

Environmental Impact of Irrational and Wasteful use of Natural Resources

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1. Concepts and definitions

In order to discuss the environmental impact of the irrational and wasteful use of natural resources, the limits of the task must be defined. The following are not intended as strict definitions, but are designed to illuminate the concepts which have guided the preparation of this report.

Irrationality and wastefulness

The outcomes, in terms of policies, programmes or projects of decisions relating to the use of natural resources are "rational" if they make use of known resources in the best possible known ways to further the aims which a given society has set itself, taking account of all effects known to follow from the choice. A distinction should be made between "irrational use", in which existing knowledge is not acted upon, and "non-rational use", which is the result of defective or incomplete knowledge. Thus *rationality* implies the adjustment or behaviour to a perceived human purpose. While the nature of this purpose is not in itself subject to criteria of rationality (encompassing, as it must, moral or spiritual values), it includes the satisfaction of basic human needs and the handing down to successive generations of at least the same opportunities for fulfilment of their purposes as have been enjoyed by those which preceded them.

"Wastefulness" is probably best regarded as the particular form of irrationality in which a given level of fulfilment of human purposes is achieved with the use of *more* resources than necessary. In any case, the *composition* of resources used may entail "waste" in the sense that some resources are used to excess while others are under-utilized. Finally, resources may be "wasted" in support of profligate life styles for some while others lack the resources for even basic subsistence. While the first form of irrationality wastes resources, this last wastes opportunities for human satisfaction.

Private firms, transnational corporations and States are all capable of irrational action. If the overriding purpose and the criteria for judging actions derived from it can be clearly defined, the *global* rationality of resource use could be improved: (a) by inducing all decision-making units to rely more extensively on the approved criteria, or (b) by shifting the power of choice to those units which do.

Rationality, as defined here, must not be confused with "commercial rationality" in the sense of maximum

profitability *in terms of market costs and prices*: these may not reflect the "true" burdens and benefits accruing to society from the activities involved. At both the national and the international level, the aim should be to achieve broader social needs rather than the private demands of those who have the purchasing and political power to own and control resources. The rationality of actions must be tested in terms of *socially* meaningful prices, costs, and interest-rates, which aim to take account of all effects, including the environmental effects which ordinary market criteria tend to neglect.

Environmental impact

The environmental impact of social, political and economic activities comprises the direct and indirect effects, either beneficial or harmful, which those activities may have on the quality of man's habitat and his welfare. "Quality" in this sense must be taken to include the social, economic, and physical characteristics of man's environment, and should not be restricted to any one of these alone. Three basic types of environmental effects are:

1. *Encroachment effects*. One activity may affect others through the changes it introduces in the social and physical setting in which those other activities take place. Such "encroachment effects" may impair the level of productivity and cost-effectiveness of producers or the satisfaction which people derive from work, consumption and other conditions of life. Resulting stress situations may require the diversion of resources to remedial and welfare services, quite apart from the loss in working efficiency and the increase in absenteeism which they generate.

Encroachment-effects may impinge on either mental or physical well-being. They may stem from changes in the natural environment, like air or water pollution, the fouling of land surfaces, and the degradation of scenic or recreational values or from the growing density of human populations. They may change the social environment, create stress, or disrupt home, family and social patterns of living. In all these cases, the cost to human beings is difficult to estimate by established measurement techniques.

2. *Exhaustion effects*. These effects occur when an activity reduces the future availability or accessibility of resources. Through excessive current use or wasteful methods of production, a resource may be depleted or

degraded to an extent that precludes regeneration, thereby ruling out future productive activities. Current economic criteria must therefore be amended to provide timely warning signals and guidance in order to avoid permanent depletion or exhaustion of essential resources.

Closely related to depletion is the neglect of future increases in productive costs in making decisions about current output. For example, in the extraction of minerals from the most accessible strata, such neglect will accelerate current exploitation and may pre-empt for the future opportunities which it might have been rational to spread more evenly over time.

3. *Distribution effects.* Finally, there are effects which spring from the distribution of command over economic resources. Extreme forms of poverty and extreme degrees of inequality of access to resources are themselves a form of environmental encroachment, depriving much of the population of opportunities for human satisfaction. Activities which improve employment and income-earning opportunities for the lowest income groups, both nationally and internationally, are needed if such encroachment is to be reduced.

Any activity may give rise at one and the same time to all of these three types of environmental impact. The use of land for industrial development may "encroach" on existing resources, "exhaust" forest or wildlife resources, and "redistribute" incomes against the poor by displacing farmers or craftsmen in excess of the new employment opportunities created. When the effects are cumulative or contradictory, the problem of evaluation becomes even more complex.

The environmental impact of the world's economic activities depends on three principal factors:

- (a) The level and composition of the global output of goods and services;
- (b) The method chosen to produce that output (including the extent to which waste products, by-products and end products are recycled), and
- (c) The nature of the resources used in production (in particular, whether they are renewable or recyclable, exhausting or non-recyclable, or environmentally damaging in the process of use and recovery).

