

CHAPTER 2

Environmental Problems

2.1 HUMAN ACTIVITIES AND ENVIRONMENTAL PROBLEMS

In the coming decades, mankind will be faced with a multitude of environmental problems. Not only are these problems numerous, but they vary greatly in their nature and in the scope of their impact. Some are widespread, others are local; some are obvious, others involve hidden effects which become all the more worrying once they are recognized. Simulation modelling may play a role in developing policies to minimize these environmental problems.

Different human communities are confronted with different sets of environmental problems, and, even if they had the same problems, they would probably see them differently. This is particularly true of comparisons between developed and developing countries. Most environmental problems of the former result from intensive industrialization and advanced standards of living, achieved with little regard to possible environmental effects. Although similar difficulties are now arising in the developing nations, many of their environmental problems are different, and centre around the need to increase food production and resource utilization to match the requirements of a rapidly expanding population.* Some of the more important environmental problems in these two groups of countries are listed in Table 2.1. A number of the problems listed for developing countries in this table are of little or no importance in developed countries; but the reverse is not often true. It may be assumed, in fact, that problems in the first column either already exist in the developing countries, or are likely to appear as development proceeds unless measures are taken to avert them. At present, however, they are overshadowed by the problems listed in the second column.

While the problems in the developed and developing worlds may differ greatly, these lists are not meant to suggest that the environmental problems mentioned are peculiar to one or the other group of countries. Some of the worst atmospheric pollution is found in rapidly developing cities of the third world; rural depopulation is a problem in Australia as well as Peru. Nevertheless, these same problems may be viewed or dealt with differently, depending upon the state of development, the institutional and political systems, and the economic capability of the nation in question.

Finally, there are environmental problems which threaten all mankind alike, although often they are poorly recognized. Even if perceived, it is difficult, if not sometimes impossible, to generate international consensus on possible solutions.

*They were considered in detail at a symposium held in Nairobi, Kenya, in 1974 (SCOPE, 1974a, 1974b).

TABLE 2.1 Important Environmental Problems in Developed and Developing Countries in Connexion with Different Fields of Human Activity

| Developed Countries | Developing Countries |
|--|---|
| 1. FOOD PRODUCTION | |
| <ul style="list-style-type: none"> – effects of strategies for planting, fertilizing, pest control, irrigation and storage. – development of unstable, monocultural systems. – reliance on energy-intensive practices. – effects of land allocation for crop types and/or grazing. – soil erosion and problems of water use. | <ul style="list-style-type: none"> – effects of strategies for planting, fertilizing, pest control, irrigation and storage. – effects of introducing fertilizers, pesticides, and mechanized methods. – spreading of weeds and pests through the introduction of new crop varieties. – effects of 'slash and burn' practices, and of clearing scrub. – soil deterioration – erosion, salinization, waterlogging. – desertification of arid lands, resulting from overgrazing or unwise clearing and cropping. |
| 2. USE OF FORESTS | |
| <ul style="list-style-type: none"> – environmental impacts of planting and harvesting strategies. – environmental impacts of disease and pest control. – conflicts in providing for habitat preservation, recreation and multiple usages, including forests as energy sources. | <ul style="list-style-type: none"> – forest destruction. – poor forest management resulting in undesirable changes in species composition. |
| 3. PATTERN OF LAND USE | |
| <ul style="list-style-type: none"> – environmental effects of land allocation policies for cities, waste disposal sites, agriculture, forests, transportation, natural and recreational areas, etc. – problems of settlement on flood plains, geologically hazardous areas, etc. – spoiling of land by extraction industries (oil pipelines, strip mining, slag heaps, etc.) and lack of adequate measures of control. – long term effects of various land uses. | <ul style="list-style-type: none"> – effects of dense urban settlement – disease, sewage, pollution, etc. – untimely exploitation of non-renewable resources. – environmental results of land tenure systems leading to fragmentation. – penetration of little known areas, and resultant transport of disease, exotic species, etc. |

TABLE 2.1 (continued)

| Developed Countries | Developing Countries |
|---|---|
| <ul style="list-style-type: none"> - excessive energy use through an energy-intensive standard of living, and failure to adopt energy conservation techniques. - environmental impacts associated with production, storage, allocation and transmission strategies. - environmental hazards of some new energy sources (nuclear safety, oil shale exploitation, etc.) and lag times in the development of improved sources (solar, nuclear fusion, etc.) | <ul style="list-style-type: none"> - depletion of nutrients and deterioration of soil due to use of charcoal and dung as fuel. - impacts associated with developing supplies of energy to support increased levels of industrial and agricultural production. |
| <ul style="list-style-type: none"> - environmental impacts of developing, storing and allocating water supplies. - short and long term impacts of weather modification. | <ul style="list-style-type: none"> - difficulties of availability of water in quantity and quality necessary for urban settlement. - problems with rural water supplies. - adverse effects of new irrigation systems, including introduction or increase in diseases, and changes in soil composition and structure. - incidence of floods. |
| <ul style="list-style-type: none"> - impact of pollutants on health, property and food production. - introduction of synthetic trace chemicals. - transportation of pesticides and disease. | <p>6. POLLUTION AND WASTE DISPOSAL</p> |

Air

- pollution impacts of traffic patterns.
- thermal effects of power plants.
- effects of weather modification efforts.
- trapping of terrestrial radiation by gases; effect of changes in ozone layer.
- depletion of solar input by particulates.

Water

- pollution by municipal sewage and industrial waste.
- eutrophication of freshwater bodies from sewage and agricultural runoff (including intensive animal production areas).
- thermal pollution by power plants.
- contamination of ground water reserves by underground disposals, percolation from landfill, etc.
- marine pollution by oil discharges and spills, and hazardous waste disposal.

