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**THE STATE  
OF THE ENVIRONMENT  
1972-1982**

**UNITED NATIONS  
ENVIRONMENT PROGRAMME**



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OF THE ENVIRONMENT  
1972-1982**



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## **FOREWORD**

The present report focuses on the changes (positive or negative) that occurred in the state of the world environment in the decade following the United Nations Conference on the Human Environment convened at Stockholm in June 1972. It attempts to evaluate the first ten years in which mankind has consciously and cooperatively attempted the rational management of a small planet.

## INTRODUCTION

1. One of the tasks assigned to the Governing Council of the United Nations Environment Programme (UNEP) by the General Assembly of the United Nations in its resolution 2997 (XXVII) of 15 December 1972 is to "keep under review the world environmental situation in order to ensure that emerging environmental problems of wide international significance receive appropriate and adequate consideration by Governments."

2. To assist the Governing Council in this task, the Executive Director was requested to prepare each year a report on the state of the environment. The first reports (1974, 1975, 1976) discussed a broad spectrum of environmental issues. By decision 47 (IV) of 14 April 1976, the Governing Council decided that the annual state of the environment report should be selective in its treatment and that an analytical, comprehensive state of the environment report should be prepared every fifth year. Accordingly, subsequent annual state of the environment reports (1977-1981) dealt with selected topics (see table). The criteria for the selection of these topics have been: first, the topics should be of international importance, either because they have global or regional significance, or because, while primarily national, they represent problems which are widely shared; second, the topics should be emerging, in that they have been attracting public or governmental attention, or because new scientific knowledge or hypotheses have recently been developed, or because there has been (or may soon be) a change in the situation; third, the topics should be urgent, in that the consequences of the problem could be serious or occur in the near future; fourth, the topics should be ones which have received insufficient attention from Governments and the United Nations system; fifth, the topics will often represent problems which UNEP has itself contributed towards resolving, or on which it intends to work.

3. On the occasion of the tenth anniversary of Stockholm in 1982, it has been found appropriate that the first comprehensive state of the environment report should cover the decade after Stockholm. This comprehensive study,<sup>1</sup> prepared through an extensive process of consultations with Governments, members of the United Nations system and other intergovernmental bodies as well as the scientific community and non-governmental organizations dealing with environmental issues, was designed to constitute a basic contribution to the analysis of the major environmental trends to be addressed by the United Nations, through UNEP which is one of the main tasks of the Governing Council's session of a special character in 1982. Careful and critical evaluation of the problems that have emerged

1. Published for UNEP by Tycooly International, Dublin, under the title *The World Environment: 1972-1982*.

**Topics treated in annual state of the environment reports**

Subject area	Topic	Year
The atmosphere	Climatic changes and their causes	1974*, 1976, 1980
	Possible effects of ozone depletion	1976
The marine environment	Oceans	1975*
Freshwater environment	Water resources and quality	1974,* 1976
	Ground water	1981
Land environment	Land resources	1974*
	Raw materials	1975*
	Firewood	1977*
Food and agriculture	Food shortages, hunger, and losses of agricultural land	1974,* 1976, 1977
	Use of agricultural and agro-industrial residues	1978
	Resistance to pesticides	1979
Environment and health	Toxic substances and effects	1974,* 1976*
	Heavy metals and health	1980
	Cancer	1977
	Malaria	1978
	Schistosomiasis	1979
	Biological effects of ozone depletion	1977
	Chemicals in food chain	1981
Energy	Energy conservation	1975,* 1978
	Firewood	1977
Environmental pollution	Toxic substances	1974*
	Chemicals and the environment: — possible effects of ozone depletion	1977
	— chemicals and the environment	1978
	Noise pollution	1979
Man and environment	Human stress and societal tension	1974*
	Outer limits	1975*
	Population	1975,* 1976*
	Tourism and environment	1979
	Transport and the environment	1980
	Environmental effects of military activity	1980
	The child and the environment	1980
Environmental management achievements	The approach to management	1974,* 1976
	Protection and improvement of the environment	1977
	Legal and institutional arrangements	1976*
	Environmental economics	1981

\* Brief treatment.

during the past ten years, the solutions that have been found, and the effectiveness of the world community in responding to environmental challenges is vitally important at a time when financial resources are insufficient to support all the programmes and projects required, and when environmentally sound development is becoming increasingly essential to meet the needs of people in all parts of the globe.

4. The present report draws heavily on the comprehensive study mentioned above and attempts to highlight the major changes (positive or negative) that occurred in the world environment in the decade after Stockholm. It also brings into focus the major environmental issues encountered or likely to be encountered.



## I. THE CHANGING APPROACH TO THE ENVIRONMENT

### A. Evolution of environmental concerns prior to 1972

5. The concept of "environment", and the pattern of action at national and international level to safeguard it, evolved in the years leading up to the Stockholm Conference, were given new form and direction there, and have continued to develop subsequently.

6. The International "environmental movement" that generated the Conference has a long history and no sharp beginning. In part, it is the successor to the great voyages of discovery and exploration that made people aware of the shape of the world and the diversity of its land and waters, rocks, vegetation, fauna and cultures. Another of its roots is in international science, which gained strength during the 1960s and 1970s. The International Geophysical Year (IGY) of 1957/1958 gave international co-operation a major impetus, because it demonstrated conclusively that world-wide scientific problems could be tackled successfully in this way and that; indeed, there was no other way to secure simultaneous world-wide observations of the upper atmosphere or the co-ordinated study of remote areas like the Antarctic. IGY was also the direct inspiration of the International Biological Programme (IBP), 1964-1974, which had as its central theme "biological productivity and human welfare". Much of the understanding of world environmental systems developed in the 1960s and 1970s during these international programmes and those that stemmed more or less directly from them.

7. The other major evolution in recent years has been in the wider public's appreciation of environmental issues. In the developed countries a conservation movement appeared in the last decade of the nineteenth and first decades of the twentieth centuries. It was concerned with both the efficient management of natural resources and the preservation of natural habitats and historic monuments. National forestry and agriculture societies provided a forum for the first kind of activity, while the second was stimulated by bodies like the Moscow Society of Nature Investigators, the National Audubon Society, Wilderness Society of Sierra Club, the National Trust and the societies that now make up the Fédération Française des Sociétés de Protection de la Nature and its Federal Germany, Netherlands, Swedish and Swiss counterparts.

8. But the widening of the "environment movement" in the second half of the twentieth century brought three developments of major importance. First, the scientific and nature protection components grew together, especially under the influence of professional ecologists. Second, appreciation of the environment grew in many countries outside Europe and North America. Third, and most important, the character of the approach changed. A much broader conception of the environment was adopted. The

movement became concerned with literally all aspects of the natural environment: land, water, minerals, all living organisms and life processes, the atmosphere and climate, the polar icecaps and remote ocean deeps, and even space. It also turned towards the human situation, at the level both of whole communities and of individual needs for housing and living, and emphasized the relationship between the man-made and natural environments.

9. This new movement has a broader and scientifically more sophisticated perception of the relationship between man and environment. It was concerned not only with the condition of natural resources but with how values, institutions, technology, social organization, and, in particular, population influenced the way in which those resources were used and conserved. Whereas the earlier nature protection movement was concerned with safeguarding certain grounds of prudence or aesthetics, the new environmental movement, while including this, went beyond it. It became concerned with a much wider range of environmental phenomena, on the grounds that the violation of ecological principles had reached the point where at best the quality of life was threatened, and at worst the long-term survival of humanity could be imperilled.

10. These developments were strengthened during the 1950s and 1960s by a number of demonstrations of the damage human activities could do — the air pollution episodes in London and New York between 1952 and 1966, the fatal instances of mercury poisoning at Minamata and Niigata between 1953 and 1965, the reductions in aquatic life in some of the North American Great Lakes, the deaths of birds caused by the unexpected side-effects of dichloro-diphenyl-trichloro-ethane (DDT) and other organochlorine pesticides and the massive oil pollution from the wreck of the *Torrey Canyon* in 1966. These widely publicized events caused many people in the developed countries to fear that pollution was already jeopardizing the human future, and the revelation, at about the same time, of the upward trend in atmospheric carbon dioxide concentrations and of possible mechanisms whereby human activities might perturb stratospheric ozone concentrations added force to these concerns.

### B. The Stockholm Conference

11. It is not surprising, therefore, that representatives of the developed, industrialized countries approached the Stockholm Conference with environmental pollution problems weighing heavily on their minds, and with the need for a world-wide conservation programme to safeguard the planet's genetic and natural resources as a strong second concern. Experience in these countries had demonstrated that environmental deterioration could threaten their citizens' health and well-being, and damage ecosystems and species important to their quality of life. There were also fears that more subtle and widespread effects could modify the global environment over a longer period, at great cost to the whole of mankind. The accelerating consumption of resources by industrialized societies, their ever-mounting demand for energy, and the pressure on resources generated by the rapid rise in human

population suggested to many that continuing economic growth could be jeopardized by environmental constraints.

12. Such people believed that the central lesson of ecology — that the numbers of any species were limited by interactions with the environment — had to be applied to man. They argued that preventive measures had to be found urgently if disaster was to be avoided. The Stockholm Conference was accordingly expected to lead to a global campaign to curb pollution, conserve resources, and lay the foundation for their more careful management.

13. But the developing countries approached Stockholm with a different perspective. These were the nations where poverty was rife, where infectious diseases took a terrible toll, and where human settlements commonly failed to provide adequate shelter, clean drinking water, and safe disposal of human wastes. They were also deliberately engaged in stimulating rapid change, with too limited financial resources and a marked shortage of skilled people. If therefore, the thesis that pollution prevention was cheaper than cure was accepted intellectually, there was nonetheless a temptation to industrialize by the cheapest route first and cure the resulting pollution afterwards.

14. Moreover, it could be argued that if the capacity of the environment to assimilate wastes was itself a natural resource, it was one in which developing countries were rich, and could exploit by accepting industries intolerable in the more congested environments of the developed world. Environmental concern was therefore often dismissed as the business of the rich countries which caused most of the pollution, and moreover had the wealth to cure it. Debates on doomsday theories, limits to growth, the population explosion, and the conservation of nature and natural resources were thought of as largely academic, of no great interest to those faced with the daily realities of poverty, hunger, disease and survival. Indeed, arguments were presented to show that environmental concerns could well retard development efforts in the developing countries.

15. An important event in the preparation for the Stockholm Conference was a seminar on development and environment held at Founex, Switzerland, in June 1971. This meeting began to clarify the links between environment and development, destroyed the notion that they were necessarily incompatible, and began to convince the representatives of the developing countries that environmental concerns were both more widespread and more relevant to their situation than they had appreciated. It was pointed out that developing countries in the arid zones and humid tropics have always had to deal with natural environmental problems such as droughts or water-borne diseases, which have materially affected their development, and that they have evolved certain traditional techniques of water management and shifting cultivation that, if properly applied, are environmentally sound.

16. Another link between environment and development was forged by the recognition that many problems confronting developing countries had

been encountered earlier by developed countries, whose mistakes could be avoided. Resource deterioration, squalid housing and inadequate sanitation, affecting poor people throughout the world and generally resulting from under-development, were seen to be just as much environmental problems as those caused by industrial emissions. At Founex and Stockholm the phrase "the pollution of poverty" came into use to describe the worst of all the world's environmental problems, and it was recognized that the skills of all nations were needed to tackle it.

17. The Founex meeting thus began to bridge the gap in understanding of the relationship between environment and development. There was general recognition that virtually all countries needed to undergo further development, so that sound approaches to environmental planning and management would be required everywhere. Environmental concerns should not be a barrier to development, but should be a part of the process, since development that is sound environmentally is likely also to be enduring and to avoid unforeseen and unwelcome side effects. "Ecodevelopment" — a word coined to describe this process of ecologically sound development, of positive management of the environment for human benefit — emerged as a central theme at Stockholm. These redefined concepts made the Stockholm Conference more attractive to developing countries.

18. The Stockholm Conference was, however, a focus for, rather than the start of, action on environmental problems. By the start of the 1970s, major United Nations agencies like FAO, WHO, UNESCO, IAEA, WMO and IMCO had programmes dealing with a number of environmental problems through not necessarily carrying that title. The regional commissions, IUCN, the Organization for Economic Co-operation and Development (OECD), the Council for Mutual Economic Assistance (CMEA) and the European Economic Community (EEC) were active to varying degrees. A number of developed nations had already established, by the beginning of the 1970s, national machineries to deal with the environment (departments of environment, agencies, etc.).

### C. Developments since the Stockholm Conference

19. The content of the Stockholm Action Plan, and the subsequent measures taken to implement it, are reviewed in a separate document.<sup>2</sup> It is evident that the context and the conception of environmental action have changed during the 1970s. The 1960s had been a decade of substantial economic growth — between 4 and 5 per cent in the developed countries of North America and Europe and as much as 10 per cent in Japan. In the 1970s this slowed to under 3 per cent (5 per cent in Japan). In developing countries the change was less marked, with an average growth in gross national product (GNP) of 5.6 per cent between 1960 and 1970, falling to around 5 per cent between 1975 and 1979. The price of oil rose markedly, shaking some of the assumptions on which many countries had planned their development. These

2. UNEP/GC. 10/6 (UNEP/GC (SSC)/INF. 1).

changes brought home to many people the finite nature (and generally inadequacy) of the financial resources available for development and the need to plan carefully so that waste was avoided. It was increasingly recognized that the environmental component of development must be properly evaluated within the total planning process.

20. In 1973 the United Nations initiated a major study of economic trends, taking into account such matters as the availability of natural resources, pollution, and the economic impact of pollution abatement. The Secretariat commenced "Project 2000" to examine alternative patterns of development up to that year, and their policy implications. Environmental considerations were built into the programmes of many intergovernmental and national bodies concerned with development strategies. The theme of environment and development singled out by the Governing Council of UNEP at its first session in 1973 as a subject of high priority became a central strand in UNEP thinking.

21. The systems approach to development planning demanded a fusion of environmental science, characterizing the physical and biological resources available and the way they might respond to new human actions, with economics and with social understanding of the needs of people and communities. One manifestation of this approach was the development of formal environmental impact assessment methods, with or without simulation models; another was the use of indicators of environmental quality. Recognition that socio-environmental systems are wide in extent and that the developed countries had a direct interest in the development of others gained ground during the decade, and was illustrated in such studies as the OECD Interfutures Study<sup>3</sup> and the Report of the Independent Commission on International Development Issues (the Brandt Commission).<sup>4</sup> The World Conservation Strategy, prepared by IUCN with the advice, co-operation and support of UNEP and the World Wildlife Fund and in collaboration with FAO and UNESCO, emphasized that conservation of the resources of the biosphere is at the heart of environmentally sound development, and that without development means are unlikely to be available for the protection of the world's wildlife and natural environments.

22. A measure of the range of environmental concerns in the world community can be judged by the themes chosen by the Governing Council for the annual state of the environment reports provided by the Executive Director each year since 1974 — especially after the first three years (see table). The impacts of diseases whose prevalence depends especially on environmental factors, the effects on people of chemicals in the environment, soil loss, and the ways in which human activities influence the environment together account for the bulk of the list. The condition of the physical environment, so obviously a focus of emphasis in the years leading up to Stockholm, has become of lesser concern. It was the causes of environmental

3. Interfutures: Facing the Future (Paris, OECD, 1979).

4. North-South: A Program for Survival (London, Pan Books, 1980).

deterioration and the impact of such deterioration on human well-being that became the centre of focus. This shift of emphasis does not mean that there have not been significant changes in the physical environment. Carbon dioxide concentrations in the atmosphere continued to rise, concern about acid rains grew, and that about man's impact on stratospheric ozone remained. The pollution of the oceans and inland waters and the loss of soil and of productivity through erosion, desertification and salinity were at the forefront of attention. The depletion of genetic resources, especially in the tropical forests, was widely debated, and much concern was expressed over the enormous increase during the decade in the volume and number of man-made chemicals reaching the environment.

23. However, the changes in the nature and scale of impact on the physical environment in the past decade may well have been less important than the parallel changes in human institutions and perceptions. There was an "information explosion" among scientific journals. The decade saw rapid advances in the capacity of computers, and rapid reductions in the costs of electronic data storage and retrieval systems. Satellites brought the prospect not only of improved intercontinental communications, but of more efficient surveillance of changes on the earth and in the atmosphere. New instruments greatly enhanced the resolution of chemical analysis. Computerized data banks holding scientific results, abstracts and information offered a possibility, yet to be realized in the 1980s, of making systems like International Referral System for sources of environmental information (INFOTERRA), the International Register of Potentially Toxic Chemicals (IRPTC), and the Global Environmental Monitoring System (GEMS) more comprehensive and quickly responsive than had been contemplated at Stockholm, if UNEP could link directly with the most relevant national and international data banks.

24. The decade witnessed also a massive expansion in the establishment of national environmental bodies (agencies, department, councils, committees, etc.). In the early 1970s there were hardly 10 countries that had established such bodies; by the end of 1974 the figure had risen sharply to about 60, and by the end of the decade research about 100. There has been also a considerable increase in the number of non-governmental bodies dealing with environmental issues. Although it is difficult to give accurate figures, it is estimated that there were about 2,500 non-governmental organizations in 1972; the number rose to about 15,000 in 1981, of which some 5,200 were registered by the Environment Liaison Centre. The period saw also a burst of legislation dealing with environmental issues both in developed and developing countries. In OECD nations, for example, whereas only 4 major national environmental laws were passed in the 5 years 1956-1960, 10 in 1961-1965 and 18 in 1966-1970, between 1971 and 1975, 31 such measures were adopted, and a further 25 followed in the 4 years 1976-1979 inclusive. By the end of the 1970s regular statistics or reports on the state of the environment (or both) were being produced in many countries (for example, Germany, Federal Republic of, Finland, Japan, Philippines, Spain, Sweden, United States of America).

