VIII. CONCLUSIONS

The twentieth century has been a century of change. It has been a century of unprecedented world population growth, unprecedented world economic development and unprecedented change in Earth's physical environment.

From 1900 to 2000, world population grew from 1.6 billion to 6.1 billion persons, about 85 per cent of the growth having taken place in Asia, Africa and Latin America (United Nations, 2001). And although population growth rates are slowing, United Nations population projections (United Nations, 2000, 2001) show that the world population is likely to exceed 8 billion people by 2030. As was the case with world population growth in the past, future growth is expected to be uneven: from 2000 to 2030, the more developed regions are expected to grow by about 2 per cent, while the less developed regions would grow by about 45 per cent.

In 1900, about 86 per cent of the world population were rural-dwellers and just 14 per cent were urban-dwellers (Matras, 1973); but by 2000, the share of the world population living in rural areas had declined to 53 per cent, while the number of urban-dwellers had risen to 47 per cent (United Nations, 2000). By 2030, over three fifths of the world will be living in cities. Virtually all the population growth expected during 2000-2030 will be concentrated in the urban areas of the world.

The enormous expansion in the global production of goods and services driven by technological, social and economic change has allowed the world to sustain much larger total and urban populations, and vastly higher standards of living, than ever before. For example, from 1900 to 2000, world real gross domestic product (GDP) increased 20 to 40 times (DeLong, 1998), while world population increased close to 4 times and the urban population increased 13 times. The benefits accruing from the unprecedented growth of the world economy have occurred among both more developed and less developed countries, but growth has been unevenly distributed. The twentieth century's economic progress was disproportionately greater in the regions that had already been more advanced at the start of that century.

Partially as a result of this economic expansion, substantial improvements have occurred in developed and developing countries alike in the quality and length of life. These achievements reflect progress in providing basic social services such as education and access to safe water and sanitation and have contributed to lowering levels of infant and child mortality and illiteracy, and raising life expectancy and school enrolment ratios. Although living standards have improved during the twentieth century throughout the world, the pace of improvement has varied among countries. In particular, acquired immunodeficiency syndrome (AIDS) and other emerging or re-emerging diseases in some countries and economic and political dislocations in others have reversed past progress in improving health and mortality.

Relatively rapid and uneven population growth and economic development are occurring simultaneously with degradation of aspects of Earth's physical environment. For example, according to J. R. McNeill (2000), the twentieth century experienced topsoil loss equal to that of the previous 1,000 years. Total energy use during the 100 years of the twentieth century was 10 times that of the previous 1,000 years. World food production has increased at a faster rate than population and more food per capita is available now than ever before in world history; but the increasing scarcity and degradation of agricultural and other environmental resources cast serious doubts as to how long food production can surpass population growth. Throughout the world, many fragile, biologically unique ecosystems, and the many species of plants and animals they contain, are threatened. Forest areas are diminishing, especially in tropical areas. Industrial pollution and harmful run-offs from agricultural production threaten the quality of water and air. Fresh water is already in short supply in some regions—approximately one third of the world's population lives in countries classified as experiencing moderate to severe water stress or scarcity—and future population growth will only increase the pressure on this renewable, but limited, resource. Emissions of carbon dioxide and other greenhouse gases continue to mount.

Although scientists debate the exact numbers and rates of change, the general trends in population, environment and development noted in the present report seem clear. As this report shows, what is more uncertain is the extent to which the size, growth and distribution of population have affected economic development and environmental trends. The review of the relationship between population growth and economic development contained in an earlier edition of this report (United Nations, 1999) concluded that the relationship was complex and varied over time and place, while emphasizing the intermediary role of institutions with respect to the form and size of the population impact. The 1999 report reflected the consensus that slower population growth buys time for Governments and relevant institutions to respond to changing conditions.

A study by the Intergovernmental Panel on Climate Change (Watson, 2000) concluded that there was no doubt that human activities were disturbing the global carbon cycle through the combustion of fossil fuels and through land use, land-use change and forestry activities. A recent study at Texas A&M University (Crowley, 2000) concluded that 75 per cent of global warming since 1900 had been due to human influences, "particularly to rising levels of carbon dioxide and other heat-trapping 'greenhouse gases' that come from the burning of fuels and forests". Such human influ-

ences, however, stem mainly from modes of production, not from the size, growth and distribution of population. Moreover, humans may have a positive effect on the environment also; it was the combat of humans against the traditional environmental threats of bubonic plague, smallpox, tuberculosis and the like that led to the twentieth century gains in life expectancy and health.

This report indicates that population and demographic change interact with environmental change and economic development in a variety of ways. To begin with, it is clear that population affects and is affected by the environment and economic development. The challenge is to identify the complex interactions and effects of population, environment and development. To date, while some progress has been made, this challenge remains formidable for researchers and policy makers alike. Sorting out the interactions between population, environment and economic development needs more and better data.

