



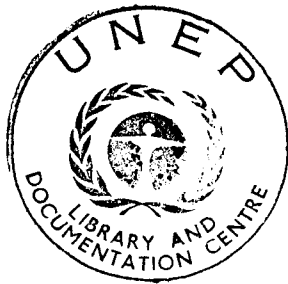
**THE STATE
OF THE ENVIRONMENT
1975**

**UNITED NATIONS
ENVIRONMENT PROGRAMME**





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FOREWORD

During 1974, United Nations Conferences were held on several issues which have been the subject of increasing concern by the world community in recent years: Population, Food, the Law of the Sea. Part I of this report takes a brief look at the problems and perceptions aired at these conferences and on the vistas for future action opened up therein. The report also touches on other issues which were seen during the year as being of crucial importance: energy, raw materials and outer limits. Finally, an attempt is made to report on how these matters relate to the idea of managing the environment.

The report is based upon the viewpoints expressed in papers presented to United Nations Conferences and in discussions with various members of the scientific communities. It was initially presented to Governments at the third session of the UNEP Governing Council, held in Nairobi in April 1975. At that time several amendments were made which are reflected in the relevant extract from the report of the work of the third session of the Governing Council in the annex to the report.

I. INTRODUCTION

1. The purpose of this report is to help man understand the interacting forces that shape our future, to point up the kinds of actions required to enable man to avoid the dangers he faces and maximize the opportunities to ensure his survival and well-being on Planet Earth.

2. During his past year, understanding has increased of the integrated nature of the issues of environment and development. The environment is affected by natural factors and by man's activities as he seeks to ensure his well-being. In essence, these activities may be called the process of development. When the process is such that it takes account also of the effects on the environment, and thus provides for well-being and viability in a sustained manner, it constitutes management of the environment.

3. The choice between alternative strategies in managing the environment is the choice between alternative patterns of development in reaching the goals of increasing the physical, economic and social welfare of all human beings, in the provision of at the least the basic needs of man: food, shelter, clothing, health, education and work. The importance which Governments attach to an integrated approach to the environment is witnessed by the establishment of national machineries or committees for the purpose. By the end of 1974, many Governments¹ had established national environmental ministries, departments or secretariats.

4. Also during this past year, the international community has sought to create a new basis for dealing with problems of raw materials and development, the law of the sea, population and food. An integrated approach was particularly stressed by the General Assembly's sixth special session held during April and May 1974, which called for the establishment of a New International Economic Order, and adopted to this end a Programme of Action.

5. In the two years ahead, there are to be a special General Assembly session on Development and International Co-operation, HABITAT (the Conference on Human Settlements), and United Nations Conferences on Water and Desertification. Through the actions taken at these gatherings, if those actions are taken in full realization of the interrelationships

¹ Algeria, Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, China, Czechoslovakia, Denmark, Finland, France, Gabon, German Democratic Republic, Germany (Federal Republic of), Ghana, India, Indonesia, Iran, Ireland, Israel, Ivory Coast, Japan, Kenya, Korean Republic, Kuwait, Malta, Malaysia, Mauritius, Mexico, Morocco, Netherlands, New Zealand, Norway, Papua New Guinea, Pakistan, Philippines, Portugal, Poland, Romania, Senegal, Singapore, Spain, Sweden, Switzerland, Syrian Arab Republic, South Africa, Turkey, United Kingdom, United States of America, Uruguay, Yugoslavia, Zaire.

of the issues involved, the world community may move towards a more integrated action on environment/development. Clearly, UNEP must contribute effectively to this process.

6. 1974 saw United Nations Conferences on Population, on the Law of the Sea, and on Food, and the following sections report on the perceptions at these conferences and on the vistas for future action opened up therein. They also report on other issues which were seen during the year as being of crucial importance: energy, raw materials and outer limits. Finally, an attempt is made to report on how these matters relate to the idea of managing the environment.

II. POPULATION

7. The world population has now reached nearly 3.8 thousand million people and, barring unforeseen catastrophic disaster, is projected to reach at least 6.5 thousand million by the end of this century.² This projected growth will create problems concerning the generation of capacities to support the population while providing acceptable conditions of life, themselves dependent on the possibilities of productive employment within the limits of the capacity of the environment. Problems are apparent, for instance, in parts of Asia, Africa and Latin America where population pressures have aggravated the already serious lack of the basic sanitary facilities, etc. These are environmental problems, affecting the very capacities and energies of the population to focus on their resolution.