The first of these is discussed in Section 3 below and the third in Section 4. Technology is the subject of separate UNEP activities.

Natural resources

Natural resources are those economic goods which are not created by any human transformative industry. The natural resources of a country — land, water, minerals, living organisms, etc. — must be so managed as to enable it to maintain a continuous flow of goods from them, taken as a whole and including their value in trade, for both present and future generations. At the global level, the world's

resources must be managed for the benefit of mankind as a whole.

Like products, natural resources can serve as "final goods" (directly consumed water, plants or minerals); like "man-supplied" factors of production, they can serve as inputs. Judgments about the use of natural resources cannot however be made independently of judgments about the use of human and technological resources, as the overwhelming bulk of goods needed by mankind can only be produced if all of these are brought together in the right proportions.

Development

Development is used to mean increasing human welfare, improving its distribution (including the achievement of minimum living standards), creating and sharing opportunities to participate effectively in economic, social and political activities, and enhancing this generation's developmental and environmental legacy to the next. In this sense, development, like environment, is a global concern, not one restricted to the poorest nations. Development transcends the mere provision of material goods, essential as some of these may be for development to occur. This definition would preclude any nation, rich or poor, from pursuing material well-being without regard for environmental effects, because the quality of habitat is an essential dimension of the quality of life.

2. The interaction of man and planet

The earth's biosphere consists of: (a) the *atmosphere*, comprising the ozone shield, oxygen, nitrogen and carbon dioxide; (b) the *hydrosphere*, and its composition of rivers, lakes, underground water and the oceans; (c) the *soil cover* of the earth's terrestrial area; and (d) the *vitaspHERE*, i.e. the so-called "living matter" of the earth. The four components are in constant interaction with each other, and changes on one component will inevitably lead to changes in the others.

Human activity directed at the satisfaction of material wants has inevitably become a part of these interactions and affected the evolution of the biosphere. Until recently, however, man has not been guided by a knowledge of the complex changes in the biosphere which his activities have initiated, or even by a consciousness of the need for rational planning of his activities in relation to its components. As understanding of these effects and this need has improved, man's earlier non-rational attitude to the biosphere has become increasingly irrational, in that it ignores the knowledge that continuation of current trends in both industry and agriculture implies growing environmental degradation, depletion and pollution, and consequent feedback effects on human welfare and opportunities for improvement.

However, more "rational" management of human

activity and the biosphere, aimed at improving the quality of human life and simultaneously conserving the quality of the planetary environment, is still possible. The feasibility of this option depends on (a) the improvement and diffusion of knowledge about the interaction between environmental effects and quality of life and (b) the strengthening of political will and social awareness so that both public and private decisions are duly influenced by man's growing environmental knowledge.

A. The nature of environmental contamination

Some "resource-encroachment" effects which may be identified as flowing from recent patterns of economic activity are:

(a) A steady reduction of areas of biologically active soils in favour of the construction of towns, ports, roads, mines, factories, etc. This process absorbs perhaps 7–8 million hectares of arable land every year;

(b) Soil erosion and compression (by heavy vehicles), which provoke degradation of the soil, reinforce its vulnerability to droughts, and may induce climatic changes;

(c) Growing contamination of soils, waters and bio-products obtained from them with toxic compounds.

The knowledge which will be required in order to understand man's impact on his environment and to improve the basis for his decisions affecting it must be developed through intensive research on environmental effects and extensive monitoring of the environment itself. As these activities develop, perhaps man will perceive more clearly than he now does the ecosystem in which he plays an ever more active role and will begin to shape his activities toward a more rational pattern of use of the world's natural resources.

Knowledge of the physical effects of man's activities on his environment must in turn lead to a substantial modification in the existing pattern of human activities. In addition to knowledge from the natural sciences, improved knowledge is needed from the social sciences about how the present complex of human activities evolved and how those patterns of behaviour might be modified in the future.

B. The social pattern of man's intervention

Four principal human factors have made important interacting contributions to the present state of environmental affairs. The first is the growing power to inflict damage on the environment that has resulted from the combination of population growth and rising *per capita* incomes, together with technological advances which have increased man's ability to divert resources to his own purposes. These three factors interact with each other, but are also capable of acting separately: in cases where population growth has subsided, the drive for higher material standards of living has tended to maintain environmental pressures.

→ Power alone, however, will not corrupt the environ-

ment. It is the way in which man has chosen, through both private and public decisions, to use that power that has been detrimental. The principal hope for improvement must therefore lie in modifying the information and the criteria employed in the process of those decisions and in reconciling conflicts among them.