While all the environmental problems discussed in this report are largely or entirely the result of human activities, they vary in the extent to which they can be linked directly to population size, growth or distribution. For example, growth in some types of pollution is primarily the by-product of rising per capita production and consumption in industrialized economies, where population has generally been growing slowly. Even for those environmental problems that are concentrated in countries with relatively rapid population growth, it is not necessarily the case that population increase is the main root cause, nor that halting population growth would resolve the problem: other social and technological "driving forces" are usually also contributing to environmental degradation. Nevertheless, other things being equal, continued increase in population plays an important role by increasing aggregate economic demand and hence the volume of pollution-causing production.

Population growth is generally regarded as the single most important force driving increases in agricultural demand. While most recent expert assessments are cautiously optimistic about the ability of global food production to keep up with demand for the next quarter-century or half-century, food insecurity, associated with poverty, is projected to persist for hundreds of millions of people. Nonetheless, the Food and Agriculture Organization of the United Nations (FAO) concluded (in an assessment prepared for the World Food Summit in 1996) that "with regard to poverty alleviation and food security, the inability to achieve environmentally sound and sustainable food production is primarily the result of human inaction and indifference rather than natural or social factors" (Food and Agriculture Organization of the United Nations, 1996).

The need to feed a growing population is placing mounting stress on water supplies in many parts of the world. On a global basis, irrigation accounts for more than 70 per cent of fresh water taken from lakes, rivers and underground sources. While water is often inefficiently used, institutional mechanisms for implementing effective water management policies are often time-consuming and expensive and, in some cases, they are not viable options.

Population growth, through its effects on the expansion of cropland and the harvesting of wood for fuel, is an important factor contributing to deforestation in some areas, often tropical areas and areas rich in biodiversity. However, in several instances, it was government policies favouring the colonization of forested areas that accelerated the human settlement of the agricultural frontier and, in turn, caused rapid deforestation. Commercial logging is also a major cause of deforestation in some areas.

In rural areas of low-income countries, rapid population growth has often resulted in added pressures on agricultural land, resulting in land fragmentation and the reduction of yields. Such a process is at the root of a further cycle of environmental damage as the people who lack adequate land in one region migrate to ever more environmentally fragile areas in search of better chances of subsistence. Although the rural population of developing countries is expected to increase more slowly in the future than it did over the past 30 or 40 years, several regions already have very high population densities relative to available agricultural land. Consequently, even low levels of rural population growth are likely to result in added pressures on the rural environment. In those regions, the continued destruction of natural resources as a result of attempts to extend the agricultural frontier is very likely to continue or to accelerate in the future.

When considering responses to environmental problems it is necessary to recognize that social-institutional factors can be as important as, if not more important than, technological ones. The general problem of managing locally scarce or fragile resources is not new. Many examples can be found where traditional societies developed communal rules for managing a scarce resource. Population growth has the potential to destabilize such communal arrangements, since rules that functioned adequately at a low population density may lead to overexploitation and/or pollution at a higher density. Successful adaptation may be possible—as, for instance, in the transition described by Boserup (1965) from shifting to settled agriculture—but it is important to note that changes in the social allocation of resources are likely to be required as part of such adaptation. Even though the overall social as well as environmental benefit to such organizational change may be large, the process may prove to be contentious and politically difficult.

The relationships between urbanization and environmental degradation are complicated, involving interactions with the natural and the human-made environment. The regional ecosystem (for example, coastal regions, arid regions, humid-tropical regions, mountainous regions) in which a city is located, for example, is often a critical determinant of environmental conditions. In the case of ambient pollution, for example, the vulnerability of large cities to the adverse impacts of vehicle emissions depends on certain natural features (for example, altitude, direction and speed of prevailing winds; amount of sunlight; precipitation and humidity). Economic development exacerbates many urban environmental problems (for example, solid waste, automotive pollution) because the quantity of urban wastes generated per capita also tends to increase steadily with increased incomes.

With globalization, and new and emerging technologies and modes of production and consumption, the relationships among population, environment and development have become issues of heightened concern for Governments, the

international community and the average citizen. Population growth, structure and distribution are important aspects of environmental stress in so far as everyone requires the basic necessities of water, food, clothing, shelter and energy, which directly or indirectly affect the ecosystems (World Resources Institute, United Nations Environment Programme, United Nations Development Programme and World Bank, 2000). However, environmental stress is not just a matter of population change; it is also a matter of how and what people produce and consume now and in the future (World Resources Institute, United Nations Environment Programme, United Nations Development Programme and World Bank, 2000; United Nations, 1997).

In his message to the Global Ministerial Environment Forum (Malmö, Sweden, 29-31 May 2000), the Secretary-General noted that: "Technological breakthroughs that are unimaginable today may solve some of the environmental challenges we face. But it would be foolish to count on them and to continue with business as usual" (United Nations Environment Programme, 2000). Government domestic programmes and effective international agreements to curtail environmentally harmful activities are essential. However, population pressures are contributing factors to environmental stress. Population and development policies—especially those relating to the size, growth and distribution of population—are necessary and vital components of the constellation of actions needed to ensure sustainable development and to safeguard the environment during the twenty-first century and beyond.

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