8. Environmental problems of this order are being aggravated by the present large-scale transition from rural to urban societies. During the 1950s, the urban population of the world was estimated to be growing at 3.4 per cent per annum, but in developing countries the rate was as high as 4.7 per cent.³ Urban regions are at present growing at something like twice the rate of over-all population growth. By the year 2000 more than half the world's population will be living in urban regions rather than rural areas;⁴ this figure will include approximately 80 per cent of the people in developed countries and 40 per cent in less developed countries.⁵ In absolute numbers, this means that within the course of only one generation there is going to be an increase of nearly 2,000 million in the number of city dwellers, about 450 million in developed and 1,500 million in developing countries.

² "The Grinding Arithmetic for the Year 2000", *UNESCO Courier*, May 1974, p. 9.

³ *The determinants and consequences of population trends: new summary of findings and interactions of demographic, economic and social factors*, vol. I (United Nations publication, Sales No. 71.XIII.5), p. 190.

⁴ A. Carrillo-Flores, "Agenda for the World", *People*, vol. 1, No. 4, 1974, p. 4.

⁵ *The determinants and consequences of population trends ... (op. cit.)*, chapter XV.

9. Patterns of population concentrations and structure also present environmental problems. In 1950, there were some 75 cities of more than a million inhabitants;⁶ by the year 2000, there will be nearly 275.⁷

10. These huge increases in urban human settlement have vast national and global repercussions, and would require major policy decisions and massive investment programmes merely to maintain the present unacceptable levels of life, let alone improve them. Such increases in concentration, as they outstrip the capacity to provide productive employment, also outstrip the basic minimum resources and services required to maintain the populations, resulting in the environmental problems of inadequate and contaminated water supplies and inadequate sewage and waste recycling or disposal, inadequate health care facilities, paralysis of transportation facilities, etc. These problems cloud the future prospects and capacities of millions of people to improve their economic, social and environmental conditions.

11. There was considerable debate at the World Population Conference at Bucharest on the number of people that could be sustained at a minimum standard of living on a long-term basis; the process or processes by which such growth would eventually decline and cease; the time horizon within which this change would occur; and the need for efforts directed specifically toward limiting population growth in contrast with general economic and social development.

12. The compelling importance of the right of each nation to determine its own optimum population level was stressed at the Conference. Equally important was the acceptance by each nation of responsibility for resolving the equation of population, resources and environment, through a development process that provides for its people acceptable conditions of life. Population was thus agreed to be an issue that would not respond to generalized global solutions, but could be dealt with effectively only at the national levels—or even better on the level of the family and the individual—where the demands generated by population times consumption must be resolved.

13. Action at the international level should be supportive of national goals. There was general agreement at the Conference that population growth cannot continue indefinitely at the present rate, and the Conference also adopted a resolution on the interrelationships between population, development, resources and environment in which it recognized that the preservation of the human environment and available natural resources is a multidimensional problem of which population dynamics is one of the important elements. The resolution recommended, *inter alia*, that:

The relevant existing data should be systematically collected and analysed so that recommendations can be made on areas of co-operation from States Members of the United Nations;

⁶ *Ibid.*, p. 192.

⁷ *Ibid.*, chapter XV.

Facilities for central research services should be provided in a co-ordinated manner within the United Nations system, taking into account the role of UNEP with the aim, *inter alia*, of working out a synthesis of available collected knowledge at national and regional levels in order to assist Member States and the international community in their efforts to cope with multidimensional and complex problems of population-development-resources-environment.

III. FOOD

14. In spite of the significant increase in food production owing to the "Green Revolution" in the 1960s, the food problem in recent years has become aggravated and more persistent. At present, well over 450 million people are hungry and lack the basic necessities to live a normal life, and their number is increasing daily.⁸ The majority of them live in rural areas, and at least 40 per cent of them are children.⁸

15. Population increase has certainly been the major historical factor in the increasing demand for food. Rising affluence, however, is becoming a major new claimant, and approximately 20 per cent of the food consumed last year is attributable to this new factor.⁹ This can be demonstrated by considering the grain requirements of different societies. The *per capita* availability of grain in developing countries averages 400 lb per year, most of which is consumed directly, very little of it being converted into animal protein.⁹ In contrast, the *per capita* grain consumption in the most affluent countries approaches 1 ton per year of which only 200 lb is consumed directly, the remainder being consumed indirectly in the form of meat, milk, and eggs.

16. Affluence has also reshaped the world trade in food.⁹ The major food importers are thus no longer developing regions alone.

17. In view of the present economic climate, scarcities and high prices of fertilizers and pesticides, it is estimated that the gap between rich and poor countries and between the affluent and impoverished in all countries will widen to disturbing, if not dangerous, proportions unless effective countermeasures are taken immediately.

18. The demand for food in developing countries is likely to expand at about 3.6 per cent per year during the period 1972 to 1985,¹⁰ well above the actual average production increase of about 2.6 per cent a year in the past 12 years.¹⁰ Since the most favourable conditions for sustained increases in food production do not necessarily coincide with the areas of greatest need, distribution mechanisms have come to assume great importance.