25. The marked development of ecology and other environmental sciences has had two consequences. First, it has demanded changes in the kinds of data collected about the environment, generally in the direction of more precise, quantitative information suited to a particular type of analysis. Second, much of the anecdotal information about the environment that satisfied the needs of the past is tending to be rejected as not reliable enough for making decisions about environmental management today. In the late 1970s observations from satellites were raising questions over the truth of assertions about rates of forest clearance inferred from ground observations. New analytical methods had led marine scientists to disregard data on the concentration of trace substances in the sea acquired before around 1972-1974. Paradoxically, these advances, because they cast doubt on so much of the earlier information, hampered comparisons that might have revealed changes in the world environment between 1970 and 1980.

## II. ENVIRONMENTAL TRENDS AND ISSUES DURING THE 1970s

### A. The framework for environmental analysis

26. The environmental trends and issues analysed in this report are grouped in two main sections. The "natural environment" of air, oceans, rivers and lakes, land and the life they support is one category — the one that comes quickest to many people's minds when they think about the environment. But the lesson that has been most widely learned in the past decade is that the crisis confronting mankind lies not in this natural world, despite all that people have done to it, but in man himself. Millions still endure squalor, inadequate housing and lack of the most basic services, and the provision of adequate food, better health care and improved settlements is barely keeping abreast of growing populations, and in some places falling behind them. The major ways in which people interact with and transform the physical environment to satisfy their needs are discussed in the second section of this chapter. The scale of such transformation is continually increasing, and taking fresh forms, and unless the forces that drive these interactions are understood a process of development that improves the human condition without detriment to the natural world, and without the risk of failure through the destruction of the very resources on which the future depends, will not be achieved. The last ten years have emphasized that development cannot be secured without conservation, or conservation without development. That is the central message of the World Conservation Strategy written near the end of the period reviewed in the present report.

### B. The natural environment

#### 1. Atmosphere

27. Life on Earth depends on the atmosphere, which is subject to wide natural variation and to human modification. It is only recently that mankind has become aware of the extent to which human activities can interfere with this vital resource. The alternations these activities are causing and the impacts of those alterations on human well-being are, however, difficult to identify and measure.

28. Emissions of sulphur oxides SO<sub>x</sub> are much higher in the northern than in the southern hemisphere (145.5 and 5.5 million tons/y respectively). Between 1970 and 1980 global man-made emissions of sulphur oxides grew at about 5 per cent per year, to give a total increase of 40-50 per cent over the decade. Total emissions of anthropogenic SO<sub>x</sub> reached 196 ± 30 million tons annually at the end of the 1970s. Concentrations of sulphur oxides and suspended particulate matter were decreasing in most areas with control policies, but increasing where such policies were lacking or ineffective, especially in developing countries.

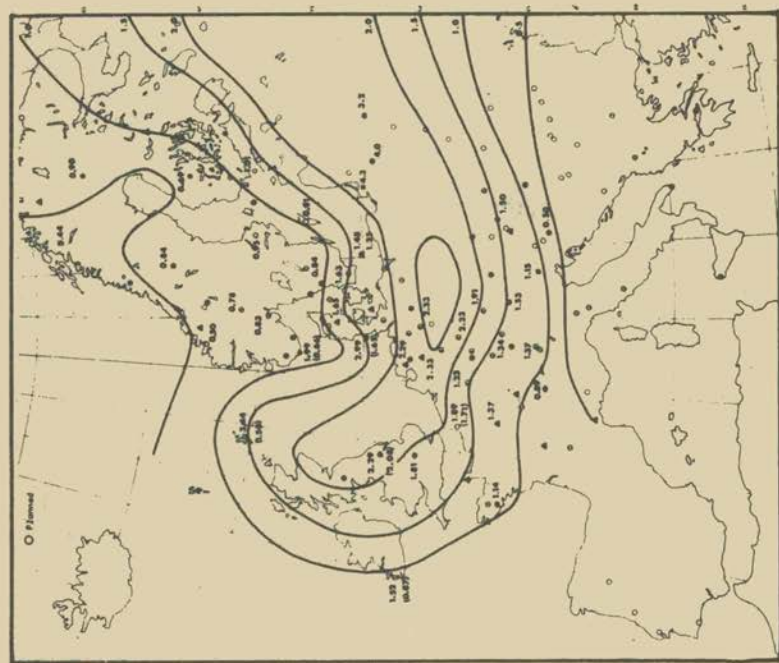
29. Acid rain was established as a phenomenon that resulted from the



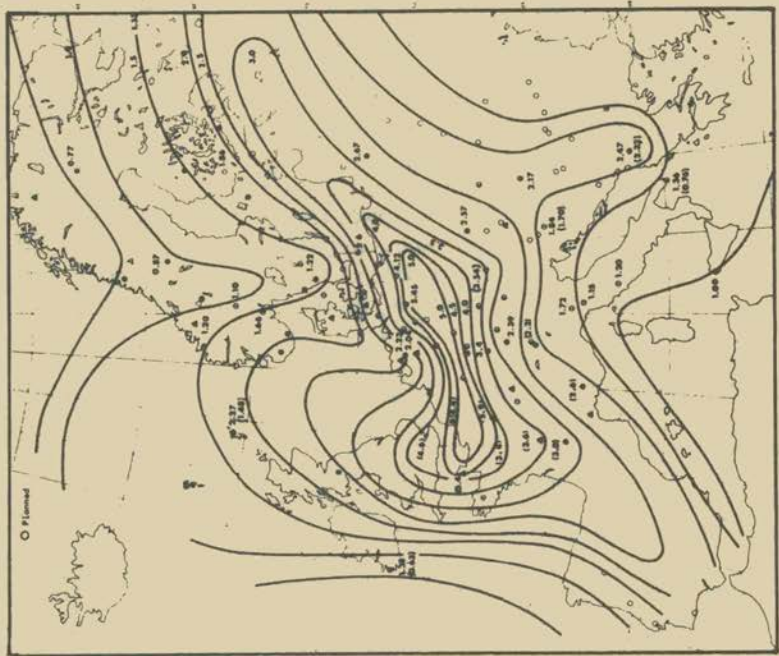
among fossil fuels) and by smelting of sulphide-bearing ore minerals. In the long-distance transport of sulphur oxides and nitrogen oxides produced primarily by fossil fuel combustion (coal has the highest sulphur content) past ten years it has been clearly established that transport over distances of 1,000 km and upwards is common in western Europe and eastern North America, and that there has been an increase in the acidity of precipitation over these areas (figure 1). Its adverse effects, such as acidification of inland waters and consequent effects on aquatic biota, were of increasing concern during the decade.

30. Photochemical oxidants, which cause smog, have been encountered in many parts of the world, especially in urban areas with high automotive traffic densities. Recent evidence from field studies conducted in Europe and eastern North America has established that photochemical pollutants and their precursors can be transported up to several hundred kilometres and, therefore, give rise to more than a local problem restricted to urban centres. Although general conclusions about oxidant trends over the last decade are difficult to reach, it has been found that, where effective controls were imposed, the concentration of the oxidants decreased. On the other hand, where controls were absent or ineffective or where automobile use increased, the concentration of oxidants increased.

31. The changes in stratospheric trace constituents that attracted most attention during the decade were those of fine particulate matter and ozone. Stratospheric particulates appear to have increased by about 9 per cent a year, with possible but yet undetermined effects on climate. The depletion of stratospheric ozone was postulated as a result of increasing releases into the stratosphere of chlorofluorocarbons from such sources as spray cans and refrigerators (by the end of the 1970s there were insufficient data to conclude that supersonic air-transport contributes to this ozone depletion). The UNEP Co-ordinating Committee on the Ozone Layer estimated that continued releases of chlorofluorocarbons (CFCs) 11 and 12 at the 1977 rate would eventually deplete the ozone layer by about 10 per cent by the year 2050. The model used by the UNEP Committee calculated that a total ozone of about 1 per cent should have already occurred, but such a small amount could not be directly detected with current analytical methods. Although it was reported in 1980 that world production of CFCs 11 and 12 had fallen by 17 per cent between 1974 and 1979, other CFCs, methyl chloroform and carbon tetrachloride emissions appeared to be on the increase worldwide, and their impact could more than offset gains achieved through reduction in the use of CFCs 11 and 12. It is commonly accepted that the main effect of the depletion of stratospheric ozone would be an increase in the amount of ultra-violet (UV) radiation reaching the earth's surface. Countries established networks of stations to monitor UV-B only recently, and no trends had been reported by the end of the decade. The increase of UV-B radiation can kill micro-organisms and destroy individual cells in plants and animals, with consequent detrimental effects on different ecosystems, can cause various forms of skin cancer in humans, and may cause undesirable global perturbations in the earth's climate.



1954-1959



1972-1976

Figure 1. Annual mean concentration of sulphate in precipitation (mg S/litre)

32 Carbon dioxide (CO<sub>2</sub>) concentrations were slowly and steadily increasing in the 1970s, chiefly as a result of the increasing use of fossil fuels and widespread clearing of forests. Before 1850 the concentration of CO<sub>2</sub> in the atmosphere was between 265 and 290 parts per million by volume (ppmv). At the Mauna Loa baseline station Hawaii, the concentration of CO<sub>2</sub> rose steadily at the rate of about 1 ppmv per year after 1957. In 1970, the concentration of CO<sub>2</sub> in the atmosphere was about 326 ppmv and reached about 338 ppmv in 1980 (figure 2). This upward trend, which has also been observed at other sites, has important — but as yet incompletely understood — implications for world weather conditions and agriculture, because it could alter temperature and precipitation patterns and the distribution of snow and ice cover.

33. While local meteorological changes occurred (as in heat islands and hazy areas), the question of whether long-term climatic changes were in progress, and if so at what rate, remained controversial. It was apparent that, because of the lack of understanding of the geochemistry and physico-chemical characteristics of the atmosphere, long-term climatic changes could not be predicted with confidence.

34. Despite the occurrence of extreme meteorological events in various parts of the world during the 1970s (severe droughts, disastrous floods, consecutive cold winters and tropical storms), there is no evidence of marked changes in the weather over recent decades.

## 2. Oceans

35. During the 1970s considerable advances were made in scientific understanding of the physical and chemical properties of the oceans, and of the circulation of their waters — important features because they determine the dispersion of pollutants and the productivity of fisheries. Before then monitoring of pollution and of ecosystems had been confined to a few localities, making it impossible to define trends for the oceans as whole. The best data came from the Baltic, the North Sea, and some North American and Australian estuaries and coastal waters. By the end of the decade, the Regional Seas Programme was collecting information about the Mediterranean and other seas as well.

36. In most of these areas the pollution that caused most concern was due to sewage, agricultural chemicals, oil, and metals (figure 3-4). Metal concentrations were clearly elevated in coastal waters, and in fish and shellfish living there. In some areas, mercury levels in species such as tuna were high enough to make these fish unsuitable as human food. Over-all, chemical contamination of the oceans appeared to be localized, with the worst conditions in estuaries and coastal areas in industrial regions, where ecological changes were apparent.

37. Some of this pollution came via rivers: the amount of iron, manganese, copper, zinc, lead, tin and antimony that reached the sea by this

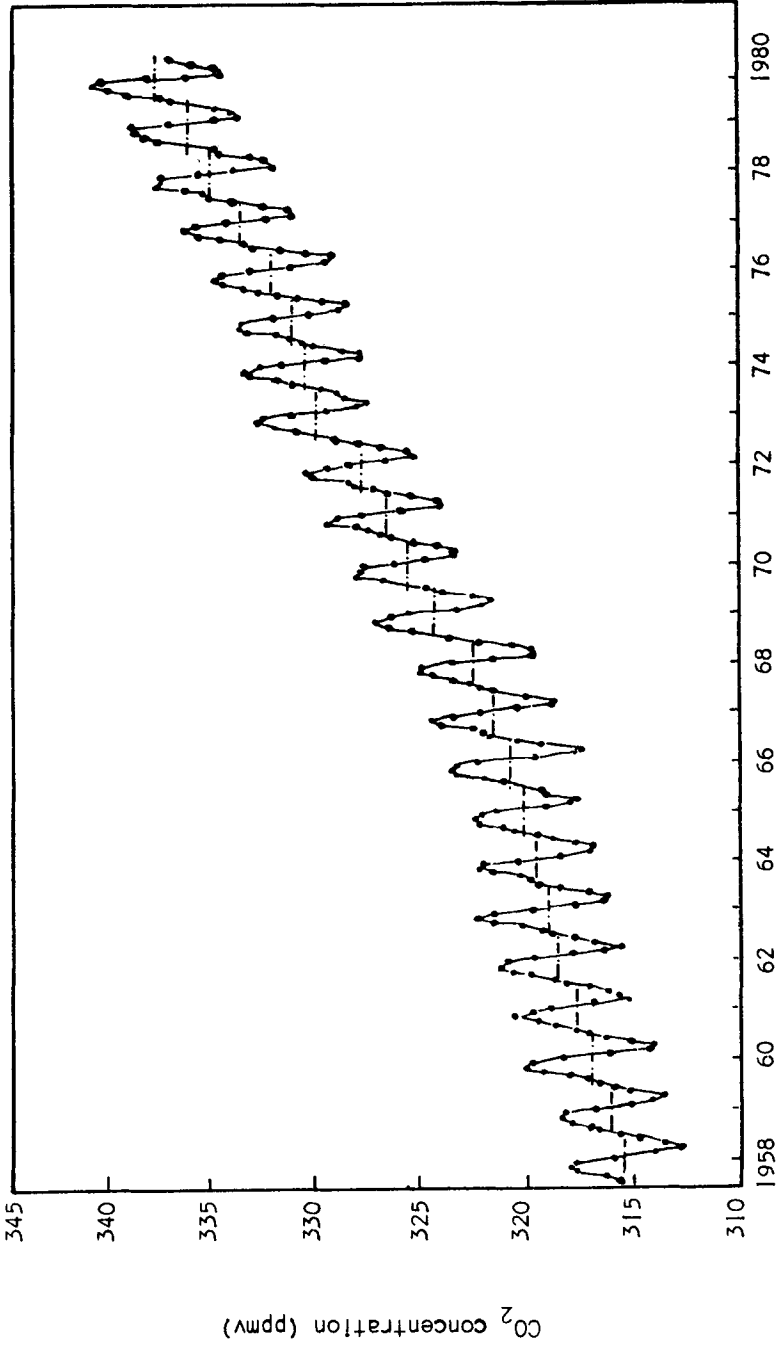


Figure 2. Average atmospheric CO<sub>2</sub> concentration (as measured at Mauna Loa, Hawaii)

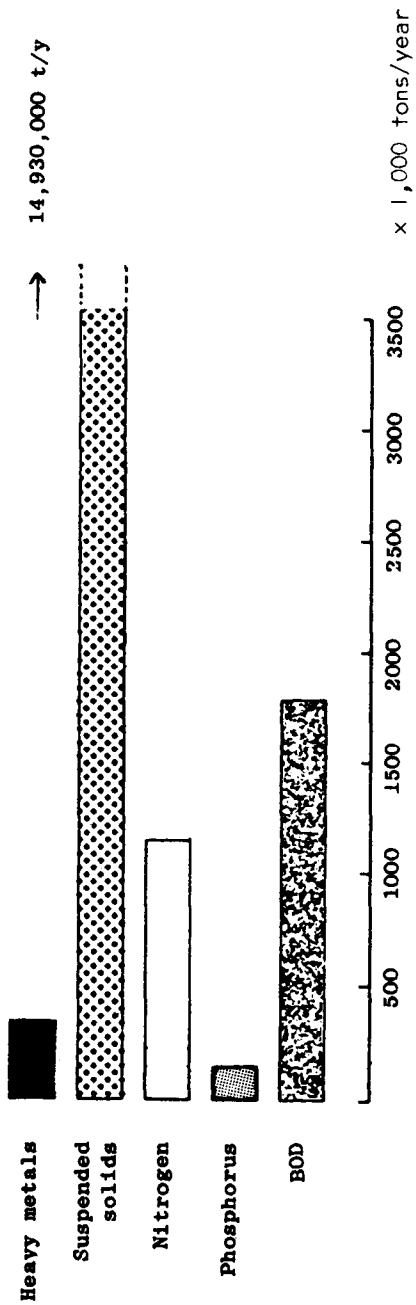


Figure 3. Major contaminants and biological oxygen demand (BOD) in the Oslo Commission Area (the north-eastern Atlantic between 66°33' E and 42° W, north of latitude 36°N)

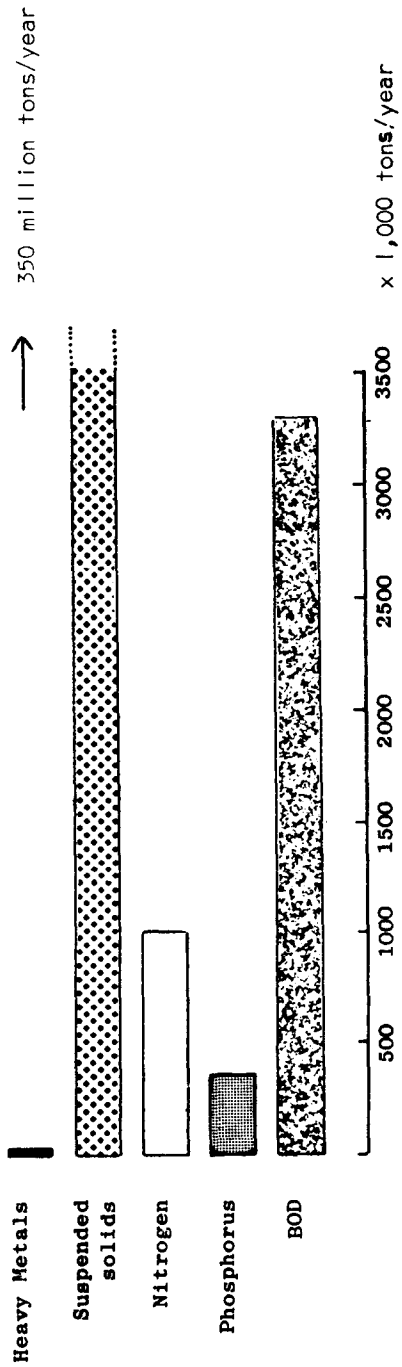


Figure 4. Major contaminants and BOD in the Mediterranean Sea

route was far greater than would be supplied by natural geological processes. Other contaminants came through atmospheric deposition: the importance of this pathway for metals and synthetic chemicals was increasingly recognized during the decade.