Land

- uncontrolled erosion.
- impacts of landfills and other above-ground disposal sites.
- irresponsible disposal of litter by individual citizens.
- leaks from underground disposal of hazardous wastes.

- sanitary and pollution problems of villages.
- air, water and land pollution are all increasing as the process of urbanization and industrialization get underway. Furthermore, they often pose special problems because of inadequate lead-time and preparation.

7. SOCIAL LIFE

- population density problems.
- excessive noise.
- impacts of social attitudes and consumer preference.

- problems of intensive urban migration and settlement.
 - rural depopulation.
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Among them are:

- possible long-term climatic change (in average, trends and variability) which may be associated, for instance, with increasing consumption of fossil fuels;
- exhaustion of non-renewable resources;
- changes in populations of animal and plant species, including extinctions and exotic introductions;
- possible changes in atmospheric transmission of radiation – for instance, through use of aerosols and supersonic aircraft.

Lack of familiarity with the scientific and technical means to solve environmental problems leads some developing nations to assume that environmental management implies that their further growth in energy and material demands must be controlled and that their rate of development may be restricted. That the developing nations can expect their material demands to grow, and their consumption of energy and matter to increase, goes without saying. While this growth proceeds, though, modern methods should be applied to reduce or to eliminate the potential damage to local and global ecology. The errors made by the developed nations which have led to the present concern must be corrected; meanwhile, the developing nations should avoid falling into the same errors.

2.2 DIFFERENCES IN OUTLOOK ON ENVIRONMENTAL PROBLEMS

In addition to differences between developed and developing countries, there are contrasts in perception of the prevailing problems between different nations and between sections of the population within single nations. For the general public, in the three-quarters of the world that is over-crowded and underfed, the prime environmental problem is simply the pressure of the population on the supply of food – pressure which accentuates day by day as population increases more rapidly than the ability to produce food. This situation is probably perceived less as a collective crisis than as a life-or-death struggle on the individual level. To those living in wealthier countries, in contrast, the smarting of their eyes from air pollution, or the fact that they can no longer swim in their preferred lake now that it is contaminated with industrial wastes, may loom as their most important environmental concern. By and large, the general public in *all* countries take a short-term outlook on environmental problems. Long-term expectations catch the popular attention only where they are given prominence in publicity. Otherwise, an individual's foresight is generally limited to days or weeks, and to environmental features directly affecting his own life.

Decision-makers in governmental bodies vary in their outlook on environmental problems according to the position they occupy. Politicians subject to re-election by popular vote, however clearly they may themselves perceive longer-term problems, must give their main attention to those environmental problems which are most prominent in the mind of the electorate; consequently the time-scale for politicians is too often limited by the next election. Decision-makers in the public

service may have longer-term views of environmental problems, particularly if their positions are such that they are likely to remain in contact with the same problems over an extended period. As a result, long-term responsibilities in the environmental field will often fall on their shoulders. They need, however, to balance the environmental effects of the decisions they make against economic, social, and other impacts, and to take into account political pressures that exist or are likely to develop.

Private corporations whose decisions affect the environment may operate on a time-scale similar to the permanent public service; however, their motivations are different. If they take into account the ways in which their decisions may affect the environment, they usually do so only insofar as these effects may modify public opinion or governmental action, or otherwise influence the profits and work of the corporation. Conversely, effects from which there will be little or no feed-back to the corporation's affairs are likely to be given little attention.

Any decision-makers who are in the public eye, whether in private corporations or in government, and whether elected or appointed, must take account of public reactions to their decisions. Among the problems which may confront them are the activities of 'action groups', usually local but often vociferous and even aggressive. Such 'action groups', however sincere, are almost *ex hypothesi* partisan in their approach to environmental questions, and consequently may hamper decision-makers in arriving at the most appropriate decisions, which are nearly always a compromise between diverse interests.

The way in which a decision-maker perceives the environmental problems with which he is confronted may be a crucial factor in the decisions reached, and the appropriate degree of balance is not easy to achieve. The problems affecting the environment and their solutions involve physical, chemical, and biological processes, technological developments, social consequences, economic progress, legal aspects, political rules, and ethical and aesthetic values. While some of these diverse fields are subject to quantitative evaluation, others are limited either to qualitative estimates or purely emotional reactions. Even if a decision-maker has some relevant expertise, it will inevitably be limited to a part of the subject-matter affected by his decisions. He cannot have detailed personal knowledge of all relevant fields. The way in which he perceives the situation with which he is confronted is consequently of great importance.

Scientists generally view environmental problems on a longer time-scale than that of the decision-maker. However, their focus is narrower, since the training and career structure for scientists do not usually encourage them to become familiar with subjects outside their own area of expertise. Thus, the physical scientist may concentrate solely on climatic change, while the biologist is more interested in the fate of endangered species. The economist may concern himself with the allocation of money values to environmental parameters, and the social scientist is likely to give more attention to the problems of the population explosion, high density housing, or rural depopulation. At present, means for encouraging interaction among these disciplines tend to be poorly developed.

There is no absolute measure for the relative importance of different environmental problems. The views of all groups, from the public to the scientist, from the least to the most highly developed country, are all relevant within their own frame of reference. It is not the responsibility of the environmental scientist or

modeller to try to reconcile or resolve these differences. Rather, he should see his role as the determination and clarification of all likely consequences of any action that may be contemplated. It is in this context that the main value of simulation modelling in the environmental field lies. If causal chains and networks can be established in complex systems, simulation modelling is a tool whereby these interconnections can be explored. Hence, the effects of modifying one part of the system can be discovered and related to the consequence for other, more remote, parts. This gives one a better understanding of the dynamics of the system, and thus enables one to predict the results of proposed actions, and to select that action which seems to be most desirable among a set of possible options.