⁸ "The World Food Problem: Proposal for National and International Action", United Nations World Food Conference, Rome, 5-16 November 1974 (E/CONF.65/4), p. 1.

⁹ "World Population and Food Supplies", World Population Conference, Bucharest, 19-30 August 1974 (E/CONF.60/CBP/19).

¹⁰ "The World Food Problem: Proposal for National and International Action" (*op. cit.*), p. 2.

19. In some areas, especially the exporting areas, food production is becoming more and more energy-intensive, increases in yield being limited to ever increasing inputs of energy. Currently, nearly 13 per cent of the North American energy budget is used for this sector.¹¹ A comparison of calorie input and output (a convenient way of computing energy subsidy for the agricultural sector) indicates that the number of calories of energy supplied to produce one calorie of food for actual consumption has risen steadily in the last few decades. For the United States system, the input-output ratio was 1:1 in about 1910; at present it is 8:1.¹² For example, the corn yield in the United States has increased from 34 bushels per acre in 1945 to 81 per acre in 1970. During the same 25-year period, inputs increased as follows:

	1945	1970
Machinery	180 × 10 ³ Kcal	420 × 10 ³ Kcal
Fertilizers:		
Nitrogen	7 lb	112 lb
Potassium	5 lb	60 lb
Phosphorus	7 lb	31 lb
Insecticides	0 lb	1 lb
Herbicides	0 lb	1 lb
Irrigation	19 × 10 ³ Kcal	34 × 10 ³ Kcal
Drying	10 × 10 ³ Kcal	120 × 10 ³ Kcal
Electricity	32 × 10 ³ Kcal	310 × 10 ³ Kcal
Transportation	20 × 10 ³ Kcal	70 × 10 ³ Kcal ¹³

20. Land and water are important requirements for food production. As the need to increase food production becomes more urgent, man is faced with continued loss of productive soil through desertification, erosion, salination and other forms of destructive land use. Pressure to expand the area under agriculture is leading to destructive attempts to cultivate land that is actually unsuitable for cultivation with the technologies at hand. Thus, the expansion of agriculture to steep hillsides has led to serious erosion in Indonesia; the increasing pressure of slash and burn techniques is destroying tropical forests in the Philippines; and attempts to apply the techniques of temperate zone agriculture to the tropical soils of Brazil and Southern Sudan have led to erosion, loss of nutrients, and laterization.

21. Overlogging of tropical forests has had similar effects. Deforestation in the Himalayas is probably contributing to an increase in the frequency and severity of flooding in the Indian sub-continent.¹⁴ It is estimated that already man's activities have despoiled some 10 per cent of

¹¹ D. Pimentel *et al.*, "Food Production and Energy Crisis", *Science*, vol. 182, Nov. 1973, pp. 443-449.

¹² J. S. and C. E. Steinhart, "Energy Use in the US Food System", *Science*, vol. 184, April 1974, pp. 307-316.

¹³ All information from A. K. and M. R. Biswas, "Energy and the Environment: Some Further Consideration", Department of Environment, Ottawa (Canada), 1974, table 10, p. 27.

¹⁴ "Report of the Symposium on Population, Resources and Environment", Bucharest, Romania (E/CONF.60/CBP/3), 25 March 1974.

the world's arable land.¹⁵ In addition, good agricultural land is coming under intense pressure, in both developed and developing countries, from urban uses. There is still land available which can be brought under cultivation, but as larger and larger areas are given over to farming, the unexploited tracts available to serve as reservoirs of species diversity and natural ecosystems become smaller and smaller.

22. Water is looming as a critical factor in expanding food production. The efficiency of water use has not been looked at seriously in most countries, and considerable improvement is required in this sector. The health costs of irrigation can no longer be ignored, in view of the spread of water-borne diseases, especially in the tropical countries. The trade-off between the benefits of extra food production and the costs of additional misery as a result of health hazards has to be carefully considered.

23. The quest for high yields has led also to the replacement of a wide range of traditional crop varieties all over the world with a few specially bred, high-yield strains. Extensive areas are now planted to a single variety of wheat or rice. This enormous expansion of monoculture has increased the risk and the potential magnitude of epidemic crop failure from insects or disease.

24. A major limiting factor in increasing food production is the capacity of plants to use energy through the process of photosynthesis. The efficiency of this process may be affected by environmental factors.

25. The task of increasing food production faces another constraint in the need to prevent damage to the environment and to health that can result from the continuing increases in the use of chemical pesticides and fertilizers. Current studies indicate that only .015 ppm of phosphorus are necessary to support algal blooms.¹⁵ This means that runoff of even one per cent of P_2O_5 from a field treated with 40 lb of phosphorus would support algal blooms in five acre-feet of water. The distribution process of these substances may be irreversible and little is known about their accumulation in the atmosphere, land, water and food chains or their synergistic effects.