The lack of awareness of the impact of man's decisions and activities on his environment and the quality of the habitat in which present and succeeding generations must live has led to life styles which are more environmentally threatening than they might otherwise have been. It has also led producers to select production technologies with little regard for environmental consequences and social cost, and these choices, in turn, have reinforced the tendency to use up the world's resources rapidly and wastefully as judged by the environmental criteria now coming to light.

Technology, the principal instrument for man's management of the biosphere, is conditioned by the social, economic and political milieu in which it is generated, as well as by the constraints of nature. It is developed by society in response to perceived needs and can be shaped to reflect a greater (or lesser) concern for the rational and non-wasteful utilization of natural resources. The factors that influence the choice of technology are also critical. Invariably, there are several ways of producing goods or exploiting resources, and the effect on the environment is an inevitable consequence of the particular choice of technology that is made. If environmental consequences can be firmly established among the criteria governing the choice of technologies, the rationality of resource use must improve.

The environmental impact of present patterns of resource use has also been intensified by the tendency toward concentration of wealth, income and resource control. The resulting inequalities have in many cases become essentially self-perpetuating. The consequence has been to shift the composition of global output toward those patterns favoured by the wealthy, be they nations, groups or individuals which are more heavily weighted than the patterns of the poor with luxury items and products based on exhaustible resources. Global output is thus more wasteful of resources than it would be if resources and incomes were more equitably distributed. The duality between rich and poor has, with industrialization and modern means of communication, taken on the character of competing ecosystems, and has become international in scope.

One important example of such "centre-periphery" or "parent subsidiary" relationships is the urban-rural interaction. The rural ecosystem formerly comprised components — villages, fields, forests and rivers — which were essentially mutually supporting. The system was characterized by a diversity in its domesticated plant and animal life which preserved evolutionary potential and gave the system a form of stability by spreading the risks of insect and drought damage.

The growth of large cities reflects a pattern and style of investment which has produced large and widening differences in income-earning opportunities between the cities and the countryside, and thus led to increasing urban migration. The rise of the urban/industrial complex created a competing system which was heavily dependent on the rural system for its supplies of labour, food and raw materials. However, the terms of trade were such that the rural areas benefitted little from the rise of the cities, and what benefit there was was offset by the net flow of energy and matter from the rural setting, overturning the delicate balance which had previously existed there. Moreover, although the need for food stimulated the introduction of mono-culture methods in the rural areas – whose people also bore the brunt of the higher risks such methods entailed – investment continued to be concentrated in the cities. Finally, as the resources required to create a job in the cities is much larger than the cost in rural areas, excessive migration to urban areas can be regarded as wasteful of resources.

This is not to argue that change is bad *per se*. Temporary instability may be necessary in order to reach a new ecological balance which raises the quality of life for all. But such a new state, in this case a rural-urban balance, is not likely to be easily achieved unless greater concern for a more equitable sharing of benefits and costs begins to govern the decisions creating change.

It is also worth bearing in mind that the apparent dependence of the weak on the powerful is largely a reflection of relative bargaining power. In a very real sense, dependence often runs in the other direction. Cities could not survive without their rural counterparts.

Moreover, the cities too have suffered from the very success of their competition with rural areas. Enormous pressure has been placed on urban infrastructures, particularly on housing, transport and public health facilities. The resulting deterioration of the quality of life in the big cities is one of the most serious environmental problems of today. Attempts to solve the problems of cities by providing housing and water supply systems, while temporarily improving the quality of life in the city stimulate further migration which offsets such improvements and creates new problems, perhaps on a larger scale.

Many of these urban problems are accentuated by the existence of inequality both within cities and in the countryside. Inequality in the latter enables the rich to send their children to the cities for education and jobs, while it also pushes the landless with nothing to lose out of the village. Inequality in cities influences city planners to make policy decisions which favour the rich, e.g. the construction of luxury flats with abundant water and electricity against the need for providing water taps, power, and toilet facilities in the slums.

A greater effort is required to provide rural inhabitants with the complementary resources needed to make their lives both productive and rewarding. Indeed, as the cost of

providing productive work and improved life styles in the countryside may be significantly less than the cost of doing so in the urban setting, this continued urbanization of life styles may require more natural resources to provide minimum living standards than would be if the pace of urbanization was slower.

3. The demand for resources

Some resources fill human needs directly, while others are remote inputs in a long chain of production undertaken to satisfy human wants. In either case, the demand for resources is shaped by the level and composition of the demand for final goods and services. Of the three factors that contribute to the irrational and wasteful use of resources – final demand, technologies of production and the management of resource use – the nature of demand plays a leading role.

The level of demand depends upon population and *per capita* income. The composition of output reflects (a) the *preferences* of those having purchasing power (or the means to divert resources to their own ends); (b) the *prices* which they must pay for the goods and services under consideration; and (c) the *distribution of income* (whose preferences count?). Although in practice the three are interdependent, they are considered in turn below in an attempt to answer the question “Can preferences, prices and income distribution be modified so as to reduce the irrational and wasteful use of resources which characterizes the present composition of global production?”

