on land but has progressed more quickly, through political conflicts and negotiation but with few or no wars. This process is accelerating inside EEZs, hopefully leading to the conditions of property rights required for management. It is difficult to know which path it will take in each region.

It would be incorrect to see, within this context, only a "vicious circle" in which, decade after decade as fisheries expanded, countries and fishery management bodies collected information, assessed resources, gave advice to managers, concluded in overfishing. The correct image is that of a "dynamic spiral" which has recurrently passed through sequences of discovery, development and insufficient management as the whole system was evolving along many axes, as follows:

- ⊙ The areas exploited, and fully or overfished, have expanded, from the North Sea (1945), the North Atlantic and Pacific (1960), the tropical Atlantic (1970), the Indian Ocean and the Southwest Atlantic (1980) until the entire world ocean has been searched and "developed" (1992).
- ⊙ The whole spectrum of available resources has been progressively "colonized", from traditional bottom fish and large whales (1945-60), to small pelagic fish and temperate tuna (1960-70), to tropical tuna and shrimps (1970-80), to krill and oceanic squids (1980-90).
- ⊙ The available space (and the resources it contains) has been progressively allocated by decolonization (1945-1960) and allocation of the oceans by EEZs (1960-80). The process has to continue through allocation of space inside EEZs, between conflicting economic sectors (1980-2000 ?).
- ⊙ The relative resources scarcity increased continuously through increase in demand from growing populations and real decrease in abundance through fishing, prompting the adoption of more and more stringent property rights.
- ⊙ The number of aware and concerned people has increased as the visionary conclusions [104] of Warming, in 1911 were progressively agreed by an ever increasing number of decision-makers in the North Sea (1946), in the North Atlantic and Pacific (1960), around the tropical Atlantic, the Indian Ocean and the Southwest Atlantic (1980) and by a progressively more aware industry and concerned public opinion, assisted by a growing number of Non-Governmental Organizations (NGOs).

- ⊙ The world demographic boom has continued, especially in developing countries. This is a serious problem if auto-regulation feed-back mechanisms do not operate. Demographical growth (and development) create demand and consequently control prices in a system which is supply-limited. It is one of the main causes of defeat for management of natural renewable resources.
- ⊙ The perception of the holistic nature of the problem has increased drastically as economic sectors concerned with natural resources and environment discover their own problems, realize that they all have the same source and that, in the long term, inter-sectoral cooperation is better than inter-sectoral competition.

Many other axes could be identified, delimiting the multi-variable universe in which the world fishery spiral has developed and a fractal (a reduced image) of such a spiral could also describe the process at national level, in a region, on a resource. Although the situation of fisheries does not seem to have globally progressed since 1945, there has been global progress in their context, understanding and practical experience of management, and the conditions for success are better now than they were 45 years ago even though the problem has also grown.

A danger is that action does not seem to be taken until the spiral has developed to a critical point. In the case of whales the effect was that certain stocks were depleted and others severely reduced before the spiral developed enough. This has also happened with other resources.

A series of fundamental questions is now being raised: How is the exploitation of wild resources to survive? Is it possible to avoid excessive reduction in biodiversity and genetic resource composition in coastal ecosystems for the sake of increasing total output and short-term economic efficiency? Will coastal degradation under exploitation follow the same inexorable path as land degradation under agricultural development? Will an effort be made to understand the mechanisms of production and their limits by an analytic approach, to overcome them by ecological management? Will there be, on the contrary, the temptation to break through these constraints with technology, realizing too late the serious and possibly irreversible consequences? The history of the exploitation of natural ecosystems shows that a "wise" approach is generally preferable because of the high degree of uncertainty in our knowledge about nature and about the human communities that live on them.

The modern fishery management strategy, for the end of this century (1993-2000), will have to tackle the issue discussed in section 4: take into account environmental concerns, reduce fleet sizes, improve gears to reduce by-catch and waste, improve fishery statistics and research, manage better the high seas fisheries, integrate the development of agriculture, forestry and fisheries in the coastal zone preserved environment, associate non-fishery users in decision-making, learn how to deal with uncertainty in a cautious manner (i.e., giving to the resources the benefit of the doubt), putting on industry the onus of the proof of its innocuity, allocating explicitly resources and users' rights, forecasting potential effects of climate change.