26. Expanding food production has incurred severe environmental and ecological costs as a result of poor management practices. After two decades of rapid expansion, the total world fish catch during the past several years has decreased. Over-fishing, pollution and natural fluctuations have reduced the total production of this high-quality protein. It has come to be recognized that any strategy that increases food production in the short term, while destroying the long-term capacity to provide for and sustain increases, courts disaster. The steps taken to increase food production must be environmentally sound.

27. The World Food Conference held at Rome in November 1974 created a World Food Council and an Agricultural Development Fund. In the Universal Declaration on the Eradication of Hunger and Malnu-

¹⁵ A. K. and M. R. Biswas, "Environmental Considerations for Increasing World Food Production", UNEP, Nairobi, 1974.

trition, the Conference solemnly proclaimed, *inter alia*, that to assure the proper conservation of natural resources being utilized or utilizable for food production, all countries must collaborate in order to facilitate the preservation of the environment, including the marine environment. The Conference recognized the need to move towards long-term strategies based on sustained increases in food production. This recognition was reflected in resolutions which:

Required a world soil charter and land capability assessment as a basis for rational use of the world's land resources, prevention of soil degradation application of solid protection and conservation techniques;

Called for scientific water management;

Recognized the environmental dangers of pesticides and called for progress towards integrated pest management and ecological and habitat methods of pest control;

Recommended the more efficient use of fertilizers and called for research aimed at a greater utilization of locally available plant nutrients and different types of organic fertilizers as well as biological fixation of nitrogen;

Stressed the importance, in selecting the measures to be taken to achieve the urgently needed increases in food output, of taking into account the need for the most efficient use of land and water resources as well as the short- and long-term effects of alternative technologies on the quality of the environment.

28. A number of recommendations referred to the role of UNEP:

That the joint FAO/WHO food contamination monitoring programme, in co-operation with UNEP, be further developed in order to provide early information to national authorities for appropriate action;

That FAO, UNESCO and UNEP, in co-operation with WMO and other competent international organizations, and in consultation with Governments concerned, prepare without delay an assessment of the lands that can still be brought into cultivation, taking proper account of forestry for the protection of catchment areas of land required for alternative uses. Such an assessment should take into account primarily the hazards of irreversible soil degradation as well as the costs and agricultural and other inputs required;

That FAO, in co-operation with UNEP, WHO and UNIDO, convene on an urgent basis an *ad hoc* consultation, including member Governments and industry, to recommend ways and means to give effect to the intentions of the resolution on pesticides, including the supply-demand information that FAO has been collecting, the investment required in pesticides and equipment supply, the standardization of regulatory procedures and environmental rules, and examination of alternative methods of pest control, follow-up action should be taken.

29. It is clear from the foregoing that the Conference recognized the need for ecologically sound methods of increasing food production on a sustained basis, and also recognized the need for research into, and the

fuller application of existing knowledge of, organic fertilizers, the biological fixation of nitrogen, ecological and habitat methods of pest control and the most rational use of the world's land resources.

IV. OCEANS

30. The Third Conference on the Law of the Sea, held at Caracas, recognized that effective international co-operation for the care and management of the oceans and their resources is essential for world peace and order, and sought to bring this 70 per cent of the earth's surface under a new régime of law and co-operation. It was seen as being urgent to achieve universal acceptance of the concept that resources beyond national jurisdiction are the common heritage of all mankind, and to gain commitment to ensuring that the resources of the global "commons" are in fact utilized and cared for in the interests of mankind. It was generally considered that States had the obligation to protect and preserve the marine environment. The Conference will resume in early 1975.

31. This past year has also seen the development of a regional approach to the care and management of the oceans, with the Mediterranean region receiving particular attention. The results achieved in regard to this region will be significant in the development of activities in, for example, the Indian Ocean and South Pacific areas.

V. ENERGY

32. Energy has long been viewed as an essential ingredient in stimulation and supporting economic development. Historically, as countries have advanced economically and technologically, their energy and resource consumption rates have risen. Thus, the developed countries use several times more energy *per capita* than developing countries. However, a transition in the relative distribution of world energy consumption is slowly taking pace. For example, North America's share of global energy consumption fell from as high as 50 per cent in the mid-1920s to slightly less than 33 per cent in 1968. During the same period, the Soviet Union's share went up from a little less than 2 per cent to 15 per cent. The average annual growth rate of the developing countries during the period 1950 to 1968 was 7.5 per cent, compared with 5 per cent for developed countries. Furthermore, the average *per capita* energy consumption of developing countries increased at a much faster rate (4.8 per cent) than that of developed nations (2.8 per cent),¹⁶ even taking into account the significant population increase in developing countries.