A. Life styles and the environment

It is those who control budgets, whether of households, public or private enterprises, or Governments, who determine the uses made of the world's resources, and it is through change in their preferences and the factors which influence their attitudes that these uses can be modified. There are life styles at every level of income which are wasteful of resources. This also implies, however, an opportunity to modify wasteful life styles in environmentally beneficial ways. The behaviour of households and their expenditure patterns are influenced by the information they have about the private and social benefits and consequences of the specific goods and services they consider for purchase.

The “technologies” available for shaping and influencing preferences directly are not often applied with either social or environmental objectives in mind. Yet commercial organizations have used such means widely and with substantial effect. Similar tools may be equally effective in modifying life styles in ways favourable to the environment and the conservation of exhaustible resources. Improved means for disseminating information and enhancing understanding about the environmental effects of alternative life styles should therefore be actively sought and widely

and vigorously utilized. At the same time, more effective controls over the dissemination of false or misleading information should be implemented.

The advocacy of such tools – and indeed of price controls and income transfers – to modify life styles suggests a knowledge of environmentally desirable directions of change which may in fact be far from complete. In any event, the obvious cases of decay or damage, can and must be managed with more direct techniques, for example the total prohibition of the use of DDT by some countries. The aggregate environmental effect of smaller finite changes in life styles is more difficult to assess. A modified input-output approach which relates classes of goods and services (including leisure) to the kinds of resources used and environmental costs entailed directly and indirectly in their production might advance knowledge and provide at least rough guidelines for the improved assessment of alternative life styles. In this context, both the rate and form of material growth and their future consequences for the environment must be the object of assessment.

Much of the world's expenditure is controlled through institutional and governmental budgets. Their "life styles", too, are not immune to improvement through increased understanding about the environmental costs and consequences of alternative policies and programmes. Constraints have been placed on atomic testing and the build-up of military systems. More effective constraints may follow as environment-contaminating and resource-exhausting effects are more fully comprehended.

B. Prices and social costs

Prices and the quantitative rationing of goods and services have frequently been used as social tools for altering the structure of expenditures, although their use to repair or prevent environmental decay is still not widespread. Prices have the obvious effect on choices that a higher price discourages use and a lower price stimulates consumption. Market prices typically reflect only those costs and benefits which accrue directly to the price-setting authority, whether public or private. If the costs of environmental damage are excluded from price-setting calculations, resource use will be stimulated despite its social cost.

The problem is to ensure that all social costs and benefits are entered into the price-setting calculus, whether the agency responsible is public or private. Stating the problem and finding an explicit solution for it in specific cases are, unfortunately, two very different things. Converting social effects into explicit monetary terms is usually a hazardous and controversial undertaking. Moreover, the consideration of social costs and benefits in the making of policy decisions, say on soil erosion and land reforestation, will not necessarily prevent environmental decay unless those who cause or prevent the damage are explicitly penalized or rewarded for their actions.

It is not, of course, only the configuration of final

goods prices that matters but also the prices of the intermediate products and the primary resources which enter into their production. To adjust prices for social costs and benefits along the entire production chain would be an enormously complex task. Nevertheless, it may be possible to make adjustments which shift prices in clearly desirable directions, for example, by ensuring that firms bear the costs of preventing or repairing the environmental damage which can be directly attributed to their activities.

Price adjustments of these kinds should not, however, be regarded as substitutes for direct efforts to modify preferences and income distribution in environmentally favourable ways. Raising the cost of luxury items may reduce consumption, but residual differences in life styles may yet be obviously inequitable and wasteful. Decision-making at all levels therefore needs to be more adequately informed by scientific information and analysis, accompanied by improved understanding of the criteria for judging environmental effect, whether local or global.

C. Income distribution and resource use

An important determinant of the composition of the final bill of goods, and hence of the life style or styles in a country, is inequality in the distribution of purchasing power. If the gross domestic product of a country was evenly distributed, the production system would be oriented towards meeting the needs of the ordinary people, subject, of course, to resource constraints. When on the other hand the distribution is highly skewed, there is a natural tendency for producers to accord higher priority to the needs of those with higher purchasing power.

A good example is the tendency in most countries to direct more scarce resources to the building of luxury flats than to the far more urgent social needs of providing shelter for the dwellers of slums, shanty towns, and pavements. Another, particularly blatant in some developing countries, is the allocation of large amounts of scarce foreign exchange and energy resources to private transport which is highly valued as a status-symbol by the rich, while neglecting the development of a public transport system which requires substantially fewer resources per consumer. The present pattern of industrial growth is itself a product of inequality in the international distribution of purchasing power. In such conditions, the task of promoting the co-operative efforts and the community spirit required to further common ends, such as the improvement of the environment, becomes even more difficult than it need be.

