

The global environment

Past, present and future

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The changing status of the global environment, in both developed and developing countries, and our perception of these changes since the convening of the United Nations Conference on the Human Environment in Stockholm in 1972 are reviewed. The present as well as potential future environmental issues facing mankind are discussed under three interrelated broad categories: interrelationship between people, resources, environment and development, rational use of natural resources and new patterns of development and lifestyle.

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Slightly more than a decade ago, in June 1972, the United Nations convened a major intergovernmental conference on the Human Environment at Stockholm, Sweden. It was undoubtedly the most important environmental event of an international character that took place during the past two decades, and to a great extent set into motion a process through which international environmental issues and concerns were to be discussed, reviewed and analysed.

When the Stockholm Conference was first proposed by Sweden in 1968, the industrialized countries in general reacted favourably. This is not surprising since interest in environmental issues in those countries was high. The activities of numerous citizens groups and non-governmental organizations continually focused the attention of the general public and politicians on deteriorating environmental situations. Many groups took to the streets to protest, and, especially in the USA, environment and Vietnam became two of the major issues over which youth rebelled against the establishment. These pressure groups and several scientists started to publicize critical and emerging environmental issues, some real and others not so. At the crest of the environment movement, the Earth Day attracted an estimated 20 million participants in the USA alone.

In contrast to the favourable disposition of the industrialized countries, the reactions of developing countries to the Stockholm Conference when it was first announced, were mixed, and the favourable reactions were lukewarm at best.¹ Interest in the environmental concerns were not as high as in the West, and there was a general feeling that the environmental problems were less of a priority compared with the real problems facing them — alleviation of poverty.

By the time the Stockholm Conference took place, many of the initial concerns and doubts expressed by developing countries were alleviated sufficiently for them to participate in the gathering. This turned out to be fortuitous since the Soviet Union and the rest of the Eastern Block of nations (with the exception of Romania) did not take part because of the conflict over the status of East Germany. Eventually 113 nations participated.

The Stockholm Conference agreed on a Declaration and an Action Plan. The Declaration consisted of a Proclamation and 26 principles.

¹Margaret R. Biswas and Asit K. Biswas, 'Environment and sustainable development in the Third World: A review of the past decade', *Third World Quarterly*, Vol 4, No 3, 1982, pp 479–491; Reprinted in *Philippine Geographical Journal*, Vol 26, No 4, pp 160–173.

The Proclamation was somewhat general and put man firmly as the central focus of any equation by stating categorically that 'of all things in the world, people are the most precious'.

The Conference undoubtedly raised the environmental consciousness of the world and sensitized public opinion. The Conference itself and the simultaneous *Environmental Forum*, organized by environmental pressure groups and other non-governmental organizations, together constituted one of the largest international gatherings ever held.

Looking back, more than a decade later, the Stockholm Conference appears to have been more of a success than many realized at that time. Its timing was right: it was held when the environmental movement in the West was at its peak, and developed countries were willing to provide funds for international environmental protection and management. It established an institutional machinery, United Nations Environment Programme (UNEP), as the environmental conscience of the UN system, and also to look after the events following the Conference.

Many of the major environmental trends of the present and of the future, for example, ecological disturbances caused by the pursuit of short-term benefits in the development process, resources impoverishment and environmental degradation as a result of population growth, are not new, but have long been recognized as serious problems. What is new, however, is the accelerating pace and scale of the problems. New, too, is the recognition of their interrelationships, which means that they can be understood and dealt with only within the overall framework of the web of causes and effects that bind them together. It also means that they cannot be resolved by further fine tuning of traditional responses. In this sense they are of a wholly new character and requires not only better understanding and development of new attitudes and perceptions, but also new modes of management responses, a fact that was clearly recognized at the Stockholm Conference.²

The various environmental issues will be discussed herein under three broad categories: interrelationships between people, resources, environment and development; rational use of natural resources; and new patterns of development and lifestyles. These categories, however, are not discrete: they, too, are interrelated.

²Report of the United Nations Conference on the Human Environment, A/CONF 48/14/Rev 1, United Nations, New York, 1973, pp 1–28.

³*Ibid.*

⁴For a review of these UN World Conferences, see Margaret R. Biswas, 'World Population Conference: A perspective', *Agriculture and Environment*, Vol 1, No 4, 1974, pp 385–391; Margaret R. Biswas, 'World Food Conference: A perspective', *Agriculture and Environment*, Vol 2, No 1, 1975, pp 15–39; Margaret R. Biswas, 'Habitat in retrospect', *International Journal for Environmental Studies*, Vol 11, 1978, pp 267–279; Margaret R. Biswas, 'United Nations Water Conference: A perspective', *Water Supply and Management*, Vol 1, No 3, 1977, pp 255–272; Margaret R. Biswas, 'UN Conference on Desertification in retrospect', *Environmental Conservation*, Vol 5, No 4, 1978, pp 247–262; Margaret R. Biswas, 'UN Conference on Science and Technology for Development', *Mazingira*, Vol 4, No 2, 1980, pp 36–53; Margaret R. Biswas, 'UN Conference on New and Renewable Sources and Energy: A review', *Mazingira*, Vol 5, No 3, 1981, pp 52–70.