33. Increasing energy requirements and the recent increase in energy prices have affected the developed nations badly, but the predicament of developing nations is even worse. Current estimates indicate that added

¹⁶ See foot-note 13.

petroleum energy costs, both direct and indirect, to the developing countries will be of the order of \$10 to \$15 thousand million in 1974, compared to about \$4 thousand million previously.

34. The costs of energy have also increased. It has been estimated that for oil, the input-output rate of energy is 615 calories to 1, for strip-mined coal, 3 to 1, for nuclear power plants currently in use, 2 to 1.

35. The potential for the conservation of energy, for the development of more "energy-economic" patterns of energy use, is substantial. For example, with a comparable *per capita* income, the *per capita* use of energy in Sweden is half that of the United States.

36. Different patterns of energy use and electrical power generation have different environmental consequences, and the effects on the environment of changes resulting from the energy crisis require consideration.

37. The major long-term potential environmental hazards from energy development and consumption practices are thermal pollution; possible climatic changes caused by constantly increasing levels of heat fluxes, carbon dioxide and particulates, and sulphur dioxide; and problems of management of radioactive nuclear wastes and of the deterioration of safety standards with increased risk of operational accidents. To this should be added environmental problems caused by rapid deforestation in developing countries because of their heavy dependence on wood as the main source of fuel.

38. As a rule, hydroelectric power and gas turbine plants do not add significant amounts of heat to the environment. An efficient conventional fossil-fuel plant converts nearly 40 per cent of the heat energy of combustion to electricity, 45 per cent of the remainder being discharged to the cooling water and 15 per cent to the atmosphere. Nuclear power plants discharge about 40 to 50 per cent more heat into the environment than a modern fossil-fuel plant.¹⁷ In terms of thermal pollution, hydroelectric energy is the environmentally cleanest of the existing major forms of energy, but its percentage share of energy generated is expected to be reduced, while the share of nuclear power in the market will increase substantially. The thermal pollution problem is likely to multiply as a result.

39. The release of heat to the atmosphere, either directly or through heated water, is a cause for concern. The heat island effect has been clearly identified in many cities. As the population concentrates more and more in urban regions, the reflected heat in winter in cold climates may become equivalent to nearly 50 per cent of the heat received from solar radiation.¹⁸ If the existing trends in power consumption continue, some

¹⁷ A. K. Biswas, "Beneficial Uses for Thermal Discharges", *Report No. 2*, Department of Environment, Ottawa (Canada), 1974.

¹⁸ R. T. Jaske, J. F. Fletcher and K. R. Wise, "A National Estimate of Public and Industrial Heat Rejection Requirements by Decades Through the Year 2000 A.D.", 67th National Meeting, American Institute of Chemical Engineers, Atlanta, 1970.

scientists believe that heat introduced into the atmosphere could become climatically significant at some point in the next century.

40. Problems of thermal pollution aside, consumption of fossil fuels has increased the concentration of carbon dioxide in the atmosphere from 190 ppm in 1960 to about 320 ppm at present.¹⁹ It has even been suggested that increasing levels of heat fluxes and concentrations of carbon dioxide and particulates in the atmosphere are already changing the world's climate. Some present studies indicate that these factors may have contributed to the movement of subtropical highs towards the equator, causing decline in rainfall in subtropical semi-arid regions. Such climatic changes have deleterious effects, especially on food production. This issue must be the focus of far greater collaborative international research.

41. Another potential environmental problem of consequence is the management of highly radioactive nuclear wastes like plutonium; which have to be completely isolated from the biosphere for some 200,000 to 240,000 years—a period much longer than the history of man.²⁰ The young nuclear industry may thus be faced with the need to design an almost eternal fail-safe system, which in turn will require implicit assurance that social institutions will retain sufficient stability to guarantee the continued existence of a cadre to take care of these highly radioactive toxic wastes.

42. With a large increase in the number of nuclear power generating stations, there is an increased risk that safety standards in construction as well as in operation will deteriorate, and indeed existing standards have been questioned in some countries. The risk of operating accidents, with the consequence of radioactive contamination which may last for centuries, therefore increases.

43. Equally hazardous may be the spread of materials that could be utilized for weapons of mass destruction. These dangers raise important moral and ethical questions of a kind that man has never faced before, and a rational assessment must be made of the risks involved in the increased emphasis on nuclear power.

44. A significant move to nuclear power also requires analysis of effects on resources like steel and copper as well as on land-use planning, and of cumulative effects on the environment.

45. The developing countries are presented with a different type of environmental problem because of their marked dependence on wood as a major source of fuel. The *per capita* consumption of wood-fuel in these countries is just over one ton per year²¹ and their forests are coming under increasing pressure. Deforestation is creating serious soil erosion problems and more intense flooding, increasing the march of the deserts.