The expenditure patterns of the higher income groups also divert large amounts of resources to the support of their life styles. Large amounts of energy, for example, are devoted to the production and operation of cars and air conditioners, and oil-based agricultural inputs such as fertilizers, pesticides, tractors and diesel pumps are by and large the preserve of the richer farmers. Land is often preempted for large farms and garden estates while the

poor are both landless and homeless.

The social abuse of resources is not, however, restricted to the rich; the poor at the other end of the spectrum are often forced into living patterns which are environmentally destructive. Inequality in the distribution of land-holdings often forces those at the margin to use their limited land so intensively as to cause soil erosion and deforestation. The establishment of squatter colonies in central business districts of large cities is another example of environmental decay caused by those at the lower end of the income scale who are deprived of shelter and arable land in the village. Thus environmental damage and the wasteful use of resources might be diminished at both ends of the income scale if inequalities in income distribution could be reduced.

Unfortunately, inequality is self-intensifying: income disparities, especially in market-type situations, give those with the most economic resources the power to widen them further. Moreover, their influence with Governments and international bodies is out of proportion to their numbers, and Government policies are often biased toward their interests. Even programmes intended for the poor must often be implemented through institutions which are dominated by those having economic power. Therefore, the development programmes of Governments often tend to strengthen the position of those who are already dominant and influential.

The natural operation of market forces cannot therefore be relied upon to improve the distribution of incomes either within or among countries. Rational Government policies aimed not only at redistributing incomes, but also at ensuring that members of the community have opportunities to participate fully and effectively in the development of their own society, are clearly required. For this larger purpose there is a need for conscious attempts on the part of Governments to modify the rules and operations of the credit- and input-distributing agencies to benefit the poorer sections of the population, effect constructive changes in the control over resources, particularly land, and introduce and encourage technologies which ensure a greater participation of people in the processes of production.

D. Disparity between rich and poor countries

No less important is the growing disparity in the standards of living between rich and poor countries, and its impact on the global pattern of resource use. Through their superior purchasing power, the rich countries have succeeded in consuming an overwhelmingly large proportion of the aggregate world production of natural resources, while many of the countries of origin of those resources have been left with little for their own domestic use and/or have been paid very low prices for their exports.

Consumption levels are very high not only in the rich countries. Similar resource – wasteful habits, made possible

by imports, are quickly acquired by the elite in the poor countries, making it difficult to generate a high rate of saving or to channel internal investment towards capital goods with high multiplier effects on employment and income.

Just as the large and widening differences in economic opportunities between city and country within a country cause urban migration, similarly, a large proportion of international migratory movements is a response to the large and widening disparity between the living standards of the rich and poor countries. To the extent that such migration relieves population pressures on land and other resources in the latter and improves their resource utilization, it is to be welcomed. Unfortunately, restrictions in many developed countries are a major obstacle to migration as a means for achieving a more even global distribution of population over land and other resources. Such laws favour those with incomes and education, and the migration of skilled manpower from the poor countries involves a heavy social cost for them in terms of the resources required to develop those skills.

This section has tried to show how the nature of the global demand for final goods diverts and wastes natural resources, and how changes in preferences, prices and incomes might modify demand in more environmentally viable directions. The present composition of global output is probably not sustainable over time; certainly the present life styles of the wealthy cannot be extended to the poor without serious environmental consequences. In these circumstances, the need for more enlightened public policies cannot be seriously challenged.

4. The management of resource use

The question of control over resource use, which over the years has precipitated innumerable controversies and more than a few wars, has now emerged as a major international issue whose many dimensions and full magnitude may not yet be fully appreciated. It reflects today a growing awareness of the nature and pervasiveness of global interdependence and the exhaustibility of global resources which has sharpened the competition for resource control.

A. The present concentration of control

The present pattern of control over resource use derives in large part from the structure of demand discussed in Chapter 3. Those with purchasing power have determined the composition of output, and those who have produced for that market have naturally attached a high value to the resources required for it. Thus resource control has followed in the path of final demand, reinforcing the existing pattern of income distribution and threatening through preemptive use the development options of others.

The geographical distribution of the world's natural resources is uneven. Human needs and known resources

do not correspond one to one in any part of the world. Although the heavy concentration of oil resources in the Middle East has received a great deal of attention recently, such concentration of production in a few countries is typical of many other natural resources as well, such as bauxite, tin, copper, iron ore, manganese, coal, shale rock and tar-sand. Trade is therefore necessary if human needs are to be met throughout the world.

The distribution of known resources also does not accord with the global distribution of final output. Resources throughout the world have been drawn into production in order to satisfy the large final demands in the developed nations. The nature of the present control over resource use, crossing national boundaries as it must, is much more tenuous than it would be for an internally self-sufficient economic system.