38. Offshore oil and gas exploration and dredging for sand and gravel in coastal areas increased during the decade. Coastal zone development affected extensive estuarine areas, as well as mangrove swamps and coral reefs. Oil pollution killed sea-birds, fouled beaches and affected tourism. Although tanker accidents were the source of less than 5 per cent of all the oil

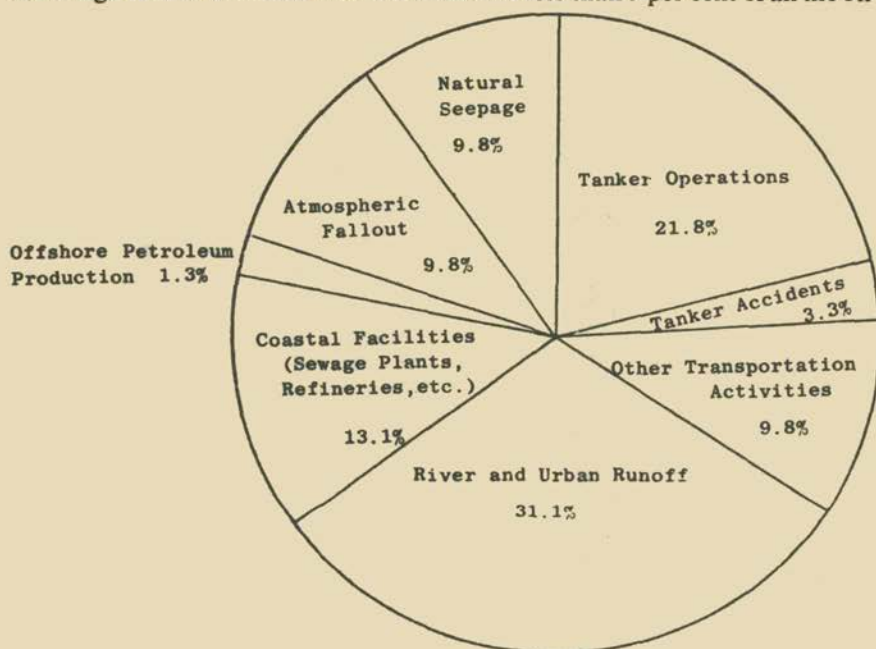


Figure 5. Sources of oil going into the oceans (after *Petroleum in the Marine Environment*, National Academy of Sciences, Washington, D.C., 1975)

entering the sea (figure 5), accidents released large volumes in small areas, and were therefore especially damaging.

39. Organochlorine pesticides and polychlorinated biphenyls (PCBs), among a wide variety of man-made chlorinated hydrocarbons, were found to be widely distributed in the sea and marine life. However, the concentrations of DDT and related pesticides diminished in coastal waters of north-west Europe and North America, and PCBs also showed some indication of decline. Except in the most highly polluted coastal localities, there was no evidence that marine productivity or fish stocks had been reduced through chemical contamination, or that floating oil had affected the recruitment rates of fish or shellfish. However, many scientists were cautious in their reaction to this generally reassuring picture because there were deficiencies in monitoring, and because they were uncertain over the possible long-term effects of ecosystem exposure to contamination.

40. World fishery yields rose during the 1960s and 1970s, with a dip in the production curve in 1972 and 1973 (figure 6). Some populations — notably of Peruvian anchoveta and North Atlantic herring — were depleted, with over-exploitation commonly blamed. Some argued that world catches in 1980 were 15-20 million tons less than they would have been had good management prevailed. By the end of the decade, however, there were hopes of recovery in several fish stocks as a result of tighter controls. Looking ahead, substantial increases in marine food production appeared possible, partly through mariculture, which expanded greatly, especially in China and South-East Asia. However, many of these expected increases are dependent on the costs of production.

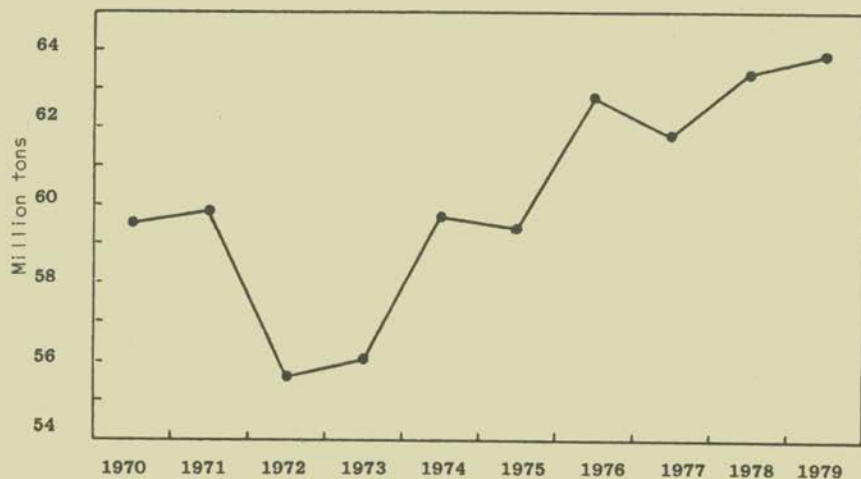


Figure 6. Fish catches in marine areas

41. The decade saw continuing concern over marine mammals. Population estimates of species that have formed the basis of the commercial whaling industry this century in the north Pacific and the southern hemisphere suggest that only about 48 per cent of the total stock now remains. A ban on all commercial whaling, proposed at the Stockholm Conference, had not been achieved by the decade's end, but catches in some species have been greatly reduced under a new management procedure implemented by the International Whaling Commission in 1975.

42. Much international activity took place during the decade. Conventions to control marine pollution were adopted. By the end of the decade, action plans were in operation or planned for 10 regions involving some 100 coastal States. Coastal and marine national parks and reserves were extended.

### 3. Water

43. Fresh water is one of the necessities of life, but for millions of people during the 1970s it was a scarce and hard-won commodity. Among the



reasons were that inland waters occur in strictly limited volume (about 0.01 per cent of global flow in rivers and their associated lakes and swamps), they undergo both seasonal and yearly fluctuations, and they are subject to man-made changes in their physical and biological qualities.

44. Considerable international activity was aimed at solving such problems. The International Hydrological Decade (IHD) (1965-1974) and the International Hydrological Programme (IHP) that followed brought improved knowledge of hydrological processes. Great advances were made in assessment of water stocks, even before the United Nations Water Conference convened in 1977. The need for better management of water resources, and for treatment of river basins as unitary systems, received wider recognition, and there were advances in ground-water assessment and applications of advanced technologies for surveying aquifers.

45. Recent estimates placed the total water use in 1980 in the order of 2,600 to 3,000 km<sup>3</sup>/year; this is projected to reach 3,750 km<sup>3</sup> in 1985 — about 8 to 10 per cent of the average run-off in all continental river basins. The three major uses of water are: irrigation (73 per cent), industry (21 per cent) and domestic and recreational uses (6 per cent). The decade saw further extension of irrigation (and improved drainage) to newly reclaimed lands, especially in arid regions. Industrial uses increased during the decade, but savings were also made through increased efficiency. In Japan, for example, total industrial withdrawals increased from about 50 million cubic metres in 1974, but by the mid-1970s two-thirds of this was recycled water compared with one-third in 1965.

46. Spurred on by recurrent floods and droughts, engineers and scientists made progress in flood management through both structural (i.e. dykes and barrages) and non-structural techniques (land-use zoning, flood-proofing, flood insurance, and land treatment through afforestation or soil conservation). Some research advances were made in augmenting water supplies through weather modification, evaporation suppression, desalination and recycling. Research advances were also made in development of models of river systems and ground water.

47. The large numbers of people with no access to safe, clean water and inadequate sanitary services was a matter of deep concern to the world during the 1970s. This concern was expressed at the United National conferences on human settlements (1976) and on water (1977). Whereas in developing countries the proportion of the urban population with access to safe water supply rose from 67 per cent in 1970 to 77 per cent in 1975 and then declined slightly to 75 per cent in 1980, the proportion of rural people served by safe water supply increased from 14 per cent in 1970 to only 29 per cent in 1980. The waste water treatment situation was even less heartening. While a high proportion of the developed urban populations had adequate services, the proportion of developing country urban population served by sewers and other sanitary facilities declined during the decade, from 71 per cent to 53 per cent. In rural areas the numbers served were 11 per cent and little better (13

per cent) in 1980. As a result of the worldwide interest in improving this situation, the current decade (1980-1990) was proclaimed the United Nations International Drinking Water Supply and Sanitation Decade.

48. Inland water bodies suffered over-enrichment (eutrophication) and pollution caused by discharges from industries, drainage from agricultural and domestic chemicals and wastes, and acidification from acid rain. But technologies for waste-water treatment and recycling advanced to such an extent that for many rivers and lakes the deterioration was reversed and they were biologically revived. Among large lakes, changes in the Bodensee (Lake Constance) and in Lake Washington were especially well documented. Lake Washington provides an excellent example of the rapid reversibility of eutrophication, after diversion (by canal) of the main sewage input. Other examples of reversion include Lakes Vattern and Trummen in Sweden. In general, the anxiety felt during the 1960s regarding the extent, pace and consequences of over-enrichment had lessened by 1980, although several disturbing cases still remained. During the decade extensive efforts were made in the developed countries to arrest the pollution of water bodies. A variety of regulations and incentives were tried. These were moderately effective in checking a deteriorating trend, and in a few countries the trend was reversed and an improvement in water quality resulted. In a number of countries measures to abate point-source pollution have been successfully implemented, while the control of non-point sources has not been achieved. In some countries industries were taxed for discharging wastes into public waters and sewers, and hence given an incentive to install their own waste treatment plants. In others, standards specified the maximum concentrations of pollutants permitted in an individual discharge or a type of industrial emission. Reduction of water pollution was also one motive for reducing the use of fertilizers and chemical pesticides by substituting biological nitrogen fixation and biological pest controls. The damage done by acid precipitation (resulting from the emission of sulphur and nitrogen oxides) to life in lakes in North America and Scandinavian countries continued to cause much concern in the 1970s.

49. Inland fisheries catches increased from 6.1 million tons in 1970 to about 7.5 million tons in 1979 (figure 7). The creation of several new inland fisheries in man-made lakes contributed to this growth in production. In 1979 catches in Asia made up 58.2 per cent of the world total inland fisheries catches, with Africa next in importance at 21.5 per cent and the USSR third at 10.8 per cent. There were indications in 1976 that most fish stocks in Africa were nearly fully exploited, although resources were under-developed in some areas. New man-made lakes had created fisheries in other areas, however. The Aswan High Dam created a new fishery in Lake Nubia-Nasser, but reduced downstream catches, including those off the Nile Delta coast and the Eastern Mediterranean fisheries. Overfishing had caused serious damage in some large lakes, for example in Lake Victoria. Aquaculture showed much promise in the 1970s, increasing production by 5-6 per cent in some countries and as much as 10 per cent in others (for example, in Indonesia, the Philippines and Thailand).

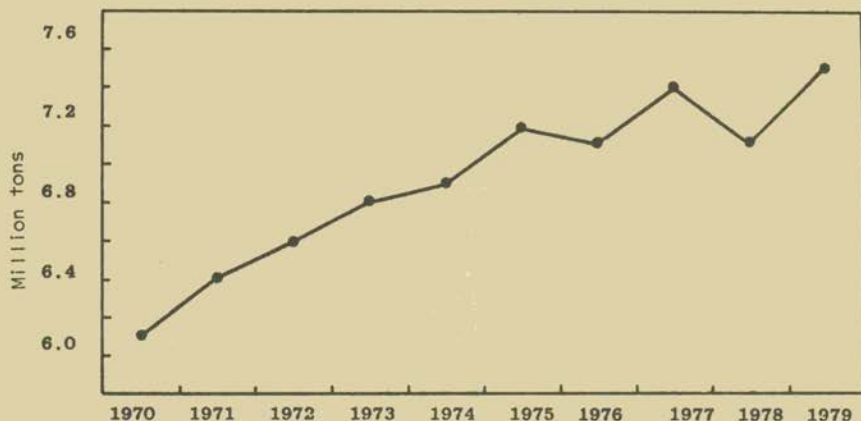


Figure 7. Inland fisheries catches

50. While man-made lakes contribute significantly to economic and social well-being through flood control, provision of water for irrigation, domestic and industrial use, hydropower generation, and fisheries development, their construction has major effects on the delicately balanced natural resources of river basins and their ecological systems. Because of the seriousness of some of their adverse impacts, the economic justification for some of these lakes was questioned in the 1970s.

51. In some places and in some ways, the world was worse off, in terms of water resources, in 1980 than at the time of the Stockholm Conference. Although water accessibility and quality improved in some regions, the absolute numbers of people without access to safe water increased. But there were some positive aspects during the decade. Planning benefited from more and better data and improved understanding, stemming from research. Flood forecasting became more accurate and some major rivers became less polluted. Irrigation practices were improved and extended. Some national water development plans went into action, while internationally, agencies were set up to assist in co-operative development of shared water resources.

#### 4. Lithosphere

52. Earth's crust is a source of benefits and risks to mankind; both enormous wealth and disastrous upheavals originate there. During the decade man exploited the one and suffered from the other. The minerals extracted in ever-growing amounts provided a physical basis for economic advances. The earthquakes, volcanoes and landslides that occurred from time to time retarded them.

53. During the decade, the elaboration of the theory of plate tectonics helped scientists increase their understanding of how and where minerals are formed and how crustal movements take place. These processes, still operating today, are responsible not only for catastrophic phenomena such as earthquakes or volcanic eruption, but also for mineral formation.

54. The definition of mineral resources and reserves and their classification were advanced during the decade, emphasizing the tentative nature of many estimates and the fact that at any one time such estimates are strongly influenced by investment factors. Much argument took place during the 1970s over the increase in mineral consumption and the possibility of depleting mineral resources; in this sense the world mineral situation in the 1970s was, in many ways, similar to the energy situation. Difficulties came to be seen as stemming not so much from exhaustion or absolute depletion of mineral resources as from a recognition of environmental costs involved in the extraction and use of increasingly larger quantities of these resources (especially low-grade ores) as industrial raw materials. Similarly, awareness was growing of the economic and social problems that accrue with the substitution of one particular type of resource for another and of the political consequences of the uneven geographical distribution of individual mineral resources.

55. The annual production of almost all major non-metallic ores expanded during the 1970s; the percentage of increase varied for different ores, depending on demand. Thus while production of fluorite increased by 12.3 per cent during the period 1970-1980 (4.2 million tons in 1970 and 4.72 million tons in 1980), that of the main raw materials for the building industry (gypsum, clay, stone, etc.) increased by from 30 to 110 per cent. With few exceptions, production of metallic ores increased at a low rate (figure 8). Annual production and prices of mineral raw materials fluctuated widely as a result of economic and political conditions.

56. Important improvements were made in the methods used to reduce deleterious effects of the mining, treatment and transport of both metallic and non-metallic minerals. Advances occurred chiefly in dust control, the reclamation of open-pit mines, the reduction of acid drainage and the treatment of tailings and liquid waste. These environmental protection measures have been implemented to varying degrees in some especially developed countries.

57. Recycling and substitution of mineral raw materials received renewed attention during the 1970s. In the United Kingdom of Great Britain and Northern Ireland, for example, an average of 163,000 tons of aluminium, constituting about 29 per cent of the total annual aluminium consumption, were recycled every year during the period 1975-1980. The United Kingdom figures for copper were 211,000 tons/y (33 per cent of total consumption), for zinc 70,000 tons/y (22 per cent of total consumption) and for iron 16 million tons/y (68 per cent of total consumption). As early as 1974 the figures for recycling in the United States of America were (in tons): 29,024,000 iron; 466,756 lead; 438,081 copper and 139,244 aluminium. An important consideration in recycling is that the energy input required to process scrap is substantially less than that needed to process primary ores. For example, in the case of aluminium, the energy requirement for recycled material is some 3-4 per cent of that required to concentrate the metal in usable form from ore; the comparable figures for magnesium and titanium are 1.5 per cent and 30 per cent respectively.

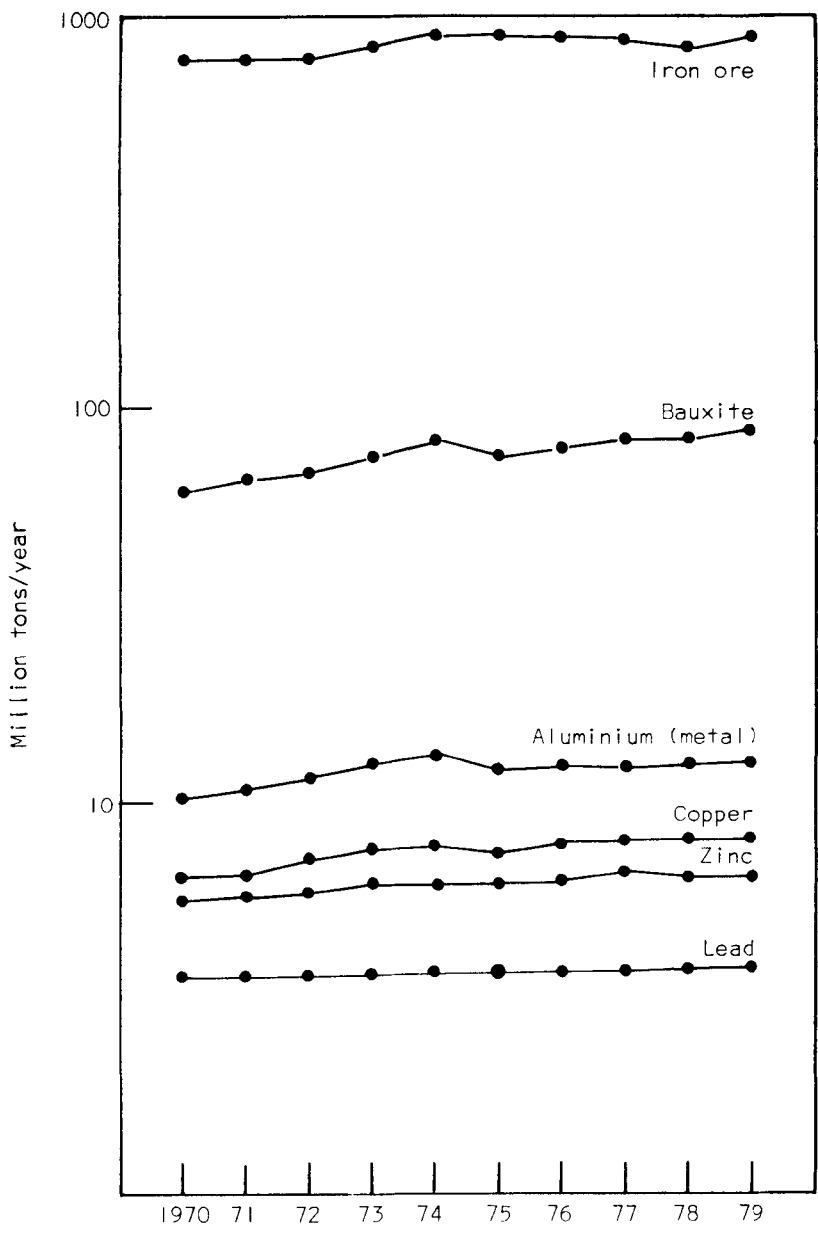


Figure 8. Production of some metallic minerals

58. Earthquakes, volcanoes and landslides claimed their tolls of lives and damaged property during the 1970s, as they had in previous decades. The Tangshang earthquake in China (27 July 1976) was a catastrophe with an intensity reached only seldom in recorded history: it killed at least 242,000 people and injured as many. The decade also saw the first successful prediction of a major earthquake, in the Haicheng area of China in 1975. More reliable warning systems seemed possible, and some progress was made in managing land use and building design and construction in such a way as to reduce risks and severity of consequences on areas vulnerable to earth movements.