¹⁹ A. K. Biswas, "Energy and the Environment", *Report No. 1*, Planning and Finance Service, Department of the Environment, Ottawa (Canada), 1974.

²⁰ A. K. Biswas and F. K. Hare, "Energy and the Environment", Proceedings, 9th World Energy Conference, Detroit, Michigan, 1974, Paper No. 26-3.

²¹ K. Openshaw, "Wood-Fuels for the Developing World", *New Scientist*, vol. 61, Jan. 31, 1974, pp. 271-272.

46. Among the concepts for energy generation which should be explored is that of the "energy farm", in which forests would be planted and managed on a sustained yield basis to produce wood for charcoal. Among the additional benefits of this concept are the prevention of erosion and the improvement of watershed management.

47. More emphasis is also needed on the development of methods for the use of solar energy. The thermal power of solar radiation intercepted by the earth is 1.73×10^{17} watts,²² which is nearly 5,000 times all other steady fluxes of energy combined. It is estimated²³ that the thermal power density of solar radiation in Southern Arizona varies from 300 calories per sq cm per day in winter to 650 in summer. If the lower figure of 300 calories per sq cm per day is assured, and a 10 per cent efficiency for conversion to electrical energy becomes possible, then 1 sq km of collection area will yield 14.5 megawatts. The total area necessary for a 1,000 megawatt plant would be about 70 sq km, and the current electric power requirements of the United States would need a collection area of about 25,000 sq km, or almost 10,000 sq mi, which is less than 10 per cent of the area of Arizona.

VI. RAW MATERIALS

48. Total resource requirements are increasing rapidly over the entire world. In developed countries, although population is increasing slowly, *per capita* use is increasing rapidly, while the opposite is happening in developing countries. Traditionally, raw materials have been classified as non-renewable resources, but a distinction may be important between "losable" resources, such as oil and coal, and "non-losable" resources, such as metals, which can be used several times over by recycling processes. Renewable resources are often exploited on a non-renewable basis and are thus lost, as has been the case with soil and trees. In managing the environment, the capacity to renew as against the mere capacity to exploit must be taken into account.

49. Any statement regarding the availability of raw materials for future generations should take into consideration that exploitation of raw materials is dependent on the state of technical knowledge, which is not a constant. Thus, with the improvement of technological capability, man has been able to utilize lower concentrations and mine in more and more regions of the world. The average grade of copper ore mined in the United States has steadily declined from 1.6 per cent in 1936 to 1.22 in 1941, 0.98 in 1946, 0.97 in 1951, 0.84 in 1956, 0.82 in 1961, 0.79 in 1966 and 0.65 per cent in 1971.²⁴ However, several qualifications should be borne in mind. First, as lower-grade ores are resorted to, more materials have to be processed for each unit of end-product. Hence, residuals

²² A. K. Biswas, "Energy and the Environment" (*op. cit.*).

²³ Hubbert, "Survey of World Energy Resources", 75th Annual General Meeting, Canadian Institute of Mining, Vancouver, April 1973, pp. 1-17.

²⁴ A. K. and M. R. Biswas, "Energy and the Environment: Some Further Considerations", Department of the Environment, Ottawa (Canada), 1974, p. 41.

from processing are growing even faster than total consumption. Secondly, an ever increasing amount of energy and capital must be used to mine, refine, transport and utilize minerals from lower concentration ores. The development and use of lower grade ore is thus energy-intensive and capital-intensive. Thirdly, in the case of strip mining, more and more topsoil has to be stripped to mine lower grade ores. The investment necessary to reclaim affected areas for other uses could be substantial, especially in arid zones. Finally, the transitory nature of mining operations could mean greater rates of migration and social disruption resulting from greater rates of exploitation. Many of these activities result in increased costs per unit output of raw materials, thus accentuating the distribution problem.

50. At present, the future appears to be bleak for resources-poor developing countries, which can ill afford to import essential raw materials at rapidly rising prices, and thus face greater difficulties than the industrialized nations. Absolute physical limits of available raw materials are less likely to be constraints on development than disparities in the distribution of these materials in relation to demand. The problems are thus not merely the physical ones, but largely the economic, political and social ones which affect distribution.

51. A fundamental shift towards less resource-intensive patterns of growth is important, especially in the industrialized world. Such a shift could improve the distribution of the world's economic activity and industrial capacity, bringing increased opportunities for employment and economic and social development to the developing world and having a generally salutary effect on the environment. It is, however, of great importance that development policies in the developing world should provide for long-term viability, drawing as appropriate on the experience of industrialized societies.