There are, however, indications that this pattern of development may not be stable and enduring, at least at the international level. As the less developed nations begin to value the resources within their boundaries more highly, recognizing both the exhaustibility of many natural resources and the needs of their own peoples, they may quite properly demand (a) improved terms of trade; (b) a greater say about the end uses their resources might serve; (c) less wasteful processes of production; and (d) lower rates of current production in the interest of future generations. Thus the present pattern of control over resource use may begin to break down and the need to devise a new international system for managing the world's natural resources in the interest of man and his descendants will arise.

B. Prospects for change in the present situation

The distribution of production of a resource at a given point in time is a function of knowledge, technology and demand structure, as well as location. The geological knowledge of most countries of the world is still highly inadequate; with further exploration, the estimated reserves of most minerals are being continuously revised upwards, and discoveries are being made in countries where the possibilities of finding a particular mineral had previously been considered remote. The pattern of distribution of both the actual and the potential production of a particular resource also changes when the rate of new discoveries in countries which were previously big producers falls behind the rate of depletion of their reserves.

The existing state of technology influences the extent of knowledge of a country's geological potential. The development of advanced methods of geophysical exploration, and of drilling in difficult terrains (e.g. offshore, desert, forest etc.) and down to great depths have greatly extended man's knowledge of the world's resource potential, and also affect world-wide distribution of production of a natural resource by making production feasible in new areas. The state of technology also determines how

much of the available physical amount of a particular natural resource is recoverable for production and use and promotes its uses in many fields (e.g. the use of naphtha in the production of fertilizer).

The structure of demand determines resource use and the direction of research and development for technology. For example, the growth of the automobile industry in the early part of the present century encouraged the development of catalytic cracking methods for increasing the proportion of petrol in the refinery output of a barrel of crude oil, and the present high price of energy is making expensive research on alternative energy sources worthwhile. The relative values of different resources are also largely influenced by the demand structure in a small number of rich countries. For example, the high value of oil in world trade is a reflection of the level of demand for it in the rich countries (and among the rich in the poor countries), while a large majority of the population in the world remains dependent on non-commercial sources of energy (e.g. dry leaves, cow dung, animal or vegetable oil, wood etc.) in its daily life. Furthermore, relative values of natural resources change over time with shifts in the pattern of demand and its interaction with the supply factors, including technology.

C. Conflicts of interest in resource use

The unequal distribution of resource location and production gives rise to various types of conflict of interest between countries, for example over the right to use particular resources. Conflict over the use of rivers which pass through or between several countries, or over the territorial limits of a country, for the purpose of defining the fishing rights in the sea or exploring the seabed, are quite common, and often lead to excessive utilization of resources to forestall competitors. International agencies can play a vital role in resolving such conflicts, and in providing machineries for adjudication in cases of dispute regarding the interpretation and implementation of agreements.

A second type of conflict arises between the *producers* and the *consumers* of a particular resource. Whereas the rich industrialized nations with a high propensity to consume would prefer an unrestricted flow of oil to the world market, the interests of many of the leading oil-producing countries demand a conservationist approach in order both to maintain its price and to limit the rate of depletion. Such conflicts of interest are not easy to resolve internationally through formal rules and procedures, given the unqualified sovereign right of Governments over the resources contained within their national boundaries. On the other hand, considering the need to ensure rational use of natural resources from a global viewpoint, and also to avoid international conflict which might lead to war, embargo and various other wasteful activities, it is imperative to take into account global ecological interests

in formulating national policies for both production and consumption.

A third type of conflict arises over the prices at which resources are bought and sold. Whereas a large proportion of the world's natural resources are *located* in the poor countries, their *production* and *use* are controlled by demand in the rich countries, and by the institutions through which world trade in most goods and services takes place. The existing structure of world trade leads to unequal exchange; the prices of resources sold by the poor countries are low and declining compared with the prices of manufactured goods sold by the rich countries. While low resource prices encourage excessive use in rich countries, the countries of origin benefit little from the possession of resources, in terms either of revenues or of their use in the domestic economy.

D. *The present means of resource management*

The management of the world's natural resources is the result of a bargaining process at many levels in which the main actors are:

(a) The Governments and domestic enterprises of nations — often found in two groups, the rich (net users of resources) and the poor (net suppliers of resources);

(b) The multinational corporations, which often represent the interests of the developed nations, but are increasingly assuming an independent stance in resource negotiations;

(c) Multinational commodity organizations of Governments, such as OPEC.

1. *The transnational corporation.* Transnational corporations operate in many countries of the world through a large network of subsidiaries, affiliates, and associates. They control much of the world's trade in natural resources. In a very real sense, they have been *the* institutions of resource management, responsible for fixing prices of both final and intermediate products at different levels of the production process, for determining how much to produce from and sell to which countries, and for research and development to find new and cheaper ways of producing goods and develop new products and uses from a particular resource.