#### 5. *Terrestrial biota*

59. Over the centuries, mankind has increasingly modified the assemblages of plants and animals (biomes) found in different regions, and changed the distribution of species and the nature of the ecological interactions between them. Many of these changes have been in inevitable accompaniment to development, but as a consequence, natural flora and fauna have disappeared from great stretches of the continents — especially those that, like Europe, are densely populated and highly developed.

60. Where development has been hampered by poverty or driven by great urgency, the fertility of the land and the stability of the soil have been placed in jeopardy. About 1,000 species of birds and mammals are currently threatened with extinction; about 10 per cent of flowering plant species are also threatened with elimination or are dangerously rare. The need to secure development while at the same time sustaining the productivity of natural renewable resources and protecting wildlife and genetic diversity is the focus of the World Conservation Strategy. In a sense, the Strategy can be looked upon as the culmination of more than a century of conservation efforts from around the world.

61. One of the chief subjects of public concern during the decades was the rate at which the tropical forests (tropical rain forests and forests in semi-arid zones) were being changed — often with considerable loss of fertility. It has recently been estimated that the extent of this destruction is about 11 million hectares a year. Transformation of rain forests in particular was occurring much faster in Africa than in Asia and Latin America.

62. In tropical deciduous forests, savannahs, grasslands, steppes and areas with Mediterranean climate, another problem was paramount: desertification. This process claimed vast areas in many parts of the world in recent decades. It has been estimated that in 1980 the areas affected by desertification totalled 27 million ha of irrigated land, 173 million ha of rainfed croplands and 3,071 million ha of rangelands.

63. The regions containing temperate evergreen forests and broadleaf deciduous forests — which in North America and Europe include some of the most densely populated and highly industrialized regions of the world — were generally well managed and remained fertile. Further north the boreal

coniferous forest zone was, even less affected, although some side-effects of timbering have been reported. During the decade fears were expressed that acid precipitation might retard tree growth over wide areas. The sensitivity of coniferous trees to air pollution was well known from laboratory experiments and observations in areas near smelters. But by the end of the decade there was still uncertainty about the extent of such damage in nature.

64. Although great areas of the Arctic tundra — an ecosystem that provides valuable grazing ground for nomadic tribes — are wilderness, parts of it were threatened, and in some cases severely damaged, during the decade, by the research for minerals, especially oil and gas, and by hydropower generation.

65. Islands, mountains and wetlands, ecosystems of special sensitivity and richness of animal and plant life, had their own special problems. The introduction of continental species to islands has in some cases completely transformed the vegetation. Phosphate and bauxite mining and timber clearing also made a marked impact, as did mass tourism, particularly in the Caribbean. Erosion in mountain areas was accelerated by deforestation, overgrazing, inappropriate cultivation, fire, road building and other factors. Dams and reservoirs sometimes led to flooding in wetland areas. Draining of wetlands was another problem, with coastal wetlands being drastically reduced by agriculture and reclamation for buildings, docks and industrial development. This led to the loss of several genetic resources.

66. On the positive side, the decade saw 14 international agreements that fulfilled recommendations of the Stockholm Conference go into effect. International conferences were held on desertification (United Nations Conference on Desertification, Nairobi 1977) and forestry (Eighth World Forestry Congress, Jakarta, 1978). Conservation measures including the establishment of a significant number of new parks and protected areas succeeded in saving a number of endangered species of plants and animals. Several germplasm banks, including banks for micro-organisms, were established or developed during the decade.

### **C. Man and the environment**

#### *1. Population*

67. The human population of the Earth passed the 4,400 million point in 1980, an increase of more than 700 million over the world population in 1970. In the last five years of the decade, the annual rate of population increase was 1.72 per cent, while in the first five years of the decade it had been 1.94 per cent. The annual rate of increase diminished in all regions of the world except Africa (figure 9). In 14 developed countries, human reproduction rates fell to — or below — replacement levels. The importance of these trends is clear, since many environmental problems have their roots in population growth. The increase in world population exerts considerable stress on the Earth's limited resources. This is particularly true in regions where population growth is fast and natural resources are scarce. The relationship between population and natural resources could be illustrated by

continued population growth in the developing countries at a rate of 2.1 to 2.2 per cent a year, which would require an increase of food supplies available to them by at least 4 per cent annually. This could only be achieved through either massive imports of food or greatly stepped-up agricultural production. Both have their socio-economic, technological and environmental impacts, some of which could be quite negative.

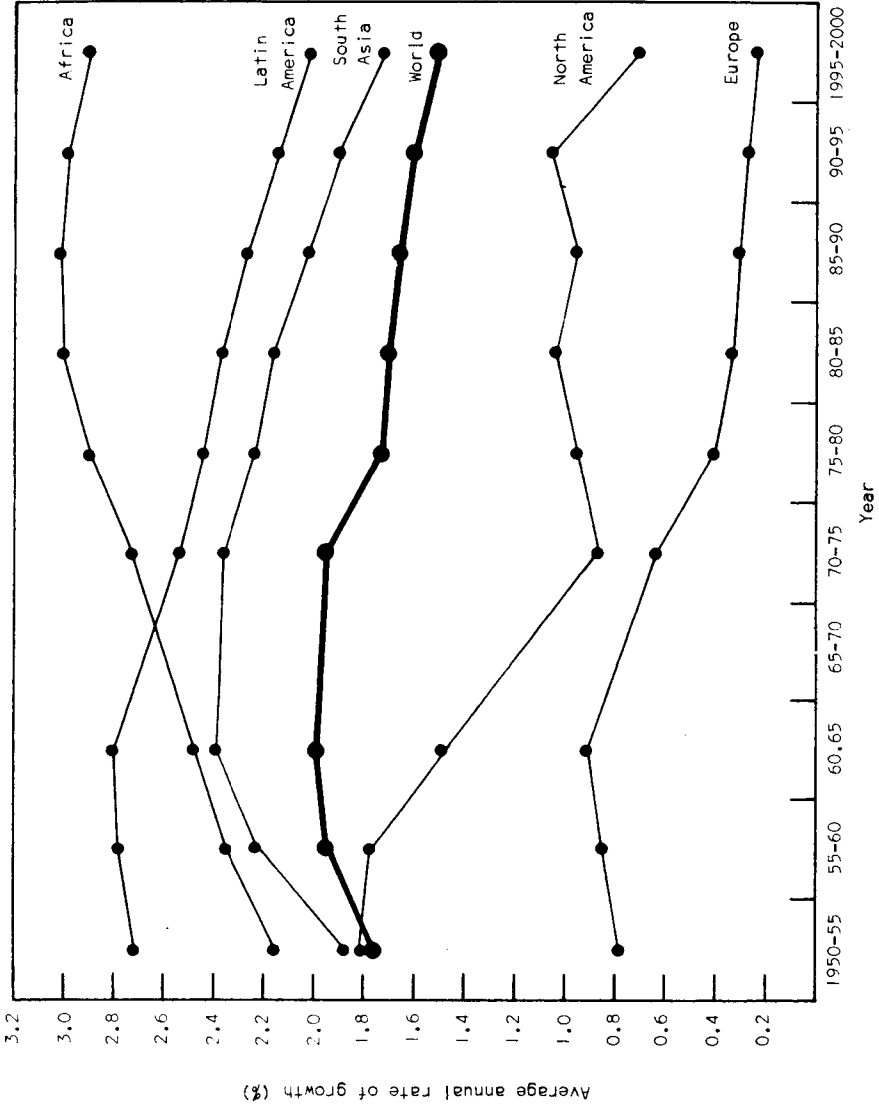


Figure 9. Annual rate of population growth (by region)



68. Where a drop in birth rates occurred, it was attributed chiefly to a growth in the number of women of childbearing age using contraceptive methods, delayed marriage in some regions, a desire to limit births because of such factors as increased childbearing costs, and the reduced roles of children in agriculture and certain industries and the consequent decline in their economic value to their families. Life expectancy at birth increased from 55.8 years in 1970-1975 to 57.5 years in 1975-1980; in developed countries the figures were 71.3 and 71.9 years, in developing countries 53.1 and 55.1 years. This difference between developed and developing countries is largely due to the difference in infant mortality.

69. During the decade the dispute over the relative roles of socio-economic conditions and family planning programmes in reducing birth rates was largely resolved: evidence showed that higher socio-economic conditions accompanied by family planning led to reduction of birth rates. Family planning programmes were widely adopted, and in 26 developing countries with substantial efforts the birth rates were reported to have declined by 14-40 per cent between 1965 and 1975 (although recent census data suggest somewhat slower declines in some countries).

70. Despite the moderation of population growth, it continued in many developing countries faster than education, health, sanitation, transport and other public services could be provided. And international support for population policies began to flag at precisely the time when commitment to family planning was spreading.

71. Large numbers of people continued to migrate from one country to another during the decade. Until the early 1950s, the main migration routes in recent history were from Europe to the Americas, Australia and New Zealand. During the 1970s, a change occurred: the main routes were now from developing to developed countries and to OPEC countries. By 1980 about 2 million workers from developing countries had migrated to oil-rich northern African and South-West Asian countries. A great number of skilled workers (teachers, technicians, etc.) are also temporarily located in these countries under contracts.

72. Wars and political upheavals added to the stream of people crossing international borders during the 1970s. The numbers generated each year have increased from about 2.5 million in 1970 to 7.5 million in 1980 (the total number of refugees in the period 1970-1980 has been estimated at 28 million) and have placed heavy stress upon the resources of the receiving countries. The statistics on numbers of refugees moving out of their homelands do not reveal the proportion returning or finding a new home. Altogether, the number of unsettled refugees was estimated to be of the order of 8-10 million; in 1980 there were some 3 million refugees and displaced persons in Africa for whom permanent solutions had not been found, in addition to large numbers in various parts of Asia.

73. An underlying theme of the 1970s was the recognition that development is a multidimensional concept that encompasses not only economic and social aspects of national activity but also those related to population, the use of natural resources and management of the environment. During the decade a series of efforts were made to specify the relationship among people, resources, environment and development as one means of indicating the conditions in which environmentally sound and sustainable development might be achieved. Although, in principle, large-scale models appear to be a way of incorporating a vast array of variables and interdependences, none of the existing models in their present form is yet adequate to serve as a conceptual framework for the study of these factors.

## 2. Human settlements

74. The urban population of the world increased from 1,350 million in 1970 (37.5 per cent of world population) to 1,800 in 1980 (41.3 per cent), but the annual rate of urban growth remained at 2.9 per cent, as in the 1960s. Regional differences are significant, the percentages of urban populations in 1970 and 1980 being: Africa (22.9 and 28.9), East Asia (28.6 and 33.1), South Asia (20.5 and 24.8), Latin America (57.4 and 64.7), North America (70.4 and 73.7), Europe (63.9 and 68.8), Oceania (70.8 and 75.9), USSR (56.7 and 64.8). The rural population, although decreasing in percentage terms, also increased in absolute numbers, from 2,310 million in 1970 to 2,600 million in 1980.

75. The decade of the 1970s marked the mid-point in a gigantic transformation of human settlements patterns (figure 10). In developed countries, where previously the majority of the world's largest cities were to be found, growth began to dwindle in what had been known as urban areas and a process of spread into the surrounding areas was under way, while in developing countries it not only continued to climb rapidly, but for the first time produced more big cities than in the developed regions. In 1950, there was only one city (greater Buenos Aires) in the developing countries with a population over 4 million. In 1960 there were eight cities that had reached or exceeded that size, compared to 10 cities of the developed regions. By 1980, there were 22 cities in the developing regions with more than 4 million population each, whereas in the developed regions there were only 16 such cities. So rapid was the urban growth rate in developing countries that it seems certain that if this trend continues the number of people living in cities will double by the year 2000. Projections suggest that the developing countries by that time will have about 61 cities of more than 4 million each, compared with about 25 in the developed regions. Eighteen cities in developing countries are expected to have more than 10 million inhabitants each by that year. Because this growth took place against a background of low incomes, it outstripped these countries' abilities to provide both accommodation and services, and the result was a mushrooming of squatter settlements around the perimeters of vast cities. From 20 to 80 per cent of the urban populations of various cities lived in these shanty towns.

76. Conditions for people living in urban areas of the developing world improved hardly at all during the decade. Rural settlements were generally no

better off, while dwellers in squatter settlements and slums were increasingly faced with a lack of safe water and waste disposal facilities. Overcrowded housing was a common feature in both rural and urban settings, with three or more persons frequently occupying a single room.

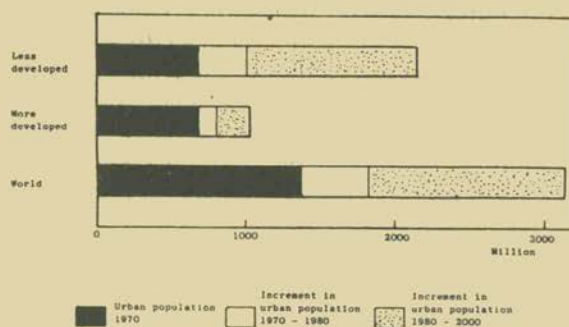


Figure 10. Trends in urbanization

77. Nevertheless, some important innovations were introduced in the developing countries, and for the first time a positive, citizen-oriented approach was taken towards squatter settlements. Self-help programmes and community development were probably the most significant advances among low-income populations, but they were also helped by more flexible building codes and regulations to permit the requirements of these groups to be met. At the national level the emphasis in development policies shifted from maximizing economic growth to improving the quality of life for the poorest. More attention was given to equality in access to employment, shelter and basic resources, the use of indigenous materials in buildings, energy conservation, some solutions to transportation and land-use problems, and rehabilitation and upgrading of older structures. Citizen participation in decision-making about human settlements increased, with the encouragement of Governments.

78. In developed countries, the major urban issues during the decade were the deterioration of inner city areas, the need for energy conservation as a result of rapidly increasing fuel costs, and public participation in improving the quality of life. Waste disposal was a growing problem because of increasing consumption of consumer goods and extravagant packaging. Pollution of watercourses by garbage and industrial chemicals increased. The change from fast economic growth and suburban expansion to decreasing growth rates, the emergence of environmental concerns, more turbulent social conditions, and strained economic circumstances constituted a challenge that will continue into the 1980s.

### 3. Human health

79. The heightened environmental awareness of the 1970s extended to human health. Although it was recognized that both environmental and

genetic factors interact in disease production, the importance of environmental determinants was emphasized — for example in water supply, urban environmental quality, climate and the pattern of human contacts. Environmental factors play a major role in the transmission of communicable diseases, which accounted during the decade for a large proportion of illness and death in developing countries. In developed countries, quite different kinds of environmental factors played an equally important role in producing the degenerative diseases that predominated there.

80. Each year during the decade six diseases (diphtheria, pertussis, tetanus, measles, poliomyelitis and tuberculosis) accounted for the deaths of some 5 million children in developing countries, and made a comparable number liable to severe disabilities including blindness, paralysis and mental handicap. WHO responded by developing its Expanded Programme of Immunization to reduce sickness and death from these six diseases by providing immunization against them for every child in the world by 1980. The diseases that showed a downward trend during the 1970s included smallpox, onchocerciasis and schistosomiasis. Smallpox was totally eradicated by 1980. Onchocerciasis, although its transmission was reduced, remains a serious threat, especially in tropical river basins. Various forms of schistosomiasis are still serious health hazards, although the decade saw advances in chemotherapeutic treatment and integrated control of snail hosts.

81. The prevalence of malaria, cholera, meningitis and dengue haemorrhagic fever increased during the 1970s. Malaria continued to be the most important single disease in sub-Saharan Africa and one of the most significant elsewhere in the tropics. In Africa approximately 50 per cent of children up to the age of 3 were infected, and it was estimated that one million children died from malaria every year. DDT spraying in the 1950s and 1960s had produced dramatic reductions, but during the 1970s there was a resurgence of the disease. In India, for example, the incidence of infection rose from 40,000 in 1966 to 1.4 million in 1972 and 6 million in 1976. While environmental and economic factors contributed to the general resurgence of malaria, the most important ones were insecticide resistance in the mosquito, and drug resistance in the parasite.