VII. OUTER LIMITS

52. Perhaps less acute and immediate, but in the long run no less important, are the risks to collective survival from human activities that may impinge upon the "Outer limits" on which human life depends. There are generally considered to be two different kinds of limits to human development and progress. Firstly, natural limits are set by the fact that growth within a finite space cannot continue for ever. For example, it has been estimated that, were present rates of population increase to continue indefinitely, within some 2,500 years the total mass of mankind would exceed the mass of the earth. There are also natural limits to the resiliency of ecosystems. Overgrazing in semi-arid zones, surpassing the recuperative capacity of the ecosystem, accelerate desertification. Scientific and technological advance can postpone the time and moderate the manner of reaching these limits, but it cannot repeal fundamental laws of nature.

53. Secondly, there are man-made barriers to growth and human development. "Physical" outer limits arise from activities that have their roots in economic and social behaviour—i.e. in the social, institutional, political and international conditions that restrict the ability of individual countries and some groups within countries to take full advantage of the available resources base.

54. Even though there is widespread agreement among scientists about these man-made barriers, there is considerable disagreement about the natural limits, whether they are caused directly by single factors or by interactions between many. The issues of the nature of such limits, the associated time scales and the paths by which they will be reached thus remain open. And yet the answers to such questions are crucial to decisions on patterns of resources consumption, economic growth and population increase.

55. The problem is that the factors determining outer limits are not known. The mineral and energy reserves ultimately available to man are unknown, as is the potential for substitution. Also unknown are how much new land can be made suitable for agriculture and at what cost, the extent to which additional fresh water supplies can be developed, the seriousness of the disruptions to ecosystems caused by man's efforts to acquire these resources and the timing of technological advances required to extend present limits.

56. Most public attention has been focused on the direct effects, and within this category, on acute rather than chronic manifestations. Far too little is known about the effects of small amounts of persistent substances, such as chlorinated hydrocarbons, radiation, mercury, lead and DDT, on the human body when accumulated over a 20 to 30 years period.²⁵ Nor is much known about social and behavioural responses likely to result from growing resource and environmental pressures. It is now evident, however, that far more serious efforts must be devoted to overcoming these areas of ignorance and that mankind must search for strategies that, taking appropriate account of the uncertainties and risks involved, promote its welfare in a broader sense than hitherto accepted as an appropriate objective for policy.

57. In spite of these uncertainties, it is becoming evident that man's activities, based on the massive leverage which science and technology have made available to him, have reached a scale and intensity at which they are significantly modifying many of the elements within the biosphere that are essential to sustaining human life. Increased consumption of fossil fuels, proliferation of nuclear reactors, the introduction into the environment of more than a thousand new man-made chemical compounds every year, vast man-made changes in the surface of the planet and its plant and animal life—all impinge on the natural systems in ways we still cannot fully evaluate and understand. But there is increasing evidence

²⁵ Report of the Symposium on Population, Resources and Environment (*op. cit.*).

that they are giving rise to serious risks to human health and well-being in such areas as possible climatic change, marine pollution, contamination of the food chain, polluted water supplies, and damage to the earth's ozone buffer.

58. One area of concern is the possibility that the world climate is changing and that man's activities may be influencing, or be capable of influencing, such changes. But whether or not such changes derive in part from man's activities, they can have a major, even decisive, impact on his future prospects. Since a considerable portion of the high agricultural yields of the past two decades can be attributed to a beneficent climate, climatic changes could seriously hinder concerted efforts to increase food production. Some meteorologists believe that the recent droughts in Africa and India can be linked with the poor harvests in the Soviet Union and China as symptoms of a major world-wide climatic change. Although it is still not certain whether this is a short-term or long-term change, we can no longer be complacent about the effects that such changes could precipitate. Activities that may adversely affect climate must be avoided. For instance, there is need for agreement to place a moratorium on development in the Antarctic.

VIII. CONCLUSIONS

59. The developments and issues discussed herein form a complex system of cause and effect relationships in which the dynamics of the future will be shaped. Thus both the potential for conflict and need for co-operation will increase greatly. It is not in any one of these issues, but through the interaction among them, that future events will be decided. With increased population, the provision of basic human necessities to each person required more food, energy and raw materials; intensifying the supply of food requires more land, water, energy and fertilizers; the inflation accompanying energy price rises means that less energy is available to increase food production and remedy fertilizer shortages. The common denominator in virtually all responses to these problems is to call for more capital investment, more technology, and more co-operation. It is here that these concerns inevitably merge with the important issues of monetary and trade relations, war and peace. It is equally important to be aware of the interrelationships between the vast number of "public services" rendered by the natural environment. For instance, almost all potential plant pests are controlled by natural ecosystems. Insects pollinate flowers, natural vegetation reduces floods, prevents erosion and beautifies the landscape. As the size of human populations and economic activities increase, so does man's potential for disrupting such systems. With the world's population doubling in the next 30 to 40 years and economic activities at least tripling during this period, man's impact on these systems can no longer be ignored. This system of relationships is global in scale. That is not to say that all global problems can be met with global solutions—for there are few global solutions. But they can only be understood and dealt