In this process, it will be realized that the land-less farmer has a mirror image in the

ocean (i.e. the "fish-less" fisher), both deprived of resources for similar reasons, and that "agrarian" reforms are also required in the coastal areas. People may finally, realize that, although they live on land, their vital link is water, fresh or salt, for irrigation or for fishing, from which all life comes and to which all waste, ultimately, goes.

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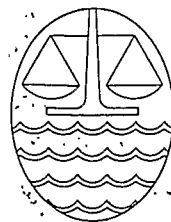
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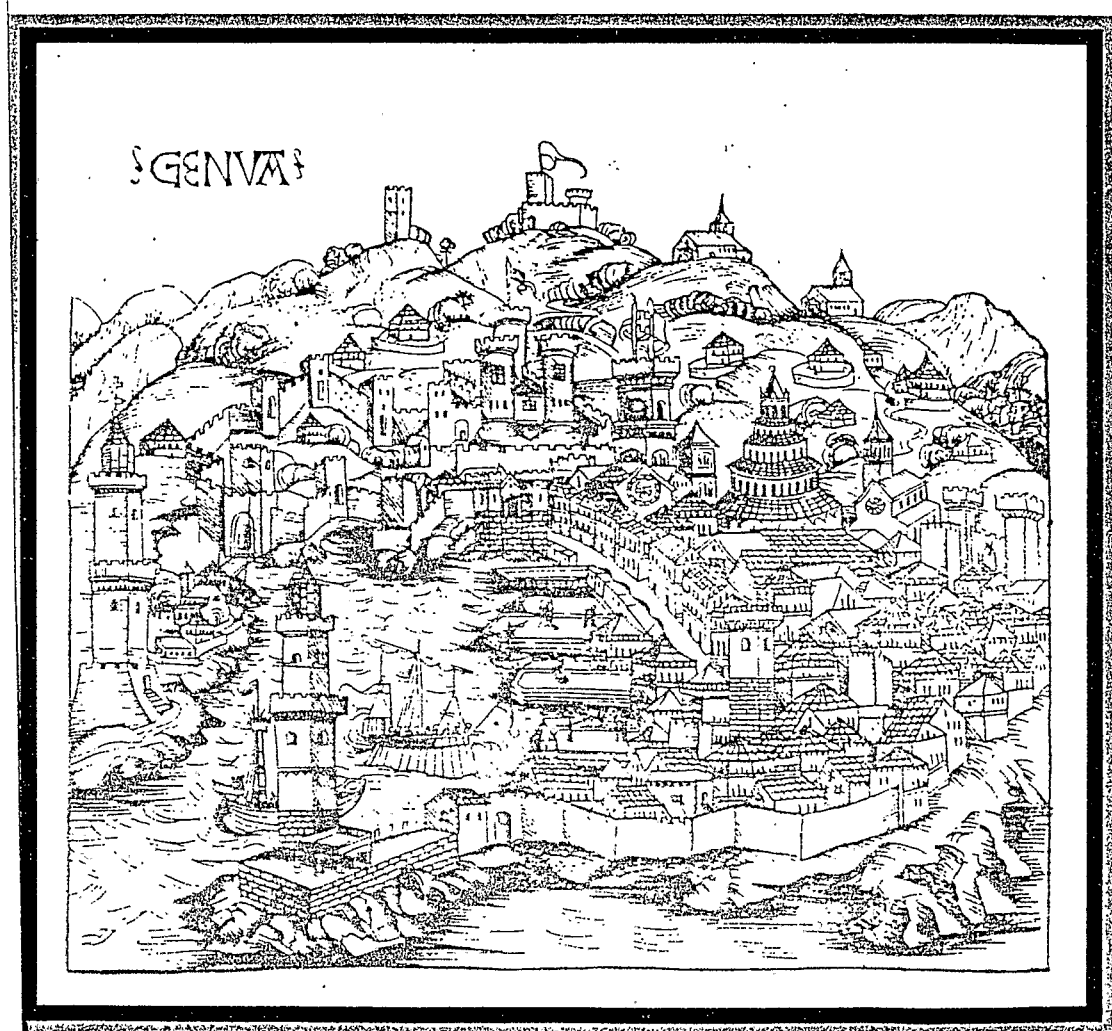
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