82. Concern over the impact on human health of chemicals in the environment increased in recent years and resulted in the vigorous development of a number of new international programmes such as the UNEP/ILO/WHO International Programme on Chemical Safety (IPCS), the International Register of Potentially Toxic Chemicals (UNEP), and the Chemicals Group Programme of OECD, and in the enhancement of work to assess the carcinogenicity of large numbers of chemicals by the International Agency for Research on Cancer (IARC). Epidemiological information on the effects of exposure to various chemicals has been accumulating, along with information derived from animal experiments, but there are still major uncertainties as to the effects of protracted exposure to very low concentrations of virtually any chemical. There is thus a widening gap

between the data that new analytical techniques are now making available on ever-smaller amounts of chemicals, in the environment and in the human body, and the degree of understanding of their effects on man and other organisms. However, controls were introduced in a number of countries to ensure that admissible daily intakes through food were not exceeded. Likewise, action was taken in a number of countries to reduce exposure to pollutants through inhalation of air and ingestion of water. Monitoring activities for the surveillance of pollutant levels in air, food, water and human body fluids and tissues, as well as for the study of their time and space variations, were variously expanded in many countries during the decade, food and water contamination in particular having become a subject of increasing concern not only in industrialized countries, but in developing ones as well.

83. Understanding of the respective role of environmental and genetic factors in the production of cancer advanced. Ionizing (e.g. X-rays) and ultra-violet radiation, nitrosamines, fungal toxins, pyrrolizidine alkaloids, biological agents and industrial chemicals received particular attention. Several studies were undertaken of a possible threat not even conceived a decade previously: the health effects, in particular skin cancer, that might follow depletion of ozone in the stratosphere as a result of the continued use of certain chemicals, primarily chlorofluorocarbons.

84. Although there has been a substantial increase in average food supply in industrialized countries in both absolute and per capita terms, in the developing countries the increase was slight, just keeping pace with the rise in population. The main problem in the 1970s was the unequal distribution of food within and between countries, and the situation was least satisfactory in Africa and the Far East. Malnutrition remained a major underlying cause of death and illness in many developing countries, where 30 to 40 per cent of children under the age of 5 are significantly undernourished. In developed countries, in contrast, obesity increased, and its role and that of nutrition in promoting cardiovascular disease were explored. The importance of nutrition and life-style as determinants of health gained fresh recognition. Health-conscious groups paid increasing attention to exercise, reduction of salt intake and animal fats, and other factors believed to influence cardiovascular disease. The role of smoking as a dominant cause of lung cancer and serious influence on other cancers and coronary heart disease was confirmed, and in the late 1970s there was a slight drop in tobacco consumption in industrial countries. Alcohol and drugs caused increasing concern, and the importance of environmental factors in mental health was widely appreciated.

85. Despite these improvements in understanding of environment-health relationships, there was little improvement in the health of the vast populations inhabiting rural and shanty towns in many developing countries, where pollution in terms of microbial contamination is predominant. Efforts were made to expand health care for such people, but it was clear by 1980 that political commitment and resource availability would be the dominant factors in improving the situation.

#### 4. *Bioproductive systems*

86. Over the world as a whole, cereal production rose from 1,315 million tons in 1971 to 1,596 million tons in 1978; the production of pulses, fruits, nuts and vegetables also increased. In 1979, however, world cereals production fell to 1,553 million tons, largely as a result of shortfalls in the USSR, South Asia, and several African countries. Meat production rose by about 30 million tons between 1971 and 1979; milk and egg production also increased. In spite of such increases in food production, more than 450 million people were chronically hungry or malnourished during the 1970s, largely because of inadequate food distribution within and between countries of the developing regions. FAO estimated that a 60 per cent increase in food production would be needed to maintain current patterns of consumption, assuming a rise in world population to 6,300 million by the year 2000.

87. The decade's production increases resulted largely from bringing new areas under cultivation or irrigation. For example, following India's dramatic successes in the "green revolution" of the 1960s, more and more land was irrigated. Rangeland management was improved in those areas where overgrazing was brought under control. However, in many countries agricultural land was being eroded and transformed other uses, thus reducing productive potential. In developed countries alone, more than 3 million hectares of productive agricultural land appear to have been transformed to settlements and roads during the decade. Worldwide, this figure may have been around 5 to 7 million hectares.

88. Soil degradation — erosion, salinization and alkalization and chemical degradation — occurred in all parts of the world to varying degrees and caused production losses. According to various estimates, between 30 and 80 per cent of all lands under irrigation have been subject to salinization, alkalization and waterlogging. Salinization and waterlogging are believed to be seriously affecting 200,000—300,000 hectares of the world's best land each year.

89. Desertification continued on a broad scale during the decade: some 6 million hectares of land were destroyed or impaired annually as a result of severe and recurrent drought and irrational human exploitation. A more comprehensive measure of the damage caused by desertification is the area of productive land deteriorating each year to a level at which it yields zero or negative net returns. In 1980, annual land degradation following this definition was assessed at 20 million hectares. Between 600 and 700 million people were threatened by this deterioration. Most of the cures for desertification are well known, but although a United Nations Conference held in 1977 produced a Plan of Action to Combat Desertification, these cures had not been put into effect in much of the world by 1980. Four main obstacles to the implementation of the Plan of Action were identified: the insufficient priority given to the subject by the Governments concerned; the lack of adequate funds to support activities to combat desertification; the

need to strengthen co-operation and co-ordination within the United Nations system to deal with the problems; and the need for accelerated research and development to fill the gaps in knowledge, especially of the social-cultural dimensions of desertification.

90. The decade marked the beginning of what may be a new era in biological production: the bio-technological era. Advances in genetic engineering made possible the production of many valuable substances with the aid of microbes and their enzymes. Production of insulin, interferon and some vaccines in this way was shown to be possible. There were prospects for developing cereal crops capable of increasing the fixation of atmospheric nitrogen. The Earth's bioproductive system may in future have to produce not only food, fibre and timber, but also industrial materials and fuel. This has caused increased competition for land, a trend that will become more pronounced in future.

91. Concern continued about the side-effects of agricultural chemicals on the environment. The consumption of fertilizers was about 69 million tons in 1970/1971, and increased to about 107 million tons in 1978/1979 (figure 11). Nitrates from nitrogenous fertilizer residues polluted ground and surface waters, with consequent hazards to aquatic life and human health. Chemical pesticide usage also increased greatly (figure 12), with adverse effects on some animals, fish and birds. Yet crop losses were so great in some places that there were strong arguments for using more pesticides, rather than less. At the same time, the demand for increased testing of new pesticides for environmental effects was slowing their introduction by industry, and meanwhile, pests in ever-increasing numbers were developing resistance to the older types. This led to a shift in emphasis to integrated control with ecological and habitat measures occupying a central role in research and applications.

92. During the decade, public concern was expressed about effects of airborne pollutants on crop plants, forest trees and livestock.

93. Post-harvest losses of crops caused concern: post-harvest losses in durable crops (cereals and legumes) in the developing countries was estimated at a minimum 10 per cent a year, and in perishable crops (root crops, vegetables, fruits) no less than 20 per cent. In some regions, the figures are much higher: for example, South-East Asia rice losses were estimated to range up to 37 per cent of the crop. In past years, measures and technology to reduce such losses have markedly advanced. Product processing on the spot (canning food and drying vegetables, grain and fruit) is one such measure. The use of better storage facilities is another.

94. Total roundwood production increased during the decade, though at a less rapid rate than during the 1960s. Almost half of total world production, and in individual developing countries up to 80 per cent of their production, was still used for fuel.

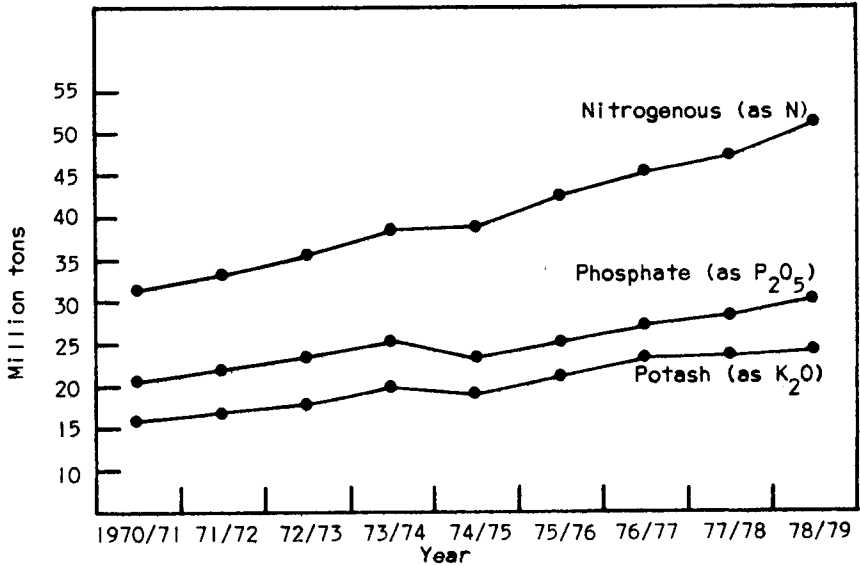


Figure 11. World consumption of fertilizer

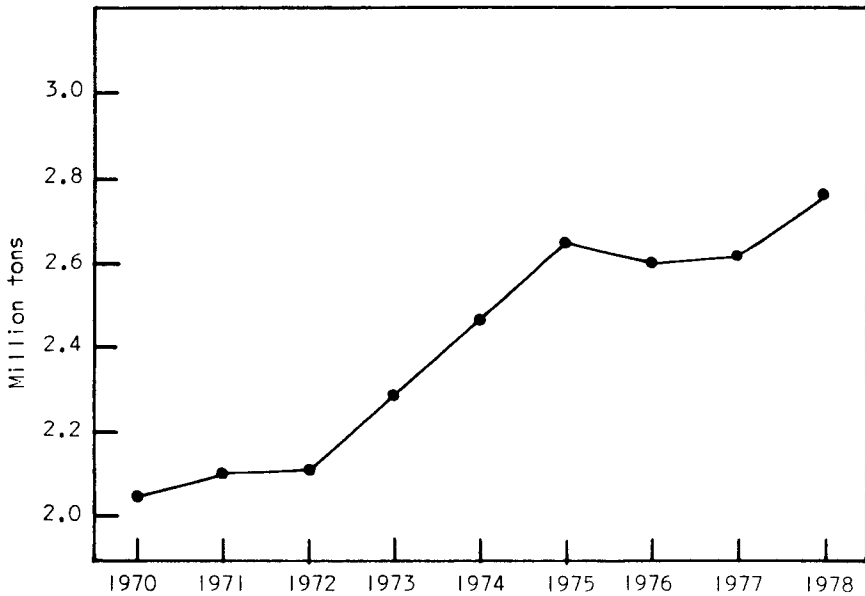


Figure 12. World consumption of pesticides, fungicides, etc

95. As the decade ended, the priorities for the next decade in agriculture and forestry were clear: more action was needed to stop the loss of arable soil and desertification, to manage forests and water wisely, to use appropriate methods of cultivation, to develop environmentally sound pest control methods, and to reduce losses of food actually produced.



## 5. Industry

96. The 1950s and 1960s were an era of rapid industrial development with little regard for environmental consequences, but during the 1970s two factors changed. For economic reasons there was a slow-down in industrial production by comparison with the contributions of other sectors to gross domestic product in many parts of the world. As a major source of pollution, industry came under pressure to conform with higher standards for the living and the working environments. The need to protect the occupational health of workers was more widely recognized during the decade.

97. Yet by the end of the decade, industry was seen as only one source of pollutants, and it was recognized that because industrial activities help raise living standards in most countries, controls should be adopted with due regard to their implications for national economic well-being. It was also apparent that wise management required a sound scientific understanding of pollutant sources, pathways and impacts.

98. In the developing world, economic growth was given first priority during the 1970s. A United Nations conference in Peru in 1975 set a target that the share of developing countries in total world industrial production should rise from the then current 8.6 to 25 per cent by the year 2000. As the 1970s passed, progress toward that goal was slow.

99. The decisions made by industrial managers, whether in the private sector or government, were influenced by two sets of factors that evolved during the decade: (a) public efforts to improve environmental quality; and (b) industrial efforts to introduce new production techniques, relying on alternative materials and waste treatment to reduce or eliminate effects harmful to people and ecosystems.

100. Some public efforts took the form of more specific industrial regulations and standards for the work-place and for controlling emissions. Others consisted of experiments with economic incentives and disincentives. By 1980 there were the beginnings of systematic analyses of the full range of social costs and benefits of such measures: some of these reviewed the proportion of new investment devoted to pollution control and to possible effect on prices. It was suggested that the negative effects of environmental regulations on rate of growth were likely to be small, and that over-all costs of pollution control measures in developed market economy countries were of 0.75-2 per cent of GNP. Product price increases due to pollution control varied greatly. In the United States of America in the early 1970s, the percentage of such price increases ranged from 1 per cent for food products to 4.6 per cent for petroleum refining. Environmental regulations were seen to confer substantial societal benefits, including a healthier environment, the employment stimulated through the creation of jobs in the pollution control equipment industry and for those operating and maintaining this equipment. Considerable resources were devoted to pollution control in a number of countries. For example, in Japan five major industries (steel, petroleum, thermal power, pulp and paper and chemical) had a combined capital

investment of \$3.3 billion in 1974 to meet environmental regulations. For the United States of America, it was reported that in 1975, \$5.6 billion was invested in pollution control. In 1979, 57.3 per cent of investment for pollution control in Japan was for air pollution control, 20.6 per cent for water pollution control, 8 per cent for control of noise and vibration, 4.3 per cent for industrial waste disposal and 9.8 per cent for other protection measures.

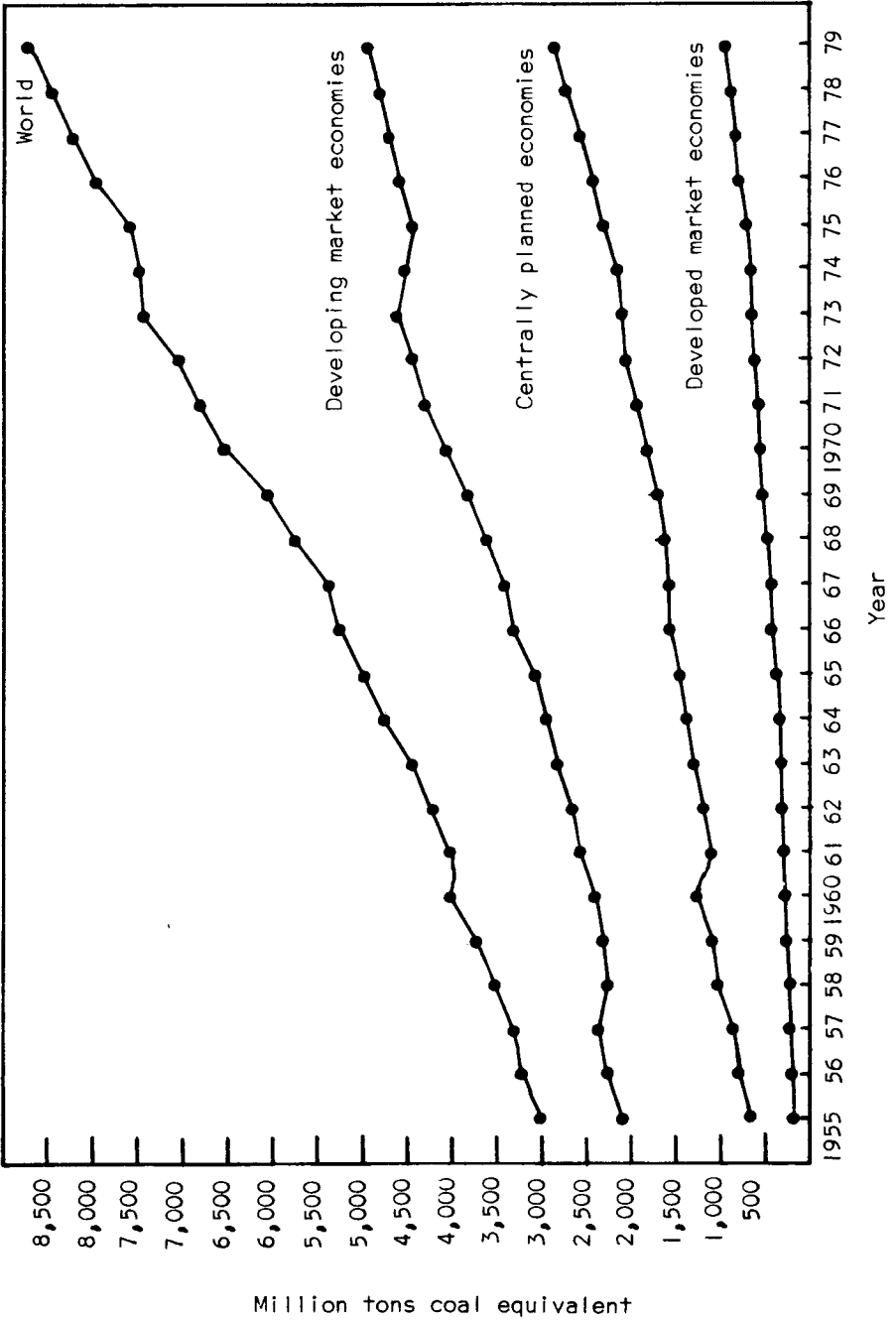
101. Several successful measures to reduce pollution (including noise) and waste through improved technologies were reported by a number of industries. For example, in the chemical industry progress was made in increasing the efficiency of conversion in sulphuric acid manufacture from 97.5 per cent to 99.5 per cent, which is equivalent to emission reductions from about 17.5 kg/t to 3.5 kg/t of sulphuric acid manufactured. The pulp and paper industry uses large quantities of water, and the costs of waste treatment are affected by the volume of effluent. Recently constructed mills reduced the liquid effluent discharge from 180 m<sup>3</sup>/t to 70 m<sup>3</sup>/t to pulp; and by incorporating advanced system technique and staff training it was possible to lower that discharge rate to 20-30 m<sup>3</sup>/t of pulp. The petroleum industry reduced its waste water output, and the iron and steel industry was able to cut down smoke and dust emissions. Apart from its very high energy use, the manufacture of aluminium by the reduction process forms toxic fumes, in particular fluorides and carcinogenic tars. Emissions are controlled with electrostatic precipitators and wet and dry scrubbers, and by 1980 the goal for new plants was to allow no more than 1 kg of combined gaseous and particulate fluoride to be emitted per ton of aluminium produced. Improved production techniques significantly reduced power consumption in the reduction process to an average of 16,400 kWh/t and a number of plants were consuming less than 13,700 kWh/t. The nickel industry recycled tailings water to minimize contamination of public waters and tried to control wind-blown dust from fine tailings through wetting and revegetation of worked-out areas. And the lead-zinc industry recycled water for pollution control.