The transnational corporation is typically interested in maximizing its total profits. It may, therefore, deplete mineral resources rapidly in one country because they are high-grade, easily transportable or under threat of nationalization, while holding similar resources in another country as reserves; it may only extract resources at the source, exporting them (possibly at fictitious transfer prices) for further processing in its own plants abroad; and it may ignore environmental and other social costs that do not enter into its calculations of private profit. The decisions about resource management which transnational corporations find natural must be tempered by other forces if the

global public interest is to be well served.

The most obvious counterbalancing force is the Governments of the producing and consuming nations in which transnational corporations operate. Unfortunately, the corporations can often play one Government against another, as a consumer against a producer or one resource source against another, or bargain technology and knowledge for access to resources, often on terms favourable to themselves. In these ways, the corporations may gain preferential tax treatment, duty rebates on imported goods, and freedom from pollution controls and measures to protect the environment.

Governments, and particularly those of poor countries, may find themselves too weak to bargain effectively or to uphold principles which depend on co-ordinated and concerted efforts of Governments for their effectiveness. Thus, higher tax rates, requirements for in-country processing of resources, and pollution controls imposed by one country alone may simply destroy its own hopes for immediate development as the corporation affected takes its business to less far-sighted nations.

2. *Commodity organizations.* A recent development of considerable significance is the foundation of organizations of Governments owning a particular resource (e.g. OPEC for oil, CIPEC for copper, and similar organizations for countries exporting tin, bauxite, or iron ore). These act as a counterbalance to the multinational firms in the world market, and have succeeded in negotiating better prices and improved conservationist measures, in enlarging the participation of the host Governments in the production process, and in ensuring better utilization of the country's natural resources within the national economy. However, the degree of success achieved by these organizations varies with the natural resource. In the case of oil, which is exhaustible, and where the large exporting countries are geographically and culturally close, OPEC has succeeded over the past five years in displacing the multinational firms in control over production, distribution and prices and has been able to bring the development of the oil industry in individual countries closer to their respective environmental and developmental needs. In contrast, in the case of copper, which can be recycled, and whose leading exporting countries are spread over the whole world, such a transformation of the production-ownership structure has not yet been accomplished.

Attempts have also been made in recent years to bring together major consumers of a particular resource (e.g. oil), mainly in order to improve their bargaining position *vis-a-vis* the countries producing that resource. So far, for a variety of political and economic reasons, such attempts have not been successful. However, a useful objective for such organizations could be to find ways of regulating excessive consumption of depleting resources and narrowing the gap in consumption standards between their members and the rest of the world.

interest between spending units. Conflicts will arise from the competition for resource control, from differing judgments about the priority uses of depleting resources and the optimal rate of depletion, from opposing assessments of the extent of environmental damage associated with alternative production technologies, and from uncertainties about the present and future costs of different life styles. The resolution of such conflicts in environmentally favourable ways is a basic problem which merits serious concern.

The functions which must be performed to resolve conflicts successfully are reasonably clear:

- (a) Define the nature and scope of the conflict;
- (b) Assemble the most recent and relevant knowledge for analysing the dispute;
- (c) Assess the environmental consequences and offsetting social benefits associated with the opposing positions, the range of possible compromises, and other options which deserve social consideration;
- (d) Choose among these alternatives;
- (e) Announce and enforce a decision.

What is less clear is who should be responsible for the performance of these functions and what machinery is required to ensure that they are performed well. These conflict-resolving functions need to be performed at every level of decision-making – for the family, village, province, nation and the world as a whole, for both public and private bodies, and for those who control resources as well as those who demand them.

At most of these levels, suitable agencies already exist – the head of the family, the village elders or town council, the planning authority and the United Nations. For the most part, however, environmental concerns have to date played a relatively minor role in the resolution of conflicts. As environmental matters increase in importance, these agencies will require relevant information, competent technical, social and economic advice, and an informed populace so that social sanctions may reinforce more formal decisions. The rapid and widespread dissemination of new environmental knowledge is therefore an essential input to the more effective performance of conflict-resolving functions. At some levels the establishment of permanent advisory committees or councils on environmental matters may be required. They would be similar to the councils on science and technology recently established in a number of countries, and conceivably the functions of some of these could be broadened to encompass environmental analysis.

The growing concern for environmental problems has already disclosed that the interdependence of economic activities, life styles, and patterns of resource use throughout the world is much greater than it was judged to be only ten or twenty years ago. This growing interdependence and the increasing recognition of it will inevitably reveal new areas of conflict. The burden is likely to grow most rapidly at the international level, at which the means for conflict resolution are most in need of strengthening. It

must be hoped that as experience with environmental matters accumulates, the need for more effective machinery for the settlement of global disputes and the formation of global environmental policies will be recognized.

A particularly urgent problem is that of improving on present methods of managing the world's natural resources, in order to ensure that global public interest and the needs of future generations are adequately represented. The transnational corporation is mainly a vehicle for private interests; commodity organizations represent mainly the self interest of resource-producing countries, and in focusing on one resource must neglect opportunities for substitution among resources and issues of competing technologies; and the poor and needy nations of the world have yet to find the united and powerful voice in world councils to which their populations are entitled. If international monetary affairs merit the several formal and informal councils devoted to their resolution, certainly the world's natural resources which man is dissipating so rapidly and carelessly merit a "World Resources Council" to consider criteria for the rational use of resources and perhaps to fund their conservation.