People – resources – environment – development

An analysis of the report of the United Nations Conference on the Human Environment³ will indicate that though there was reasonable understanding at that time of the interrelationships between population, resources, environment and development, the approaches adopted in the resolutions were basically sectoral. Since that Conference, however, our understanding of the development processes has been enhanced greatly. This, to a certain extent, was facilitated by the holding of subsequent major United Nations World Conferences on Population (Bucharest, 1974), Food (Rome, 1974), Human Settlements (Vancouver, 1975), Water (Mar del Plata, 1977), Desertification (Nairobi, 1977), Science and Technology for Development (Vienna, 1979) and New and Renewable Sources of Energy (Nairobi, 1981).⁴ Through the preparatory processes undertaken for these conferences, as well as through the discussions during the conferences and the subsequent implementation of their recommendations, man's understanding of the complexities of development processes has evolved further. For example, it is now

better recognized that development is a multidimensional concept which encompasses not only economic and social activities, but also those related to population, the use of natural resources and their resulting impacts on the environment.⁵

While the interrelationships concept is not novel, the need for rapid development and technological advancement has meant that, very often, whatever knowledge of interrelationships was available tended to be disregarded. However, attempts to solve seemingly technical problems such as desertification, loss of productive soil or deforestation have indicated that emphasis should be placed not only on such physical factors as climate, soil type, modes of cultivation or land-use patterns, but also on diverse factors including demographic trends, types of technology used, levels and distribution of income among the population, consumption patterns, cultural habits and educational levels of the inhabitants, etc. Without such a holistic approach, actions taken to solve specific problems may give rise to several other unintended side effects, the sum total of which could even be worse than the problems initially addressed. To some extent, this can be explained by the fact that the nature of beneficiaries often tend to be different. Much of the benefits of the original action tend to accrue to a more educated and powerful section of the population, whereas the adverse side effects, to a large extent, are borne by people who do not have a power base and as such are not in a position to influence the socio-economic decisions which affect their own lives and lifestyles.

Population

While it may be difficult to forecast the future precisely, one fact is certain: world population will continue to increase for a few decades. The rate of population growth is unlikely to slow appreciably, and most of this growth will take place in developing countries, which will face challenging problems resulting from rapid urbanization. According to United Nations estimates, world population is expected to increase from about 4415 million in 1980 to about 5275 million in 1990. The population growth rate in developing countries will in all probability drop slightly from the 2.2% a year rate recorded in 1975, but even then, in absolute terms and using the slowest growth scenario of any international study carried out so far, the number of persons being added annually to the world's population will be significantly greater at the end of the decade than it is today. The past trend of increase in the share of developing countries in the world's population is likely to continue: from 66% in 1950 to 72% in 1975 and about 75% in 1990. The population growth rate in developed countries will in all probability decrease from the 0.7% rate observed in 1975. Because of better health care facilities, the present trend of life expectancies at birth in developing countries is expected to continue to increase. Similarly the migration of rural population to urban areas will continue during this period in both developed and developing countries.

While it is comparatively easy to make the general forecast of population trends, it is more difficult to predict many factors which influence population trends, i.e. fertility, lifespan, mortality, or migration. Information on population trends is one of the fundamental prerequisites for considering other major environmental trends, since basic requirements for food, shelter, energy, minerals, education, employment, etc. depend on population levels.

⁵M.K. Tolba, *Development Without Destruction*, Tycooly, Dublin, 1982, 197 pp.

Interrelationships

Several studies were carried out during the past decade, which attempted to relate population to resources availability, environmental degradation and development. Some studies, like the *Limits to Growth*⁶ model, predicted that both population and economic growth must cease by the year 2000, otherwise society would overshoot and collapse. However, such studies are now generally discredited since the models developed were simplistic, inadequate, based on faulty understanding of the problems, limited or even faulty data, and considered a very high level of aggregation. These models failed to reflect accurately the important interrelationships and continual feedbacks between people, resources, environment and development.⁷ What is necessary during the next decade is a more positive approach to development which adequately reflects these interrelationships. There is still a great potential to expand the ability of the global ecosystem to support more people, by judicious combination of making more productive and rational use of the earth's available resources and by a more suitable distribution of the benefits of various production processes.⁸ Since the carrying capacity of the earth is not infinite, development plans should take full advantage of the potentials but at the same time must be aware of the constraints imposed by the life-support system.

The study of interrelationships between people, resources, environment and development is important for three major and interlinked reasons. First, it is increasingly evident that development efforts, at all stages of growth and in countries having different social, economic and cultural backgrounds, institutional infrastructures and availability of natural resources, tend to produce systemic effects at national, regional and global levels that have a cumulative impact on the overall productive process and the attainment of long-term development objectives. Second, it is also increasingly evident that such systemic effects result from strong interactions between economic, social, demographic and physical factors. Third, since the exact causal links between these interactions are at present unknown, there is considerable uncertainty with regard to the likely long-term impact of such systemic effects and, consequently, attention has largely focused on the risks of negative impacts, even though the probability of positive impacts is also quite high. Taken together, these three considerations suggest the need for a more constructive approach, emphasizing that the study of the interrelationships should clarify causal linkages and identify points of leverage so that appropriate integrated policies and programmes can be adopted to start a cycle of positive impacts in terms of attaining both developmental and environmental objectives, and ensuring that development can be sustainable over a long-term basis.

The critical issues are not so much the rate of population growth and the insufficiency or the unavailability of natural resources, but rather the uneven geographical distribution of population relative to the carrying capacity of land and the inefficient and irrational use of natural resources. Considerations of these fundamental issues broadens the scope of analysis from resource depletion, environmental degradation and population growth to include resource redistribution and transfer, environmental management that encourages more rational use of resources, development of appropriate technologies and population movement. Environmental management of this kind would require better understanding and cooperation among, as well as within, nations,

⁶D.H. Meadows, D.L. Meadows, J. Randers and W.W. Behrens, *The Limits to Growth*, Basic Books, New York, 1972.

⁷For reviews of global models, see Asit K. Biswas, 'World models, resources and environment', *Environmental Conservation*, Vol 6, No 1, 1979, pp 3-10; Asit K. Biswas, 'Global future studies: Review of the past decade', *Mazingira*, Vol 6, No 1, 1982, pp 68-75.