102. Unfortunately, by the end of the decade, adequate data were not available on the extent to which these improvements were carried out on a world scale, and what were the social gains and losses, but a searching reappraisal of industry's role in environmental protection was under way.

## 6. Energy

103. The 1970s saw a revolution in thinking about energy supplies. The "oil crisis" of 1973 brought home the fact that fossil fuels were finite, precious, and likely to be increasingly expensive.

104. World commercial energy consumption rose by about 34 per cent between 1970 and 1979 (figure 13), a rate lower than the 58 per cent increase between 1960 and 1970. About 80 per cent of the total consumption was in developed countries, where *per capita* consumption was 15 times that in



Million tons coal equivalent  
 Figure 13. World commercial energy consumption

developing countries (figure 14). Oil remained the most widely used fuel. The oil price increases of 1973 and 1979 therefore had severe consequences, especially for developing countries, some of which ended the decade spending 25 to 65 per cent of their foreign exchange earnings on oil imports.

105. The changed perceptions during the decade led people to question how supplies of non-renewable fossil fuels would be available at acceptable prices, and how such resources would last. In 1980 it was estimated that the world's proved recoverable coal reserves would suffice for about 230 years at current consumption rates. Proved recoverable reserves of oil and gas were smaller: at the 1980 consumption rates oil supplies would last for only 30 years (but with estimated additional resources for about 70 years). Gas supplies would last for about 50 years (but with estimated additional resources for about 130). By the decade's end it was therefore clear that new mixes of energy sources would be needed in future, that energy and environment relationships must be incorporated in national planning, and that something must be done to increase the efficiency of energy production and reduce waste.

106. But there was another fuel crisis during the 1970s — a shortage of fuelwood, which (with charcoal and agricultural residues) still provided 30 to 95 per cent of the total energy used in developing countries. Non-commercial sources were predominant for some 2.5 billion people in regions where animal and muscle power were the engines of agriculture, and such people spent a large proportion of their time looking for fuelwood.

107. Many developed countries expected to use more coal in the near future, as oil supplies dwindled. In order to prevent environmental damage, research and development sought technologies for fuel pre-treatment, controlled combustion processes, and flue-gas desulphurization to ensure that increased coal burning does not lead to greater sulphur oxides emissions. Ways were also sought to reduce nitrogen oxide and carbon dioxide production during coal burning, as were methods of curbing environmental devastation from future oil shale and tar sand extraction.

108. Debate about nuclear power generation, which began in the late 1960s in the United States of America, was renewed in 1970s. While nuclear power generation contributed only about half of one per cent of the ionizing radiation dose received by the average person, controversy increased, particularly following some widely publicized reactor accidents and uncertainties over waste disposal practices. The number of nuclear reactors ordered peaked in 1973 and then declined sharply. By 1979 nuclear energy provided about 7.6 per cent of the world's electrical power, over 90 per cent of the installations being in OECD countries. Uncertainty continued about the adequacy of uranium reserves for the future, and this was one reason for interest in alternative nuclear fuel cycles.

109. Renewable energy sources attracted increasing attention during the decade. Hydropower contributed 23.7 per cent of world electricity in 1970, and a substantially greater absolute amount (though a slightly smaller

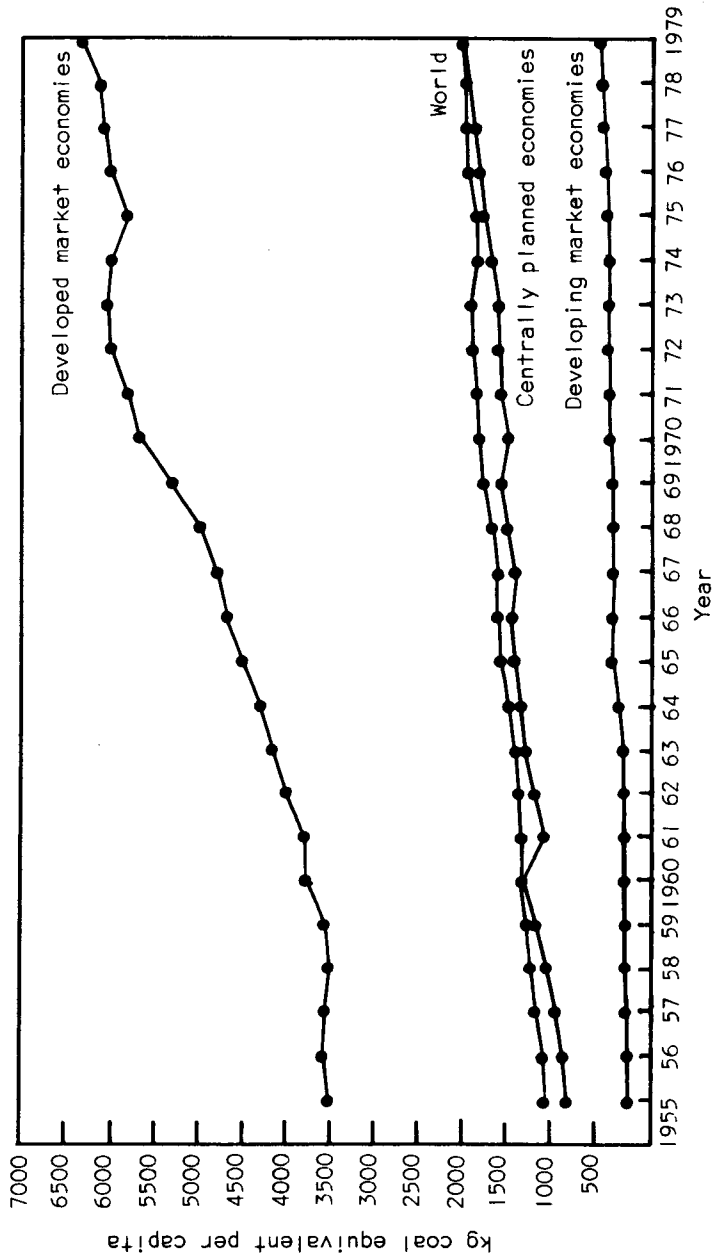


Figure 14. Per capita energy consumption

share, 21.6 per cent by 1979). Great hydro potential remained untapped in Africa and Asia, but the development of hydropower schemes and associated man-made lakes has to be carefully assessed and their environmental costs and benefits determined. Geothermal, solar, tidal, wave and wind power were less developed, but all were studied. Simple solar systems proved their worth in water heating, grain drying and water distillation. Biological energy sources also expanded: fuelwood conservation measures were implemented, better techniques for charcoal production developed, and biogas production expanded, especially in Asia. Crop growth for ethanol or methanol production for fuel was expanded.

110. "The conserver society" became a catch-phrase as energy conservation was stressed in developed countries. Several reduced their ratio of energy use by GNP by over 10 per cent. Increased energy efficiency seemed certain to become a feature of coming decades, but in 1980 development of environmentally acceptable energy mixes remained a research priority. Investment in research and development of new and renewable source of energy was increasing.

### *7. Transport*

111. Transport continued to be an essential component of development during the 1970s, and there were parallel trends in developed and developing countries, although with substantial contrasts. For example, animal power remained important in developing countries; two-thirds of Indian rural transportation was by animal-drawn vehicles carrying perhaps 15 billion ton-km of freight per year. Pedestrian travel remained a dominant mode of travel in urban areas even in developed countries, where cycling may have increased during the 1970s.

112. Rail freight transport increased in both developed and developing countries, although unevenly from country to country. There were also international differences in the trends in passenger rail travel. In France, for example, this increased from 41 billion passenger-kilometres in 1970 to 52 billion in 1977; a similar trend was reported in some developing countries. However, in Czechoslovakia, the Federal Republic of Germany, the United Kingdom and the United States of America, there was a decline in passenger travel by rail in the decade, due to a switch to other modes. Railway technology has changed substantially in recent years with trains being improved in speed and comfort.

113. The dominant feature of the world transport scene in the 1970s was the continuing rapid growth in use of motor vehicles, especially passenger cars (figure 15). During the decade, the cost of private motoring in terms of energy consumption, pollution, congestion and noise led some governments to attempt to brake it by supporting public transport — including unconventional paratransit systems. The pace of technical development of vehicles that were quieter, less polluting, safer, and more economical users of fuel accelerated in response to mounting environmental concern and to the energy crisis.

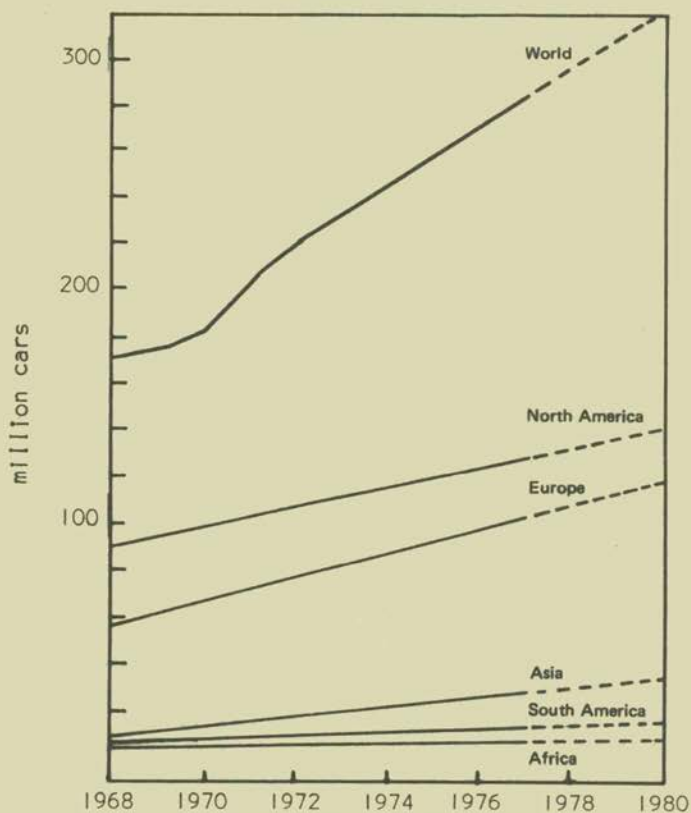


Figure 15. Regional growth in numbers of passenger cars

114. Other kinds of transport also grew. In 1977, 27 per cent more goods were moved by pipeline in the United States and western Europe than ships at the end of the decade than at the beginning, and a 77 per cent increase in tonnage. In terms of cargo transported, crude oil and oil products constituted some 66 per cent of world seaborne trade during the decade. In 1977 there were nearly 7,000 tankers, totalling about 340 million deadweight tons (dwt) as against 3,500 totalling 37 million dwt in 1954. The size of vessels has increased dramatically, the largest in service in 1954 being around 30,000 dwt, whereas in 1980 there were several ships exceeding 500,000 dwt. Between 1975 and 1980, however, the annual growth in oil transportation slowed and became approximately stable. Between 1970 and 1979 the number of passenger-kilometres in air travel more than doubled (figure 16) and a smaller trend was observed for air freight. This marked increase in civil air transport was made possible through great technological advances in navigation and aircraft design and construction in the 1970s, and major airport construction and expansion.

115. The impact of this growth in different transport modes was considerable. Motorways in the OECD countries more than doubled in length, while other main roads were extended by about 12 per cent.

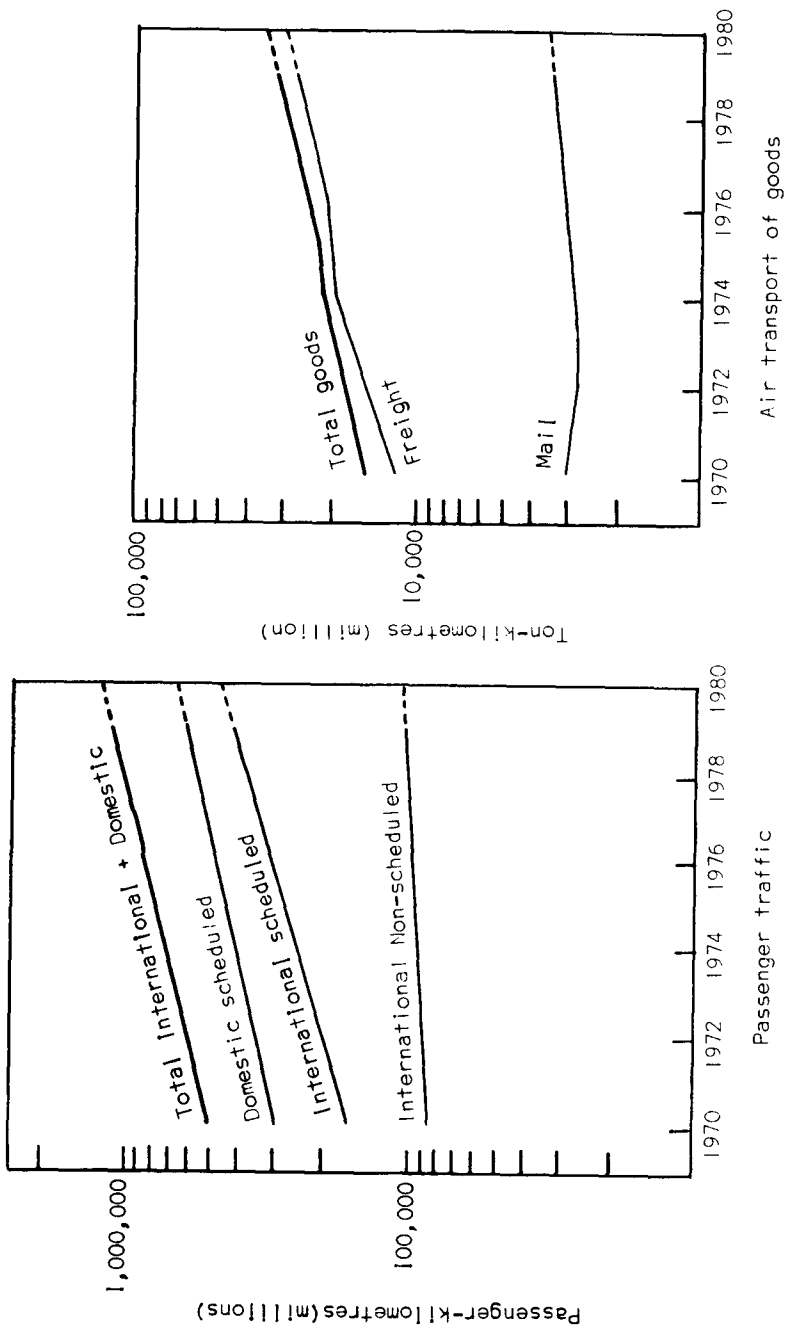


Figure 16. Growth of air transport



Substantial areas of farmland were lost, and large amounts of raw material consumed (according to one estimate, building the world's 280 million passenger cars consumed about 6 months total world production of the metals used). Energy consumption by transport doubled in some countries, and accounted for 15-33 per cent of total national energy use in OECD States. Transport remained the largest single source of marine oil pollution, causing about 35 per cent of such pollution (figure 5).

116. Road accidents continued to be a serious consequence of transport growth: about 250,000 people were killed in them every year during the decade. Fatalities declined in some countries, but in many others — notably developing countries — accident rates increased because of increasing traffic and lack of training and safety measures.

117. The adverse environmental and social effects of transport were moderated in a number of ways during the decade. Vehicles were improved to meet stricter pollution abatement, noise, energy consumption and safety standards. Transport management routed vehicles, ships and aircraft in ways designed to reduce accident risk, noise and nuisances. Education and training were used to influence people's behaviour and their perceptions of risk.

118. One predicted problem did not arise: the reduction of stratospheric ozone by supersonic aircraft ceased to be a matter of great concern, partly because such aircraft did not fly in the numbers expected.

119. At the end of the decade, the main problems lay in achieving an efficient balance between transport modes, in improving energy efficiency and preparing for new fuels in the post-oil era, in continued reduction of accidents and pollution, in ensuring that effective public transport systems were maintained even in the many developed countries where private cars remained the dominant mode of travel, and in adequate planning of land use to meet the demands of transportation.

## 8. *Tourism*

120. The number of international tourist arrivals increased over the decade by more than 100 million: from 174 million in 1971 to 286 million in 1980 (figure 17). By the end of the decade international travel was a major concern of many countries, contributing a substantial share of their national income. But while tourism brought much foreign exchange to countries in need of it, part of the foreign exchange went abroad to pay for the goods and services used by tourists.

121. The social effects of tourism were also mixed. Sometimes tourism resulted in relocation of residents of an area and damage to their economic interests. Sometimes it caused inflation and changed life-styles among local people, or challenged their cultural beliefs. It had both bad and good effects on the arts, on the one hand resulting in production of articles without artistic merit, while on the other revitalizing dying crafts.

122. The environmental effects of tourism were both negative and positive. The need to attract tourists led in some places to protection of the physical environment, historic sites and monuments, and wildlife. But the mass movement of tourists also transformed some areas and brought irreversible environmental damage. Tourist facilities marred many coastlines, while the tourists themselves choked the narrow streets of historic towns and crowded picturesque countryside. Their uncontrolled curiosity damaged fragile ecosystems on islands, coastal lands and mountains, and their increasing numbers contributed to the pollution of coastal waters. In some areas tourists left behind a trail of litter, erosion and forest fires.