with in a global framework, within which there can be a wide variety of national and regional responses. What is necessary is integrated environmental management rather than incremental *ad hoc* steps taken for environmental protection, and the realization that the ultimate self-interest of all nations is inevitably merged in the inescapable web of interdependences. An integrated co-operative approach is needed to manage the interacting relationships between resources, their development, distribution and use, technology, its orientation and use, and the minimal needs for sustaining decent standards of human life and protecting the natural systems on which life depends. Only through an understanding of these intricate inter-relationships will it be possible to solve the mammoth problems facing all mankind and to create a new international economic order. It is towards these objectives, the solution of problems in this context, that the Environment Programme must be directed.

ANNEX

Extract from the Report of the Governing Council of the United Nations Environment Programme on the work of its third session (UNEP/GC/55)

Review of the environmental situation and of activities relating to the environment programme

Introducing the Level One report, the Deputy Executive Director described the three elements of the review of the environmental situation and of activities related to the environment programme; the common environmental data base; the report on the state of the environment; and the reviews of the priority subject areas, which in the present case consisted of a review of the priority subject area "Land, water and desertification", as requested by the Governing Council.^a

In the view of all 24 delegations which spoke on the subject, the Executive Director was to be complimented on the general content and presentation of the Level One report. Nevertheless, as reflected below, a number of delegations suggested changes in the report before the Committee, and proposed guidelines to be taken into account in the preparation of future Level One documents. When further developed and supplemented along the lines proposed by the Executive Director, and taking into account the views expressed by the Governing Council, the Level One activities could provide sound guidance for policy making, not only by UNEP in all levels of its programme development and in pilot demonstration projects with interested countries, but by the world community as a whole in tackling environmental issues. Several detailed suggestions were made for the revision of specific sentences of paragraphs, in the Level One report, and the Committee agreed to request the Executive Director to take those suggestions submitted in writing into account, as appropriate, either in revising the present report or in preparing future reports to the Governing Council.

The above comments applied in particular to the report on the state of the environment, which, it was agreed, should be presented in future as a separate document, and could be considered by the Governing Council along with the report of the Executive Director. The Executive Director's annual report on the state of the environment should be reviewed in the light of the comments of the Governing Council, published and given wide distribution, perhaps on the occasion of World Environment Day. In commenting specifically on the report before the Committee, many delegations considered that insufficient attention had been given to social, economic and cultural aspects, and to the human needs and values underlying the

^a *Official Records of the General Assembly, Twenty-ninth Session, Supplement No. 25 (A/9625), Annex I, decision 7 (II).*

philosophy behind human activities relevant to the environment. The aims of environmental development and protection must be seen as a component of a broader co-ordinated programme of development, and in the context of the real needs of mankind as a whole.

Socio-economic and political aspects were mentioned by many delegations, mainly in connexion with the subjects of technology transfer, food, population and energy, within the framework of the new international economic order. A number of delegations considered that the problems in those areas should be tackled and minimized by optimizing international economic co-operation, by rationalizing the transfer of technology, by the provision of technical assistance and training and by the development and transfer of resources. Those measures were necessary in order to speed up and harmonize economic and social development in developing countries, and could only be achieved through the implementation of the new international economic order.

It was also observed by some delegations that the speeding up of economic and social progress must be based in the first place on the endeavours of each nation; problems of the environment could only be solved ultimately by a changed economic order, primarily on the international scale to bridge the gaps between developed and developing countries, but also at the national level to bridge the gaps between urban and rural populations and between the privileged and underprivileged groups within urban centres. On the subject of population, some delegations pointed out the varying significance of population problems in different countries and suggested that the order in which problems were highlighted in the state of the environment report should be rearranged. Several specific suggestions were made for the amendment of the paragraphs on food and population, aimed at reflecting more fully all the above considerations and embodying more accurately the conclusions of the World Population Conference.

It was agreed that, poverty being one of the worst forms of pollution affecting the majority of mankind, UNEP should promote the improvement of the environment with a view to eliminating that social ill.

Some delegations commented that a number of the assumptions and conclusions in the report were open to debate, in that they were based on opinion rather than established fact. One delegation also felt that in future the report should focus on the conditions of the environment as such, rather than discuss wider problems which might more appropriately be dealt with in other forums. Another delegation observed that the report should continue to try not to obscure the uncertainties arising both from differing interpretations of scientific data and from differing philosophies and values.