⁸Asit K. Biswas, 'Population-resources-environment-development: A systems view', Presidential Address, Fourth World Congress, International Society for Ecological Modelling, Tsukuba, Japan, 1984, p 18.

since ultimately the interrelationships between the four areas frequently extend beyond national boundaries. In the final analysis, the problem of interrelationships becomes a collective responsibility of the entire international community.

Many of the conceptual issues associated with the interrelations between people, resources, environment and development have been clarified during the 1970s and are undoubtedly better understood and more widely recognized at present than they were at the time of the Stockholm Conference. Understanding of the interrelationships is still incomplete, however, and much work remains to be done during the next decade to analyse the underlying complexities, identify their policy implications and use the resultant knowledge successfully in operational contexts, so that the development process can benefit from an integrated approach, rather than the sectoral approach which is all too common at present. Techniques and means will have to be developed not only for devising intersectoral policies and programmes at national, regional and global levels, but also for ensuring their effective implementation. Such developments should finally lead to rational resources management and effective environmental protection. Major structural changes may be required, including resource transfers between nations to promote a more equitable sharing, development of alternative lifestyles and fundamental shifts in international economic relations.

Rational use of natural resources

Resources are the life-blood of any society, and the development process is sustainable only if it is underpinned by the continued availability of natural resources. Availability of natural resources, however, is not enough: countries should be in a position to utilize them effectively, which in turn depends on their ability to apply technology, as well as on the availability of funds for capital investment. There are many countries at present which have a rich resource base, but are still underdeveloped due to their inability to apply technology to transform those resources and/or to lack of investment funds, a situation which is largely attributable to constraints imposed by social, economic and institutional structures both within and among nations. During the next decade, attempts must be made to use the available natural resources successfully for further development, while at the same time ensuring that this foundation of the resource and environmental base on which development itself depends is not undermined.

Consumption of natural resources, both renewable and non-renewable, has increased in recent years. Developed countries consume the bulk of the world's natural resources, and irrational use patterns have greatly contributed to the deterioration of both the resource base and the quality of the environment. This is a trend that needs to be reversed. Furthermore, developing countries should not imitate the wasteful consumption patterns of developed countries. Renewable sources will remain renewable only if the ecological principles underlying their sustainability is respected, and similarly non-renewable resources can be rendered renewable, at least to a significant degree, by practising conservation and extensive recycling.

Food and agriculture

Let us consider an important natural resource sector — food and

agriculture — which is generally considered to be renewable. It is, however, renewable in terms of production only if properly managed. Acceleration of desertification, salinization, loss of productive soil, or loss of genetic resources, can significantly reduce the overall level of production. To provide adequate food and nutrition for the world's population during the next two decades, food production would have to be doubled by the year 2000. There are some natural constraints, such as availability of good agricultural land and adequate supply of water, which have to be considered in any planning process. Beyond these constraints, however, man dictates the pattern of development. If the strategies followed are ecologically sound and viable, it should be possible to increase agricultural production as required. Food is a net product of an ecosystem, and as long as the ecosystem remains healthy, it will continue producing food. However, improper management practices can undermine the agricultural system in various ways.⁹ As this is a vital sector, possible environmental trends will be explored briefly.

Food is a fundamental basic need: it is imperative that its production be increased and its distribution improved, both to meet the anticipated population increase during the next decade and to improve the nutritional status of the malnourished people in developing countries, who according to World Bank estimates are likely to increase in numbers from 400–600 million in the mid-1970s to around 1300 million by the year 2000.

Since most of the good agricultural land available is already under cultivation (for example, the *Global 2000*¹⁰ study projects an increase of only 4 % in cultivated land during the next two decades), much of the increase in required food production will have to come from increased yield. While there is much scope to increase agricultural yields in most developing countries, the fact still remains that the number of people to be supported per hectare of arable land will continue to increase from the figure of about 2.6 observed during the early 1970s. Currently, most strategies to increase yields place major emphasis on energy-intensive inputs and technologies such as fertilizers, pesticides, herbicides and irrigation, without concomitant emphasis on the long-term implications of continued use of such policies. In many cases, such strategies, which evolved during the era of cheap energy, have already started to produce diminishing returns. Even though it is now universally accepted that the era of cheap energy is over, this fundamental fact is still not fully reflected in agricultural development policies. There is now considerable uncertainty about the over-all impacts of changing hydrocarbon prices on agricultural production during the next decade, and their eventual implications for the global environment, a fact that needs to be studied carefully. The uncertainty further extends to the ability of farmers to maintain and expand agricultural production while attempting to shift away from energy-intensive inputs.

Intensive land use, increased use of marginal land and continued dependence of agricultural production on climate will probably mean that the variability of food supply will increase markedly during the next decade. The real price of food will continue to increase, and it now appears that the agricultural and trade policies of a small number of exporting and importing nations will play an increasingly dominant part in determining the quantities of food available for trade and aid, as well as their prices on the world market.

⁹Margaret R. Biswas, 'Agriculture and environment: A review', *Environmental Conservation*, Vol 11, No 4, 1984, pp 253–259; see also Margaret R. Biswas and Asit K. Biswas, *Food, Climate and Man*, John Wiley, New York, 1979, 285 pp.

¹⁰G.O. Barney, *The Global 2000 Report to the President of US*, 2 vols, Pergamon Press, Oxford, 1980.

Such development trends will have important implications for developing countries. Their overall requirements for imported food are likely to grow, although at the same time the share of the world grain market of food-exporting developing countries is likely to grow from the level of little more than 10% recorded in 1975.