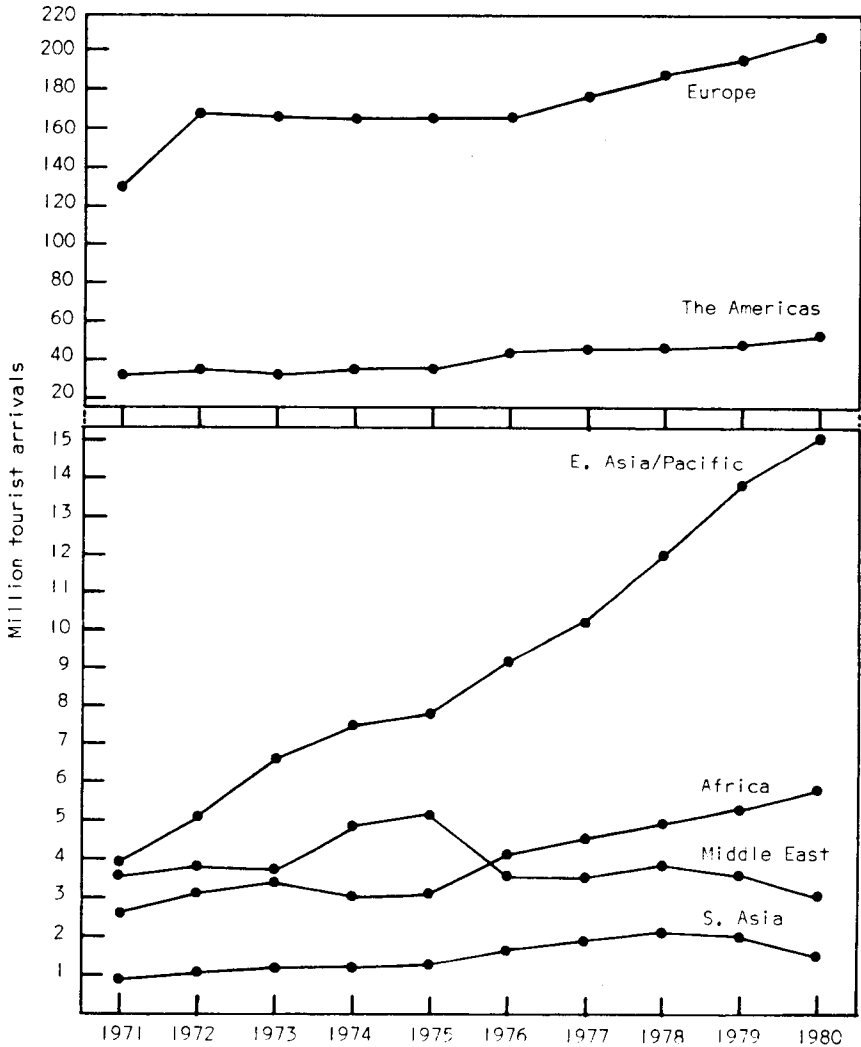


Figure 17. International tourist arrivals

123. In many areas during the 1970s the limits of desirable tourist influx were being reached, so that planning was a challenge for the 1980s. Environmental damage caused during the decade was often the result of poor planning of individual tourist schemes and poor planning for growth. It was clear that some damage was counter-productive for the industry itself.

124. A key principle advocated by those who sought a balance between tourism and the environment (Manila Declaration 1980)<sup>5</sup> was that the type and scale of tourist development should be related to the carrying capacity of different ecosystems. Assessment of such capacity — and balancing the level of tourist activity within it — were thus seen as crucial means of preventing future environmental damage. By the end of the decade, tourism's impact on both the physical and the socio-cultural environment was substantial and widespread, and expected to increase. The prime planning initiative was seen to rest with national Governments, but because tourism is worldwide, there could usefully be collaboration on both a regional and an international scale in order to find a sustainable balance between tourism and environment.

#### *9. Environmental education and public awareness*

125. The Stockholm Conference provided an impetus for renewed interest in environmental education during the 1970s. In response to the Stockholm Recommendations, UNESCO and UNEP set up an International Environmental Education Programme which aims at promoting exchange of information and experiences in the field of environmental education. Workshops, symposia and studies were held during the 1970s to deal with various aspects of environmental education, and pilot projects were established in 17 countries throughout the world. A set of guiding principles for a worldwide programme in the field was drawn up by an international workshop held at Belgrade in 1975. Two years later the Intergovernmental Conference on Environmental Education was held in Tbilisi, USSR.

126. Environmental courses from primary to graduate-school levels were designed. But because environmental issues differed in each country, educational approaches varied too: in primary school, for example, formal environmental education was introduced as a subject in some countries, while in others it was an added component of existing subjects such as nature study or hygiene. Similar approaches were taken in secondary schools, but sometimes experimental and field studies were added. Universities helped secondary school teachers formulate courses through seminars and discussions.

127. While general environmental programmes open to all university students were practically non-existent in OECD countries as a whole in 1971, by 1979 there were 350 graduates in environmental science each year in the United Kingdom alone. During the decade, the number of post-graduate programmes in environmental studies offered by universities increased.

5. See *Report of the World Tourism Conference (A/36/236, annex) appendix 1.*

128. Public participation in environmental affairs increased during the decade. Some of this interest was spurred by the efforts of the media to cover the field. But media coverage was uneven, because it responded to the public's perception of environmental problems and to accidents and special events.

129. Environmental awareness increased most in wealthier and better-educated populations, and was stimulated by books and films as well as newspapers, magazines and the electronic media. Non-governmental organizations played an important role in the development of a better understanding of environmental issues. In areas where surveys were conducted they seemed to show a change in people's attitudes towards environmental issues. While remaining concerned about pollution, they became more alert to the scarcity of some natural resources, the necessity for conservation, and the relation between environment and development. Public organizations affected the decision-making process in a number of countries, particularly in connexion with nuclear power development. Referendums were held in Austria, Sweden, Switzerland and the United States of America to decide issues relating to nuclear power stations as a result of the intensity of public feeling. The Swedish parliament approved a cessation of chemical spraying of forests for a year, pending a solution of problems caused by the sprays, and pressure from environmental groups contributed to the reduction or elimination of lead from gasoline in the European Economic Community, Australia and elsewhere.

130. On the whole, progress was apparent in both environmental education and public awareness of environmental issues during the decade. Consensus emerged on educational methods, and the challenge now is to translate these into action. As this is done, public understanding of environmental issues can be expected to improve.

#### *10. Peace, security and the environment*

131. Wars, and the threat of war, were constant features of the decade. Between 1945 and 1979 some 80 nations were involved in 130 civil and regional conflicts causing widespread suffering and disruption. In the 1970s there were about 50 such conflicts, and by the closing months of 1980 the international situation was such that many people feared hostilities on a wider scale. The wars that were fought left environmental destruction behind, as wars always do, and the threats of war gave rise to fears of even greater destruction. These fears created tensions that diminished the possibilities of international co-operation in defining and solving environmental problems, and competed for scarce resources that could have been used for development.

132. During the 1970s the cost, in human and material terms, of the relics of past wars received increasing attention. Surveys revealed that one country alone had removed 58.5 million mines from 2.5 million square kilometres of its territory after the Second World War; another suffered 3,800 fatalities and 8,000 injuries from clearing mines in the years after the War. In

South-East Asia, social organization, agriculture and forest vegetation had been severely damaged, and were taking many years to recover.

133. By 1980 global military expenditure was 30 times as great as it had been at the turn of the century (figure 18), and four times as great in constant money terms as in 1964. The rate of increase was a little less in the 1970s than it had been in the previous decade, and it grew less rapidly than total GNP, but the share attributable to the developing countries (which could least afford it) grew particularly rapidly (figure 19). Trade in armaments increased by about 15 per cent each year between 1970 and 1975. The oceans, the stratosphere and space were increasingly militarized, and military purposes accounted for about 40 per cent of all the world's expenditure on research and development. Weapons systems, technically refined to a high degree, became sophisticated and potentially destructive.

134. Despite widespread condemnation of nuclear weapons, 469 nuclear devices were exploded between 1970 and 1980, 41 in the atmosphere, where they produce the greatest amount of radioactive fall-out. However, as a result of the Treaty, Banning Nuclear Weapons Tests in the Atmosphere, in Outer Space and Under Water, environmental radionuclide concentration in fall-out was on the whole lowered. Weapons testing nevertheless continued to appropriate substantial land areas. Concern over the proliferation of nuclear technology and the possibilities of diversion of nuclear material for non-peaceful uses increased during the 1970s.

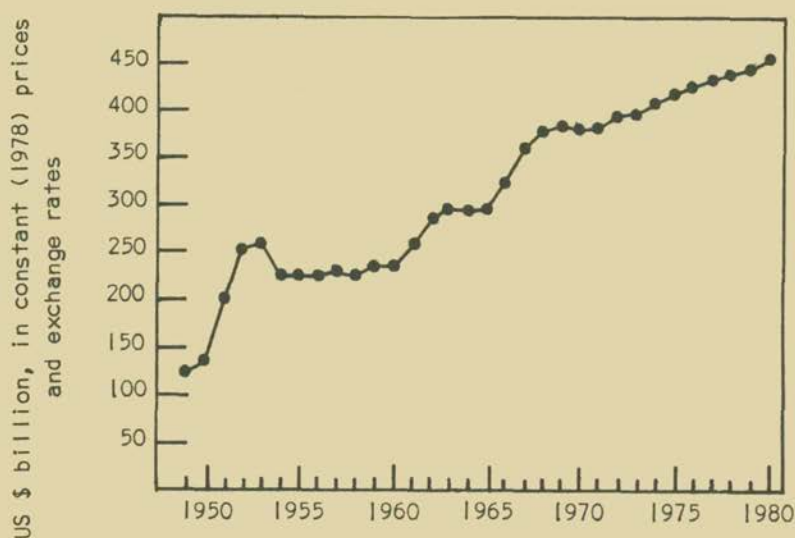
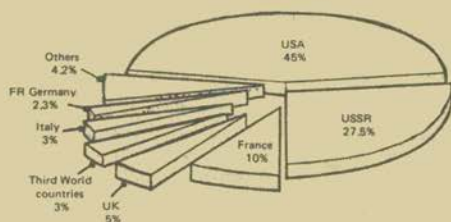


Figure 18. World military expenditure

### Shares of the supplier countries



### Regional shares of the major weapons supplied to the third world

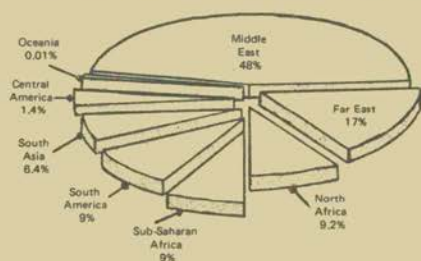


Figure 19. The exporters and importers of major weapons, 1970-1979

135. A number of studies were carried out during the 1970s of the potential effects of nuclear war. These suggested that a major conflict could kill 200 to 300 million people and destroy most of the economic resources of the principal nuclear weapon States. Climatic and other environmental changes would be likely, and fall-out would affect the whole world.

136. The destructive power of conventional weapons also grew. By 1980, aircraft carrying high-explosive cluster bombs or grenade clusters could deliver an attack comparable in devastation to that of a tactical nuclear guided missile with a 1 kiloton warhead. It was clear that chemical and biological weapons could also produce severe environmental effects, especially when used to destroy forests and other vegetation in tropical areas with fragile soils or semi-arid areas poised on the brink of desertification.

137. There was also concern over the possibility of using environmental modification as a weapon. Practices feasible by 1980 included the artificial creation of fog, cloud cover, hail, snow or rain in limited areas; the destruction of dykes and irrigation works and the pollution of water supplies; the destruction of permafrost areas; the stimulation of landslides and avalanches, and the destruction of vegetation and soil cover.

138. The United Nations took many disarmament initiatives in 1970s, but its total expenditure on this work in 1979 was equivalent to only 0.002 per cent of world military expenditure. Several major multinational agreements were signed, one prohibiting environmental modification for hostile purposes, and the United States and the USSR adopted the Treaty on the Limitation of Anti-Ballistic Missile Systems. But at the end of the decade the arms race still remained a serious threat to mankind and to the environment.

### III. CONCLUSIONS

#### A. General conclusions

139. The survey of environmental changes (positive and negative) and trends during the 1970s leads to two general conclusions, about man's capacity to perceive what is happening in the natural environment and about the relative significance of the changes that can be detected there.

140. The first general conclusion is that the data base is of very variable quality. There are startling gaps, and a special lack of reliable quantitative information about the environment in the developing world. This must be remembered when projections of the future state of the world environment are examined: many are based on only the scantiest of evidence about what, in fact, has been happening.

141. On the world scale, there are measurements of the major meteorological parameters, of carbon dioxide and ozone concentrations in the atmosphere, and of atmospheric turbidity. The distribution of exposure to ionizing radiation is now reasonably well known, and information on food contamination by some metals and organochlorine compounds is available from an increasing number of countries. There are also reasonably complete records of the surface distribution and flow of fresh waters. The state of other environmental resources is less fully documented.

142. For example, it is premature to say with certainty whether worldwide climatic warming has begun, or is likely, and there is still not enough evidence to permit confident judgements of possible human influence on stratospheric ozone. Although UNEP, other organizations and national Governments have promoted some good regional marine monitoring programmes, there are no reliable global data on the pollution of the oceans and seas. The amount and condition of ground waters is another area of uncertainty. On land, in spite of the recently completed preliminary assessment of tropical forests, there is conflicting evidence on the scale and rate of deforestation. There are general local and/or regional figures for the extent of deserts, rangelands, farmlands and other major land-use categories, but detailed information about their condition — and rates of degradation — are rarely available.

143. Information about some major human activities that affect the environment is somewhat better. Food production and fishery statistics are extensive, even if uncertainties remain about the state of ecosystems on which fish and other stocks depend. Demographic data on human populations and on birth and death rates are fairly complete, and there are also good records of energy production and use and of the scale of many major industrial activities and trade flows. But even in such areas as vital to mankind as health and



disease, deficiencies in the data base for developing countries hamper the assessment of priorities for action, or of success and failure.

144. There are many reasons for this situation. One is a lack of agreement on the parameters whose monitoring should receive priority. A second cause is a lack of universally agreed methods for analysis. But what matters is the fact that the world community, due to serious lack of resources, has not yet achieved one of the major goals of the Stockholm Conference — the compilation, through a global programme of monitoring, research and evaluation, of an authoritative picture of the state of the world environment. In the light of the present constraints an imperfect series of environmental statistics, drawing together what is available and, through its manifest inadequacies, providing a stimulus to better observation, may be a necessary step towards achieving that goal.

145. A second general conclusion concerns the essential unity of the world's environmental system, despite the great geographical and biological diversity of its components. For example, it has been shown that the linkages between the global cycles of carbon, nitrogen, phosphorus and sulphur both on land and in the sea are very close. Human actions have been influencing all of these cycles on an increasing scale. In 1980, the annual release of carbon dioxide to the atmosphere from burning fossil fuels was about 10 per cent of the amount being used by green plants in photosynthesis. In the past century about 10 per cent of the land surface has been transformed into agricultural land, this has caused a major movement of nitrogen compounds and other nutrients from the soils to the rivers and lakes, and ultimately to the sea. In 1980 the formation of nitrogen oxides and nitrate in the process of fuel combustion and fertilizer manufacture was about half of what the biosphere produces naturally. More sulphur oxides were entering the atmosphere, mainly from fossil fuel combustion, than were being exchanged naturally between the air, land and oceans as a result of the decay of dead organic matter. All these human impacts were tending to increase, and it was clear that the modification of any one cycle by man would affect the others. In this sense, life on earth functioned as a single global ecosystem, but great uncertainty remained over the nature and rate of long-term adjustment of the components of this system to these alterations in major biogeochemical cycles.

### **B. Present and future challenges**

146. Data available in 1980 suggest that the implications of the increase in atmospheric carbon dioxide concentrations should be taken seriously. Major uncertainties remain, however, about the effects of a global warming from this cause.

147. Although a number of studies suggested that it must still be regarded as a potentially serious problem, there was no instrumental evidence of change in the ozone layer during the decade. On the other hand, the suggestion made at Stockholm that acid rain could be a serious

environmental problem has gained wide acceptance. The associated changes in freshwater ecosystems have been documented, although the precise nature of the impact of acid rain on terrestrial systems is far from clear.

148. Urban air pollution still constitutes a major environmental problem in the great and growing cities of the developing countries. These countries lack the means to curb many of the airborne emissions, especially since a high proportion of their pollution results from inefficient combustion of wood, charcoal or animal dung in the home, or poorly maintained automobiles.

149. World marine fisheries landings increased during the decade, but it is a sobering thought that, according to one estimate, in 1980 they were 15 to 20 million tons less than they would have been had management been more competent. It is also disturbing to see how uncertain the estimates of potential fishery resources are, ranging in the case of Antarctic krill from speculations in the early 1970s that this species alone could double world fishing harvests on a sustainable basis to demands for extreme caution lest the entire southern oceanic ecosystem be disrupted.

150. On the global and regional scale, fisheries and marine ecosystems have not yet been damaged significantly by pollution. However, acute damage occurred in areas around oil refineries and in industrialized estuaries, bays and coastal zones, where fish numbers have been reduced and many species eliminated. Oil pollution is a nuisance, a bird-killer and a threat to coastal shellfish and tourism, and yet it has grown during the decade, but cannot be proved to have had any serious impacts on a wide scale. Yet many marine scientists feel uneasy about taking such negative evidence at its apparent face value. They argue that even if hydrocarbon concentrations are low, the contamination of the sea is increasing, that chronic effects could appear slowly but then be virtually irreversible, and that the most stringent precautions are therefore essential. In the present state of uncertainty, there are good reasons for treating such arguments with respect, and for expanding monitoring and research efforts.

151. The continuing growth of the world population and acceleration in water use had by 1970 already begun to strain the water resources of some areas, and the problems were aggravated by pollution and the continued prevalence of water-borne disease. During the 1970s, withdrawals of water for use in agriculture, industry and in the home continued to increase, although in many developed countries more slowly than in the preceding decade. Statistics remained uneven, but domestic water supplies barely kept pace with population growth in many developing regions, and waste water disposal services fell behind in many areas. Unless proper management and development of water resources are accelerated, the targets of the Drinking Water and Sanitation Decade will be unattainable, and problems will grow, especially in the developing countries. Ground-water quality also deteriorated in many areas, and statistics for this section of the freshwater resource remained inadequate.