In principle, the environmental implications of future agricultural development are manageable, provided appropriate strategies are adopted. The future environmental trends will affect land, water, inputs and ecosystems, all of which, in turn, will have impacts on agricultural development.

Desertification

While during the next decade new lands will be brought under cultivation, some of the existing land will undoubtedly undergo soil deterioration due to four principal problems: loss of topsoil, loss of organic matter, deterioration of soil structure and build-up of toxic chemicals and salts. All these developments would reduce agricultural yields.

Many signs of stress that can be observed at present also affect soil availability, as well as its quality. The magnitude of the problem of desertification and the urgency of countermeasures to reverse the existing trends can be realized from the following estimates:

- The process of desertification is accelerating at great speed, and as a result some six million hectares of productive land are being lost, and many more are deteriorating to close to zero productivity, every year.
- On the southern fringes of the Sahara, some 65 million hectares of once productive land have become desert during the last 50 years.
- Some 600–700 million people, nearly 14% of the world's population, live in threatened drylands, and of these about 60 million are immediately affected by desertification.

In addition to desertification, current trends indicate continued loss of good agriculture land to urban and industrial development. Increases in urbanization and suburbanization have accelerated the permanent loss of rich and alluvial soils, and in the industrialized OECD countries, urban land area is growing about twice as fast as population. An important future environmental trend could be the expansion of villages onto fertile land. There are already signs of this occurring in many developing countries, such as China and India, and the trend is likely to accelerate during the next decade.

Deforestation

Expansion of agriculture is a primary cause of deforestation at present, followed by demand for fuel-wood and forest products. If present trends continue, it is estimated that both forest cover and stocks of commercial-sized wood will decline by 40% during the next two decades in developing countries. From the environmental viewpoint, the potential impacts of this loss would be reduction of biological diversity and changes in climate and in soil and water regimes.

Biotic diversity is not only an important indicator of the ecological health of the planet, but also an essential storehouse for genetic materials for developing new crop varieties and medicinal drugs. While extinction has been the normal fate of virtually all species, the

magnitude of deforestation projected in coming decades could mean that the rate of natural extinction would be trivial when compared to man-made extinctions, which will occur primarily due to loss of habitats.

So far as climate is concerned, the main potential impact of deforestation could be increased levels of carbon dioxide. While much of the carbon dioxide in the atmosphere comes from combustion of fossil fuels, recent studies indicate that carbon stored in biomass is decreasing rather than increasing. Net decrease of biomass volume could imply carbon dioxide build-up in the future, though present estimates of the amount vary considerably.

Water resources

It is not only important to use land more rationally, but also imperative that water resources be used more efficiently during the next decade. At present, on a global basis, nearly 80% of all water used is for agricultural purposes. The need for irrigation is clearly indicated by the fact that even though only about 15% of the world's cropland is irrigated, it yields from 30 to 40% of all agricultural production. It is estimated that by the end of the present decade, in 1990, the total area irrigated in the world will increase to 273 million hectares, with 119 million hectares of this total in developing countries. More and more water will be necessary for irrigation. Thus, for developing market economy countries only, it is estimated that 22.2 million hectares of new land will be brought under irrigation, requiring 438 thousand million m³ of additional water. Certain parts of the world have already started to face water shortages, and the situation is likely to become worse in the future if current trends continue.

This assumes of course that the existing pattern of efficiency of water use will continue. At present, on a global basis, 1.3 million million m³ of water is used for irrigating crops, but for this 3 million million m³ of water has to be withdrawn.¹¹ This means that 57% of the water withdrawn is lost. The 43% of this water reaching the field is not all efficiently used. Over-irrigation is endemic, which not only constitutes wasteful use of a valuable resource, but also contributes to development of adverse environmental problems such as salinity, waterlogging and rise of groundwater tables. These side effects reduce the yield of the very land which irrigation, at substantial investment costs, was supposed to make more productive.

As water requirements for agricultural, industrial, hydroelectric power generation and other purposes increase, there will be increasing demands for further water resources development projects. Competing demands for limited water supplies or discharge of effluents to water-courses which would reduce water quality, and hence their potential use, could give rise to international conflicts, especially in the 148 of the world's important river basins that are shared by two or more countries. Similar tensions could arise in relation to coastal fisheries and offshore drilling. Accordingly, it is essential to codify guidelines for management of natural resources shared by two or more states.

The present decade has been proclaimed by the United Nations as the International Drinking Water Supply and Sanitation Decade. While both the United Nations Conference on Human Settlements and the United Nations Water Conference endorsed the target of clean water for all the world's population by 1990, on the basis of the present trends and of a realistic assessment of the future, this target is unlikely to be

¹¹Asit K. Biswas, *United Nations Water Conference: Summary and Main Documents*, Pergamon Press, Oxford, 1978, 217 pp.

achieved, even though the number of people, both urban and rural, having access to potable water and sanitary facilities will undoubtedly increase tremendously.

Fertilizer use

Where the various inputs, such as fertilizers and pesticides, used to increase agricultural yield, are concerned, the future environmental impacts will stem primarily from their more intensive use. Use of fertilizers per unit area is expected to increase in all regions during the next ten years. The consequence of this increased fertilizer use are expected to be more serious for aquatic than for terrestrial systems. The adverse impacts may occur from the leaching of fertilizers to lakes, rivers and coastal systems, which could contribute to eutrophication. Much of the nitrogen currently entering surface waters — in the USA more than 70%, according to one estimate — is from non-point agricultural sources. Furthermore, the presence of nitrate in drinking water supplies is dangerous to children under the age of three. Fortunately, however, levels of nitrogen that may pose hazards to human health — about 10 mg of nitrate per litre of water — are relatively rare, even in countries having high rates of fertilizer utilization.

Improper use of fertilizers could aggravate the problem of soil fertility. The atmospheric effects of fertilizer use are still not very well understood, but it has been reported that nitrous oxides from fertilizer application could deplete the ozone layer in the stratosphere. If this turns out to be a serious issue, future developments could present difficult choices between increased agricultural production and depletion of the ozone layer.

Pest management

Despite the growing interest in integrated pest management which could reduce use of pesticides, their application will also probably increase over the coming decade. From an environmental viewpoint, the problems to be expected are somewhat similar to those witnessed in many parts of the world, during the 1970s even though their magnitude and intensity could be different. These are:

- increasing biological concentration of persistent pesticides as they move up the food chain;
- development of pest resistance to pesticides;
- destruction of the natural enemies of the pest, which further reduces the effectiveness of pest control and increases the total cost;
- emergence of new pests which may not have been serious earlier;
- impacts on human health due to contacts with persistent pesticides.

Energy

As noted earlier, present agricultural practices are heavily dependent on energy input. Energy is an important natural resource, and availability of energy is a prerequisite for any development. The supply of energy, both commercial and non-commercial, is likely to remain an issue during the next decade.

Much emphasis is currently being placed on the possible future environmental impacts due to increased emissions of carbon dioxide resulting from the combustion of fossil fuels. It is anticipated that carbon dioxide emissions in 1990 will be about double those of the

mid-1970s. While scientists generally agree that emissions of this magnitude will not have major impacts, there is growing concern that, if such trends continue, accumulation of carbon dioxide in the atmosphere may cause climatic changes in the early part of the twenty-first century. According to some projections, continued deforestation and energy-related emissions of carbon dioxide could increase the concentration of CO₂ to approximately 600 ppmv by about the year 2030. While the scientific community increasingly accepts the likelihood of possible global warming from such an eventuality, there is no possible way of confirming its validity, timing or specific impacts. Much work remains to be done on this question in the future.

Increasing use of coal during the next decade could contribute to serious environmental problems, most of which could be limited if proper control measures are undertaken. Without such control measures, mining could create large-scale land degradation, including destruction of natural habitats, land subsidence and water pollution through acid mine drainage. Without adequate control systems, coal combustion could contribute to emission of atmospheric pollutants like sulphur dioxide, nitrogen oxides, particulates and trace metals. Such emissions could increase ecological and health hazards, including the problem of acid rain.¹²

Increased use of nuclear power would raise different types of environmental problems such as reactor safety, nuclear waste disposal and international security.

The major source of non-commercial energy is firewood, and it is not an inconsequential one: the total energy derived from wood in 1974 was about the same as from hydropower. Nearly 90% of global firewood consumption is in developing countries where the use of firewood is at present related to the level of economic development. The least developed countries and areas within countries tend to use the most firewood. According to an FAO estimate, firewood requirements are likely to increase at the rate of 2.2% per year, resulting by 1994 in a fuel-wood shortage of 650 million m³ annually in wood-poor countries.

Increased requirements for fuel-wood are an important cause of deforestation with its attendant environmental problems such as destabilization of nutrient cycles, soil erosion, decline in soil fertility and diminished capacity of soil to retain water (and hence often increased flooding). Accordingly, the organization and proper use of systematic fuel-wood plantation programmes in the future would, while meeting an essential need of the rural and urban communities, make a positive contribution towards environmental improvement.¹³

What is essential is to organize and manage the supply of the so-called non-commercial fuels with a view to sustaining and, if possible, augmenting their supply as well as improving the efficiency of their use. With respect to the latter, the role of women is the most crucial one, since they are principally responsible for gathering firewood and water and are in charge of household cooking. Increased efficiency will be greatly facilitated by providing training to women in the use of improved devices for cooking and heating.

The possibilities of switching to new sources of energy during the present decade appear to be limited,¹⁴ and to a great extent the energy crisis, for most countries, is a problem of oil. Kerosene is widely used in rural areas for lighting purposes, and diesel fuel is essential for transportation and irrigation. While certain oil-intensive activities like

¹²M.W. Holdgate, M. Kassas and G.F. White, *The World Environment, 1972-1982*, Tycooly, Dublin, 1982, 637 pp.

¹³Essam El-Hinnawi and Asit K. Biswas, *Renewable Sources of Energy and the Environment*, Tycooly, Dublin, 1981, 219 pp.

¹⁴Essam El-Hinnawi, Margaret R. Biswas and Asit K. Biswas, *New and Renewable Sources of Energy*, Tycooly, Dublin, 1983, 144 pp.

further mechanization in agriculture and use of automobiles do provide some scope for conservation in developing countries, the potential is somewhat limited — certainly significantly less than in the developed countries.

Marine environment

While there appears to be little threat to the open ocean waters at present, coastal waters and enclosed or semi-enclosed seas are receiving increasing loads of pollutants, primarily as a result of man's activities on land which inject matter into rivers, coastal outflows and atmospheric fallout on the oceans. The coastal areas are of critical importance for the well-being of marine biota, on whom future food supplies may increasingly depend, and for human health, for it is here that man is directly exposed to contaminants from bathing and from seafood. Continuing assessment of the significance of present trends is essential for the proper management of these areas. Alternative courses of action must be identified so that they will be available when it becomes advisable to reduce the injection of critical pollutants into the seas from key sources. A more rational approach to the development of coastal zones would pay heed to the need to protect areas identified as critical for breeding and development of marine biota, yet these same coastal areas can be expected to become more crowded as a result of projected demographic growth, together with competing demands for agriculture, industry, transportation, tourism and other development sectors.