152. Annual production of almost all major minerals increased during the decade. In industrialized countries advances were made in mining technologies to reduce the associated environmental impacts. But in developing countries the introduction of such technologies, and of environmental pollution control measures in the mining sector, is still lagging behind. Recycling and substitution of mineral raw materials received renewed attention during the 1970s, and should be further encouraged and developed as a means of conserving mineral raw materials and process energy.

153. World food yields rose in the 1970s, although not as fast as demand for food, and all projections implied a continuation of this trend. Many agricultural areas increased their productivity through the use of high yielding varieties developed during the "green revolution" and through better husbandry (but at the cost of higher energy use). However, there was also considerable waste of environmental resources through soil loss, desertification, salinization and other consequences of poor management.

154. Natural land ecosystems were in retreat in many areas. Forests were cleared for agriculture and energy on a scale that was the subject of dramatically contradictory estimates. A number of genetic resources were perceived to be at risk; and this triggered conservation measures in the marine and freshwater environments as well as on land. But at the same time the decade saw wide acceptance of the central message of the World Conservation Strategy — that conservation in its widest sense is concerned with sustaining and enhancing the biological productivity of the planet through processes of ecologically sound social development; and that only within a positive approach of this kind, which raises standards of living and education, can resources be found for the protection of the richness of nature.

155. In a retrospective look at the Stockholm Conference, it is clear that man's perception of the natural world has changed. By 1980, much had been learned about the subtle complexity of environmental systems. It is now appreciated that all environmental systems are subject to natural change, that human action commonly modifies its rate and direction, and that few changes are irreversible, although the time scales and efforts required to achieve reversal vary widely. So is the fact that while great global problems exist or may come to exist, pollution control, adequate food production and environmental resource conservation do not pose insuperable problems for developed countries, irrespective of whether they have market or centrally planned economies. Here, the means for environmentally sound development exists: the question is whether they are being applied. But problems basic to life — affecting food, fuel, soil and water — are central to many developing countries, and often force them into courses of action that cannot fail to damage their futures in the longer term.

156. This dichotomy between developed and developing countries emerges with great force when considering the human rather than the natural world. It begins with population — another of the great preoccupations of the early years of the decade. It was assumed that the demands made by the

increasing number of people were well within the capacity of the Earth, as far as its ability to supply the physical and chemical requirements for continued life and to absorb the waste products was concerned. However, the 1970s brought into focus the finite nature of non-renewable resources and the Earth's limited carrying capacity. The more people we have on Earth, the more will be the demand for the limited natural resources to support life and development, and the more will be the attendant environmental pressures. This will certainly continue to be the case for decades to come, especially in developing countries, where population growth is much faster than in developed ones. And this growth is especially great in the cities, many of which are topping the 10 million mark and expanding in a chaos of unplanned, under-serviced housing. If present trends continue, the populations in urban areas will double in the next decade, and many of these new citizens will live in squatter settlements.

157. In the developing world infectious diseases remain great killers, the six most serious of them taking the lives of millions every year, and parasitic diseases remain rampant. More parasites, bacteria and vectors are becoming resistant to more drugs and pesticides, creating additional problems for the control of several diseases. While the average life expectations at birth improved steadily almost everywhere during the 1970s, in many of the least developed countries it is still less than 50 years. The greatest challenges for environmental medicine in the years to come lie in the less developed regions, especially in curbing parasitic infections and the diseases of squalid settlements, rather than in the developed countries, where all the indications were that environmental factors were not a major cause of premature mortality and where a major challenge to medicine was to overcome the so-called diseases of civilization (e.g. coronary heart diseases, cancer, hypertension, etc.) and social and behavioural problems, and to adopt the pattern of health care more closely to the needs of people.

158. Events of the 1970s have confirmed that industry can be competitive and productive without creating pollution, and that the margin of cost added in meeting acceptable standards in those developed countries that have made estimates is of the order of 1 to 2 per cent of GNP. Good planning and design are essential, because it is almost always far cheaper and better to build pollution avoidance or pollution control into an industrial plant at the outset than to fit it afterwards. There were encouraging signs during the decade that some developing countries were resisting pressures to become "pollution havens" where industrial development was rendered cheap at the cost of environmental devastation. However, the complex interaction of technology, economics and public preference in such development must be stressed. Recycling and low- and non-waste technologies gained some ground in the decade. It should be noted, though, that not all wastes are necessarily polluting and not all recycling necessarily clean.

159. Energy problems loomed large during the decade. Oil ceased to be a cheap, secure, universally available fuel. Developing countries whose plans

depended on oil for urban and industrial use found that increases in its price imposed a crippling balance-of-payments burden. At the same time, wood (and charcoal) remained the staple fuel for much of the world, and securing supplies from depleted woodlands was severely degrading environmental resources in the areas concerned, taking an alarming proportion of the time of many poor people, and hampering their own development and the education of their children. Women bore an especially heavy share of this burden. For developed countries, the energy problem was more of an inconvenience than a disaster, but the decade revealed considerable uncertainties about how to cater for the future: how far expanded use of coal was tolerable in view of the carbon dioxide and acid rain problems, how the considerable potential contribution from energy conservation could best be realized, how far nuclear power offered a safe alternative, and what the role of new and renewable sources of energy might be. These uncertainties, and economic pressures, provoked an unprecedented wave of re-evaluation of national energy policies and of long-term planning.

160. In the 1970s human and animal muscle power still moved goods in much of the developing world, but all forms of mechanized transport grew despite the pressure of energy costs. In developed countries, personal road transport continued to grow, and ways of maintaining public transport modes at occupancy rates that realized their potential energy efficiency and gave an adequate service to those without their own vehicles were a focus of attention. As the decade came to an end, research and development of transport systems that were efficient, non-polluting and safe was a priority in many countries. Road casualties continued to take a heavy toll of life in many nations, especially in cities of the developing world that were not built for motorized traffic, and air pollution from badly maintained internal combustion engines also created serious environmental problems there at a time when controls were easing such problems in many developed countries.

161. During the decade, tourism gave an increasing number of people in developed countries first-hand experience of environments in other lands and climatic zones. But the process also threatened valuable coastal environments and had disruptive effects on some local communities even though it brought them economic benefits.

162. The development of environmental education proceeded in many countries, and public awareness was enhanced by it, by mass media and even more so in several countries by non-governmental organizations active in the field of environment. Non-governmental organizations and mass media have an important part to play in the development of a balanced understanding of the environment, and during the decade there was a slow but welcome trend of discussing and reporting objectively about environmental matters, rather than focusing on "scare stories". It is important that such trends should continue, because the resources available to the world community for sound environmental development are limited, and objective public awareness will help direct these resources into appropriate channels.

163. This problem of the proper allocation of limited resources is illustrated most graphically by the fact that military expenditure rose considerably during the decade, especially in developing countries, and accounts for a staggering sum of money per annum. The reversal of the arms race and its underlying spiral of costly technology would do much to release resources needed to assure the future of mankind and the human environment.

### C. A time to act

164. International and regional actions to protect and develop the environment increased greatly during the 1970s. UNEP, in co-operation with United Nations bodies and many regional and non-governmental groups, made real advances. Several joint programmes and activities of different organizations did much to restore damaged environments and improve the human condition. Many conventions were agreed upon, and plans of action formulated and put into implementation. For all that, it is difficult to contend that the international system is yet as efficient as it should be. And despite the evidence that people's perception of environmental problems has improved, it is less clear that many groups have adapted their life-styles in response to their new insights.

165. At the end of the 1970s, therefore, despite very great increases in knowledge, it was possible to ask the same central question as at the beginning — "is the world environment changing in ways that could be seriously detrimental in the long term to the well-being of humanity?" — and still not be sure of the answer. There was also uncertainty over the most effective ways of harnessing international scientific knowledge and turning it into practical action at the different levels, with the choice ranging from international treaties through regional and national laws, standards and codes of practice, to action-oriented programmes.

166. The economic constraints that are universally present in developing countries, and increased in several developed countries late in the decade, accentuated this search for operational efficiency. The need for balancing the cost of protecting the environment (however difficult this may be) against the benefits gained wider recognition. The search for means of judging priorities brought with it views on the possibility of securing wider acceptance of particular indicators of environmental and social well-being. However, many doubts were expressed about the validity of universal yardsticks of this kind when human needs and environmental conditions vary so widely.

167. The environmental topics discussed in this report need to be judged on many planes. At the most basic level, wise environmental management should be an evident act of self-interest, and what is needed is education and training to help people judge the true scale of the problems that

confront them, and their best solution. They need also to be aided to avoid "poverty traps" in which imperatives for survival lead to actions like cutting the last wood on slopes prone to erosion to secure warmth and cooking for the present, even though it means that crops and fuelwood for the future are at risk. At a more subtle level, environmental questions have a strong ethical content. The responsibility of States (or individuals) not to engage in actions that may damage the environment of other States (or people), and of the "international commons" beyond the limits of national jurisdiction, was stated clearly in the Stockholm Declaration. There is a danger, as the world's economic problems intensify, that this ethical base, and its logical consequence — international or national action to manage environmental resources in an integrated way — may be neglected.

168. Over-all, three features of the decade stand out. First, the technology or organizational means to avoid or solve many of the problems identified in developed countries in the 1960s and early 1970s is now known, as is the cost of implementing the various options. What is now required is implementation. But that does not mean that research on traditional problems should stop. It is overwhelmingly evident that there is a lack of information about what is happening to the biosphere and other ecosystems in developing countries. Cheaper, more cost-effective solutions adapted to the needs of those countries are urgently needed, for example for providing energy. The importation of technology evolved in developed countries under different social and economic conditions is often not effective. Research is equally vital, to define and develop solutions to emerging new problems before undue damage is done or resources wasted, for example through loss of productive soils. Better environmental monitoring and assessment are equally essential if such problems are to be recognized, and the success or failure of actions to protect the environment defined.

169. A second feature of the decade lay in people's understanding of environmental systems, and in the recognition that environmental and economic systems are inseparable. The physical sectors of lithosphere, hydrosphere, atmosphere and biosphere cannot be isolated from the social and technical spheres. The rapid changes in relationships between nations following the end of the colonial era were still progressing, and the decade ended with the north-south dialogue at the centre of the world stage. As the Brandt Commission recognized, continued economic growth in the developed world may well depend on the progress made by the developing countries; as the World Conservation Strategy emphasized, this progress is likely to be the only means whereby developing countries gain the resources for environmental conservation. Yet the "north-south" division is itself a simplification. Within both groups there are countries at many stages of development, with different economic and social priorities. Environmental conditions vary also. It is not enough to deduce that poverty defiles the environment in many developing regions: it is necessary to know exactly how this happens — and how over-consumption creates other threats elsewhere. The complexity of the socio-environmental mosaic must not be forgotten in the quest for a broad, general picture.

170. The Stockholm Conference established that certain environmental problems needed to be studied globally or regionally. The experience of the past decade has confirmed that such an approach works reasonably well where the aim is the collection of information and its assessment as a basis for national action. During the 1980s, international co-operation is likely to be needed for global and regional environmental monitoring, and its extension by the adoption of authoritative, critical assessments. Co-operation will also be important for action to combat soil degradation and provide guidance on the ground to people endeavouring to develop land in areas vulnerable to erosion and diminishing productivity, for continued efforts against desertification, for the improvement of the human environment through better planning of settlements and services, for action against the diseases that degrade the lives of so many people, for continued development of less polluting technology that is cost-effective and suited to the developing world, and for action to conserve world genetic resources,

171. But experience also shows that international action is more difficult when the need goes beyond information collection, analysis and dissemination and involves joint management of commercially important resources, especially where national interests conflict. Advances in this area will be slow, but are nonetheless essential in the 1980s. To avoid wasted effort it is important that the limitations as well as the prospective benefits of an international action are evaluated when it starts, and that the action has an agreed function that is visibly beneficial (as was the case with the agreements relating to regional seas).

172. Finally, the third feature of the decade is the growing recognition that many of the great problems of the world environment have political roots. Stable administrations, supported by popular consensus, are needed if long-term environmental developments are to proceed and resources are not to be dissipated in strife and preparations for war. And that needs thoughtful, committed and far-sighted management that works in an atmosphere of peace, security and stability.

173. At the Stockholm Conference it was generally assumed that the world's system of national Governments, regional groupings and international agencies had the power to take effective action, and that the limiting factors were scientific and economic. By the early 1980s there was less confidence in the capacity of national and international managerial systems to apply known principles and techniques, or in the effectiveness of international debates as a source of action to improve the well-being of people. The capacity of any existing economic system to bring about the necessary social and environmental developments has been challenged in many quarters, especially following the energy crisis of the 1970s. Restoration of confidence in these systems may be the greatest challenge for those seeking to improve the world environment during the 1980s and beyond.



#### IV. SUGGESTED ACTION BY THE GOVERNING COUNCIL

174. The Governing Council may wish to note that, ten years after the United Nations Conference on the Human Environment:

a) The over-all state of the natural environment has not improved; indeed, deterioration is proceeding at accelerated rates in a number of its components;

b) Notable advances have taken place in the scientific means of examining the complex and interrelated systems of the biosphere, and space research has provided means for large-scale monitoring of the earth, its resources and its processes;

c) The salient features of the state of the world environment over the past decade are:

i) *Atmosphere*

a. Emissions of airborne pollutants, which have detrimental impacts on various ecosystems and are transported over long distances, have increased;

b. There has been a slow but steady increase in carbon dioxide levels in the atmosphere;

ii) *Oceans*

a. The open ocean is in no imminent danger, but increased pollution in estuaries and coastal zones has had detrimental effects on fisheries and amenity values;

b. The southern oceans possess valuable economic potential, but environmentally sound systems for the management of their resources have yet to be evolved;

iii) *Water*

a. Water accessibility and quality have improved in some parts of the world, but there has been a world-wide increase in the absolute numbers of people without access to safe water or sanitary facilities;

b. Increased eutrophication and pollution of inland water bodies have been only partially offset by the biological revival of some rivers and lakes through various remedial and control measures;

c. Awareness of, and actions to control, environmental problems related to man-made lakes have increased;

iv) *Lithosphere*

a. Annual production of non-metallic ores, and, though to a much lesser extent, of metallic ores, has expanded, and a significant increase in recycling has taken place;

b. Important improvements have been developed, and implemented to varying degrees, in methods of reducing the deleterious effects of the mining, treatment and transport of both metallic and non-metallic ores;

c. Systems for forecasting earthquakes, and for social organization to reduce their hazards, have improved, but they still cause great losses of life and property;

v) *Terrestrial biota*

a. Destruction of tropical forests has continued, at an estimated rate of 11 million hectares a year;

b. Desertification and land degradation undermine the productivity of a total estimated area of 20 million hectares a year;

c. About 1,000 species of birds and mammals and some 10 per cent of flowering plant species are threatened with extinction;

vi) *Population and human settlements*

a. Despite a decrease in the annual rate of population growth everywhere except in Africa, world population increased by about 700 million from 1970 to 1980;

b. The world's urban population increased by about 30 per cent from 1970 to 1980, and the concomitant growth of large cities and associated squatter settlements in developing countries caused deterioration of environmental quality through inability to provide accommodation and services at a matching rate;

vii) *Human health*

a. Communicable diseases continued to cause a high proportion of morbidity and death in developing countries;

b. Chronic hunger or malnutrition affect more than 450 million people in the developing regions of the world, with particularly serious effects on children;

c. Dangers to health as a result of the use of and trade in toxic chemicals and the disposal of hazardous wastes have increased;

viii) *Bioproductive systems*

a. World food production has increased, although insufficiently to keep pace with escalating requirements;

b. Advances in biotechnology have made it possible to produce many valuable substances with the aid of microbes and their enzymes, and advances in genetic engineering open wide prospects for improved farming systems;

c. Use of agricultural chemicals has increased, with various adverse effects on the environment, and methods of reducing post-harvest losses have improved, although such losses nevertheless remained serious throughout the decade;

ix) *Industry*

a. Increased efforts have been made to curb industrial pollution in industrialized countries;

b. Some reduction in waste has been brought about through improved technologies, recycling and the introduction of low-waste and non-waste processes;

x) *Energy*

a. Despite the increase in energy costs and the resulting effort to conserve energy, especially in industrialized countries, world commercial energy consumption increased by 34 per cent during the 1970s;

b. Plans for environmentally sound mixes of energy, including energy from renewable and non-conventional sources, have been increasingly developed;

c. Despite increased efficiency in the production and use of fuelwood, shortage of fuelwood in many parts of the developing world has led to various forms of environmental deterioration;

xi) *Transport and tourism*

a. Growth of all transportation modes, especially motor vehicles, has occurred, with attendant environmental costs in terms of energy consumption, pollution, congestion, and noise;

b. The large increase in numbers of tourists has resulted in more marked economic, social and environmental impacts both positive and negative;

xii) *Peace, security, and the environment*

a. Global military expenditure has increased, consuming vast material and manpower resources, and there has been increased concern over the possible use of environmental modification as a weapon;

b. There has been an increase in the total number of refugees, about 40 per cent of whom are still unsettled;

*d.* Increased emphasis has been placed during the decade on environmental education and public awareness, with non-governmental organizations playing an important role;

*e.* Consequently, environmental issues have come to be better perceived: it is now appreciated that all environmental systems are closely interconnected, and are subject to natural and man-made changes which in some cases are irreversible. It has also been demonstrated that "environment" and "development" are compatible, and that to ensure lasting improvement in the quality of life, development must be environmentally sound and sustainable;

*f.* The considerable scientific progress in many areas of the environment has made more precise and extensive analytical data available, with the result that earlier data in a number of areas are now known to be incorrect. However, the data base still remains very variable in quality, with startling gaps, especially in developing countries;

*g.* Technical and organizational means for dealing with several environmental problems are known, but implementation is too often hindered by the lack of political will, resources and/or information;

*h.* There has been a massive expansion in the establishment of national environmental bodies and in legislation dealing with environmental issues, and a considerable increase in the number of non-governmental bodies dealing with the environment;

*i.* The 1970s brought into focus the fact that international cooperation is essential to solve environmental problems, and several international and regional actions to protect and develop the environment were undertaken in the 1970s; it is difficult to contend, however, that the international system is yet as efficient as it should be.