New patterns of development and lifestyles

Throughout the history of mankind, lifestyles and development patterns have never been constant, but have continually evolved and changed with time. Furthermore, lifestyles and development patterns at any specific time vary from one country to another, and often there are significant differences between different parts of the same country.

Present lifestyles in advanced industrialized countries can be characterized by several facts, among which are intensive use of resources, high capital investment, high rates of technological developments, low rates of population growth, comparatively low unemployment and rates of inflation, and the availability of a trained pool of personnel to carry out various functional tasks. The majority of the developing countries, on the other hand, have higher rates of population growth, low consumption of resources, high unemployment and underemployment, scarcity of capital (except in oil-exporting countries), high illiteracy rates, and often an agriculture-based economy with strong income inequality and widespread poverty. Overall economic growth and attempts at modernization of various sectors, which were expected to provide better equality and to democratize developing societies, have on the contrary often helped to accentuate economic and socio-political polarization.

Rural development

The majority of the poverty-stricken people in developing countries live in rural areas, and their incomes are mostly directly linked to the agricultural sector. So far, the concept of trickle-down development has failed to improve their lifestyles to any appreciable extent. It is this sector which needs modification, and the present patterns of growth

need to be drastically changed during the 1980s. Such modifications, however, can only take place if the rural poor, and especially those who are landless or have very small holdings and who constitute the core of the rural poverty problem, are specifically considered to be the important beneficiaries of any development strategy. It is not going to be easy to reverse the past and existing trend, since the rural poor are often illiterate, unemployed or underemployed and in poor health, and thus often are external to the decision-making process which selects development strategies that affect their lives. Future development efforts will have to consider not only the total benefits accruing from a project, but also how the benefits are distributed. Any development, in which the distribution of benefits is markedly skewed, so that they accrue primarily to a select group of élites, is bound to be unsatisfactory and unsustainable on a long-term basis. Narrowing disparities in the distribution of income is likely to improve the environment.

There are many reasons why rural development has not been more successful so far. They include:

- higher rates of population growth, which mean that the meagre productive assets owned become more fragmented in successive generations;
- lack of education and training, which means that not enough information is available as to how the meagre assets of the rural poor can be used more effectively and productively;
- poor health due to unavailability of adequate food and nutrition, lack of potable water, sanitary arrangements and health care facilities;
- weak links to the organized market economy, i.e. lack of access to credit, essential inputs and improved but appropriate technology, problems with marketing of products, etc.;
- use of resources and the environment, for sheer survival, in ways which are unsustainable over the longer term.

Poverty and environmental degradation

The presence of widespread poverty is often the cause of serious environmental deterioration in developing countries. When reinforced by accelerating population growth, it contributes to the continual erosion of the resource and environmental base from which people must earn their livelihood, thus completing a vicious circle which is proving difficult to break. To meet their desperate immediate basic needs for mere survival, the rural poor have no other option but to cultivate marginal land which is prone to heavy soil erosion, graze their livestock on land that is becoming barren from overuse, cut shrubs and trees for fuel-wood, thereby reducing the stability of soil and water regimes, and burn dung which otherwise could have improved soil fertility. Trapped in conditions of absolute poverty, their actions contribute to the further deterioration of the renewable resource base, making their plight even more desperate with the passage of time. Thus, many of the world's most severe environmental problems are in part a direct consequence of extreme poverty, and it is neither likely nor realistic to expect that impoverished people living at the margin of existence will consider the long-term sustainability of the planet at the cost of their own survival. Without determined attempts to improve their living conditions through further development, the situation is unlikely to get better. This is a major trend that needs to be reversed as soon as possible, before

damages becomes too extensive and irreversible, so that the renewable resources base of this planet can be conserved — and wherever possible enhanced — for the good of both present and future generations. As the recently issued report on *Global 2000*¹⁵ by the US Council on Environmental Quality has concluded:

Only a concerted attack on socio-economic roots of extreme poverty, one that provides people with the opportunity to earn a decent livelihood in a non-destructive manner, will permit protection of the world's natural systems. Nor will development and economic reforms have lasting success unless they are suffused with concern for ecological stability and wise management of resources.

Appropriate technology

Development depends not only on people, but also on the resources and technology they have access to, and the environmental framework within which these are utilized. Developments, both in the industrial and the agricultural sectors, should not necessarily mimic western models and technology. They should be closely related to the resources base of individual countries, which needs to be assessed and then efficiently developed on a long-term basis for the good of the maximum number of people, and with due regard for the environment. During the next decade, it is essential that biophysical resources be mobilized effectively so that the goods produced — industrial and agricultural — are less extravagant in the use of resources, do not contribute to environmental deterioration, and improve the overall quality of life.

By itself, technology employed in the service of development is neutral, but how it is used can determine the success or failure of a project. Choice of technology depends on a variety of technical, social, economic, environmental and political factors, and many times what may be considered to be the most appropriate technology in one country could turn out to be the most inappropriate for solving almost identical problems in another.¹⁶ A review of the history of modern development will often indicate that straight transfer of technology from developed to developing countries has often created more problems than it has solved. While South–South technology transfer through technical cooperation between developing countries makes a great deal of sense, it should not be axiomatically assumed that such direct transfers will present no serious problems. Developing countries are not all the same: they are often at different stages of development and may have different social, economic and institutional backgrounds.¹⁷

To the extent it is possible, appropriate technology for developing countries should be labour-intensive. While this point has received the attention of many planners and engineers for a long time, attempts to use labour-intensive techniques on a continuing basis can be best described as timid and half-hearted. The few successful examples of this approach have been due to the determined labour of a handful of dedicated individuals, and were mostly isolated efforts. Even in these few cases extensive documentation of the techniques used, their costs, effectiveness and public acceptance, and other relevant information are not readily available to others who may wish to use similar technology. Very little has been achieved at implementing such successful techniques at national levels. The virtues of appropriate technology, in short, are more often preached than practised.

Many instances could be cited of socially and environmentally inappropriate technology being imported to developing countries,

¹⁵Barney, *op cit*, Ref 10.

¹⁶See Ref 9, and Asit K. Biswas, *Climate and Development*, Tycooly, Dublin, 1984, 146 pp.

¹⁷See Ref 9.

through either bilateral or multilateral aid programmes, without critical appraisal. Foreign consultants and contractors are often used to plan, design and implement projects. In the majority of these cases, they are not fully familiar with the prevailing social, economic, institutional and cultural norms of the developing countries concerned, and accordingly they often use criteria which are based on experience and knowledge gained in the advanced industrialized countries which may not be applicable locally.

Some attention has been paid during the past decade to elaborating the concept of environmentally sound and appropriate technology, studying the problems and methodology for producing such technology, and developing criteria and methodologies for selection of the best results. However, the application of these concepts in an operational context leaves much to be desired, and needs to be accelerated.

There has been some discussion in recent years of the question of non-waste or low-waste technology, which can be defined as the practical application of knowledge, methods and means to provide the most rational use of natural resources and to protect the environment. Expressed differently, it is the planning and management of human activities in order to provide the minimum waste of materials and energy, both in production processes and in consumption patterns. Waste should be considered as a loss of potential resources, and attempts made to reduce waste will undoubtedly produce numerous beneficial results. The development and promotion of non-waste technology, which eventually should replace conventional technology, is a long-term endeavour of the greatest importance, whose realization would contribute to positive changes in all sectors of industry which would not only promote more rational use of natural resources, but also improve environmental quality.

It is clear that research and development work to promote non-waste technology has still not reached a desirable level. There is an urgent need for further work to devise criteria for economic evaluation of non-waste processes, especially of the transformation of wastes, and for the identification and operation of non-waste production processes which would take full account of environmental factors.

Hazardous waste

The persistent pesticides mentioned earlier are but one of many classes of synthetic organic chemicals which are increasingly manufactured and released into the environment, where their performance has become ubiquitous. Recent UNEP reports indicate that some four million identifiable chemicals are in current use with new chemicals entering the market annually, many of which may have unintended adverse effects on man's health or well-being. Some of these effects may be delayed by transfer processes such as biological concentration as they move up food chains. Similarly, disposal of chemical wastes is in many areas proceeding without regard to future risks, for example to ground water, which, by the time they are detected, may be prohibitively expensive or technologically impossible to correct. Man's exposure to environmental pollutants, whether in food, water or the air he breathes, is a stress which may impede his functioning or even lead to mortality, especially in cases where malnutrition or other deprivations have already applied other forms of stress. Similarly, much of the biota on which man depends for his well-being, such as agricultural crops, may be put under

stress by the impact of chemical (and other) pollutants. In view of the trends of increased production of synthetic chemicals and more intensive use in industry, agriculture and other development sectors, increasing attention must be paid to assessing the significance of trends in pollutant releases, pathways, loads and effects to ensure that warnings, where necessary, may be sounded in good time, and that alternative courses of action to society to reduce the threats are available.

Lifestyle and energy

The lifestyles and development and technological patterns that have generally evolved during the past three decades have been primarily energy-intensive and are highly dependent on oil. Sharply increased oil prices and unreliability of supplies are now forcing major adjustments for both developed and developing countries. While such major changes have had significant impacts on industrialized nations, the impacts on oil-importing developing countries have been very serious indeed, limiting their access to energy and burdening them with economic costs which they find hard to bear, and sometimes devitalizing all other sectors. A major problem facing the developing countries is one of reconciling the need for increasing the energy input for productive economic activity within the context of a global situation of depleting energy supplies and rising costs. In addition there is the further problem of a highly skewed energy consumption pattern among people of different income levels, with people in the upper income brackets using a disproportionate share of energy.

It is essential that possible alternative responses to this situation be urgently reviewed. Solutions could include, inter alia, an intensive drive to conserve energy in all spheres, changes in lifestyles that would use less energy, especially oil, than before, and development of alternative energy sources that are both renewable and indigenous. Further consideration should be given to coal, natural gas and other forms of energy, with careful assessment and review of environmental and other potential adverse effects associated with such systems, including the problem of deforestation due to increasing use of firewood and the transformation of good food-producing land to growing biomass for conversion to fuel. These alternatives, however, may not be the final solution for many developing countries, which after paying higher energy costs, may find themselves with insufficient resources to sustain a satisfactory rate of growth. Intensive international cooperation will be necessary to overcome this hurdle.

People's participation

New patterns of development will require a more decentralized and participatory approach to planning. Past experiences indicate that centralized, top-down efforts fail more often than they succeed. The leaders and bureaucrats may be more educated and sophisticated than the rural populace, but the 'best and brightest syndrome' often fails in development.

Accordingly, people's participation in shaping events that will ultimately affect their lives is an economic necessity as well as a social must. The people know what is required, and are familiar with local conditions, availability of indigenous resources and the strengths and weaknesses of the community. The people must be responsible for the

creation, operation and maintenance of development projects. Such planning and implementation processes will ensure that their needs are properly identified and that the solutions will be visible. In addition it will make them realize that the project is theirs, and that they therefore have a responsibility to optimize the use of resources and then to maintain the development works.

Development can be sustainable if it is based on the solid foundation of equity, mobilization of indigenous resources, use of appropriate technology and full utilization of human capital. Development strategies have to be centred around people, and human resource development should be planned so as to provide the necessary conditions for the much needed change in attitudes and prepare for a more conducive atmosphere wherein new ideas and technologies can be successfully absorbed.

While some conceptual studies have been carried out in the past on the incorporation of public participation in the planning and decision-making processes, and a few individual studies are available on their implementation at the project level, much work remains to be done on how to make such practices operational, especially at higher than project levels.

Environment and development

Much work has been done during the past decade on the question of compatibility between the environmental and the socio-economic objectives of development, and on the need for and feasibility of integrating them systematically with each other. Starting from the Founex meeting prior to the Stockholm Conference on the Human Environment, and through the work of UNEP and other organizations, it has been established that environment and development are complementary, and represent two sides of the same coin. Throughout the decade, perceptions of the development process have been changing and greater awareness has been developing on the importance of environmental considerations in protecting and maintaining the resource base on which development depends.

Conceptually, the complementarity between environment and development was clarified during the last decade, and to a large extent was accepted by planners and decision-makers. However, there has not been much progress in translating these concepts into practical and operational terms. Whatever progress that has been made thus far has been primarily at the project level, which not surprisingly is the simplest. Integration of environmental considerations in development plans has not been a success so far. Undoubtedly this should be a priority issue for the coming decade.

A critical analysis indicates that there are at present many opportunities for promoting development processes that will sustain long-term productivity. For example, integrated water resources development can be better planned and managed to ensure better and more reliable water availability, mitigate flood damage and increase aquaculture, and at the same time reduce adverse environmental impacts on land, such as salinity or waterlogging, and prevent the spread of water-borne diseases. Agricultural systems could take advantage of integrated pest management, organic fertilizers and nitrogen fixation, and reduce the use of persistent and destructive chemicals. Transportation systems can be planned to discourage urban sprawl and reduce dependence on

petroleum. Land-use patterns can be controlled so that good land remains available for agricultural purposes and is not lost to urban and industrial developments. There are many other ways in which both developed and developing countries can promote environmentally sound development. However, while more than enough information is currently available which can be successfully used to promote such development, it is unfortunately still not being widely used. Measures to promote environmentally sound development should therefore be a top priority for the coming decade.

While any development activity will have some impacts on the environment, the overriding consideration in the selection and implementation of development strategies has to be minimization of environmental costs and maximization of benefits. It is therefore essential that future strategies and projects be subjected to systematic environmental impact assessments. An important activity of the next decade has to be the development of new methodologies for environmental impact assessments that are reasonably accurate, and can be carried out within a limited budget and time-frame. The techniques should not be too complex, so that people can be trained to use them comparatively easily.¹⁸ Multidisciplinary and intersectoral studies and research need to be promoted in order to develop and continually refine such assessment techniques.

While there is increasing realization of the need to accept certain fundamental realities, the concept of the essentiality of long-term ecological sustainability of any lifestyle is yet to be widely accepted. The search for appropriate lifestyles will require changes in both supply and demand of goods and services, including the choice of goods to be produced and techniques used to produce them. Furthermore, production should be responsive to the needs of the vast majority of the people, and not only of the privileged few. Lifestyles must be in harmony with nature and in equilibrium with the prevailing circumstances. In other words, wasteful consumption should be discouraged, natural resources should be used rationally, and the environment should be protected.

There is an urgent need for demand orientation, especially reordering of consumption patterns in profligate societies, which will permit the transition from a consumer society preoccupied with vast resource consumption to a conserver society engaged in more constructive endeavours. What are needed during the next decade are more equitable development styles which would encourage the poor to productivity by granting them access to resources which they currently lack.

Exhortations about the need to alter lifestyles are unlikely to have much success in either developed or developing countries. The desirability of changing lifestyles in developed countries has been recognized by many of their citizens in recent years, and some examples of new attitudes and perceptions can be discussed; these are still very few and their overall impacts, though not negligible, have been somewhat limited. What is necessary is to find viable means which could help to achieve desirable changes.

¹⁸Asit K. Biswas and Qu Geping, *Environmental Impact Assessment for Developing Countries*, Tycooly, Oxford, 1985.

Other considerations

In addition to the discussions under the previous three broad categories,

there are a number of general comments worth making that relate to major environmental trends in the next decade. Some of these are implicit in the previous sections.

First, it should be emphasized that the various regions of the world are each quite heterogeneous in terms of types of ecosystems encompassed, extent and magnitude of different problems confronting them, and institutional infrastructures available through which solutions could be implemented. This means that programmes need to be developed in response to the specific requirements of the regions, even though it may be possible to include them within broad global solutions.

Second, while existing knowledge can be applied to ensure proper environmental management, this will prove futile if such exercises are not backed by strong environmental assessment programmes that will carefully assess the magnitude of each problem, monitor the results of its management, disseminate information on such results and identify gaps in knowledge that need to be filled.

Third, neither environmental assessment nor environmental management will progress in substantial measure without strong emphasis on the supporting measures identified at Stockholm, environmental education and training, public and technical information and technical assistance, especially in the developing countries in the next decade.

Fourth, many of the major problems that mankind will be facing during the next decade are not new. We already know of their existence and in many cases enough information is available to solve them. Thus, what is necessary is determination and political will to implement the solutions.

Finally, recommendations, resolutions and agreements on plans of action, while an important first step, are not enough. Much time and resources were spent in preparing the action plans that resulted from various past conferences of the United Nations. While funds were available to develop the action plans, not enough resources are available to implement them at both national and international levels. Without determined attempts to generate such resources in order to transform the plans into actions, the efforts made will be wasted, and action plans will become academic exercises that would gather dust on bookshelves. This is a trend that needs to be reversed during the next decade.