6. Criteria for resource use

Much of the discussion in preceding chapters has focussed on the main causes of wasteful and irrational resource use. These have included wasteful life styles at all income levels, the unequal distribution of income-earning opportunities and of access to natural resources, the conditions which reflect the configuration of demand for goods and services and which determine technological development and choice and the rapid growth of population. To set the patterns of resource use right would require substantial structural changes in most countries of the world. What is now needed is not laments about the past non-rationality which has largely created this situation (except in so far as we can learn from such reviews), or premature dirges for future generations, but reasonable and increasing efforts to move man's pattern of activities in the direction of a more rational use of the world's resources.

Two basic means of achieving this goal are currently in common use. The first is prohibition of certain activities in the light of minimum safety standards. These will themselves be subject to extension and revision as new knowledge may require, and will include human welfare standards and crucial ecological limits whose transgression can be shown to threaten irretrievable or intolerable long-term loss. Most of the minimal standards would probably be proposed by natural scientists and ecologists. Wherever critical margins can be identified, the best knowledge available should be assembled to enable man to call a halt to activities whose effects are irreversibly deleterious.

In addition to physical safety standards, minimal social standards, for example for nutrition, health, literacy, It

every level according to the criteria of universal well-being and environmental preservation.

A. The content of choice

Many decisions about life styles, methods and location of production and the composition of Government budgets are made without adequate knowledge or consideration of their environmental effects. Moreover, the array of world and local prices which influences expenditure patterns, the composition of output, and the rate and place of resource depletion reflects very unevenly and incompletely the real costs and benefits of the goods and services to which those prices attach. It has not been usual in any society, for example, for the price of chemicals or steel to reflect the costs of replacing (or living with) acid-etched windows or smoke-damaged furniture and building exteriors. Thus expenditure patterns, life styles, and methods of production have been biased in favour of goods and services whose prices do not cover their full environmental cost to society and against those whose prices do. Moreover, many projects, policies and programmes may be evaluated by reference to obvious market-determined benefits and costs and without regard for more elusive but perhaps equally important benefits and costs which are not revealed in the market.

It is not suggested that the full costs or beneficial value of any commodity, project, policy or programme can be easily and unequivocally quantified and valued in money terms. However, the array of possible non-market-determined costs and benefits should be considered in deciding public policies, and the means for estimating the weights appropriate to them purposefully improved. In addition, those prices which affect choice of life style or methods of production should be socially adjusted to reflect judgments about environmental costs and benefits. Moreover, when environmental damage or wastage can be traced to its source, the costs either of prevention or of compensation to those harmed, should be borne explicitly by the source.

It was pointed out above that the life styles and methods of production currently in vogue are not sustainable in the long run. They have usually been chosen however, in ignorance of their full environmental consequences. As these consequences become clearer and are understood more completely by spending units and social authorities, it is not unreasonable to expect that different choices will be made reflecting a more informed and rational view of their impact on both this and subsequent generations.

The assessment of the future environmental impact of decisions made today is particularly important. It has usually been assumed that future costs and benefits can be compared with present costs and benefits by deflating them by a discount rate so that the more remote benefits and costs are given a lower weighting. The appropriateness of the technique should not mask the fact, however, that

the discount rate used is often derived from the market rate. Unfortunately, the demands this rate reflects are often derived from very short time horizons and based on private estimates which usually exaggerate the real social risks involved. As a consequence, the market rate of discount is unusually high, and while it is appropriate for many private decisions and commercial transactions, its application to long-term environmental decisions would excessively discount future benefits and costs.

B. The power of choice

Knowledge is generated and disseminated slowly, and its effects depend on the receptivity of those whose decisions should be affected. In the present context, some spending units may modify their value systems more quickly and fully than others in response to new knowledge about the environmental consequences of alternative patterns of resource use. In such circumstances it is not unreasonable to argue that the appropriate social agency should shift income and control over resource use toward those spending units whose behaviour is considered to be most socially and environmentally responsible. After all, the aggregate environmental impact of the choices of spending units depends not only on how many are responsive to environmental concerns, but also on the size of the budgets they control.

The tools available for affecting the relative power of economic choices vary from one to another. They range from tax and price manipulations, designed to raise the costs of those life styles and methods of production which maintain or improve environmental viability, to structural changes, such as land reform and nationalization, which shift the power of choice more radically and quickly. In extreme cases absolute bans on specific economic activities may be considered and employed.

The redistribution of budgets towards those who are environmentally responsible may imply shifts of various kinds. In some instances greater centralization of the power of choice may be required; in other cases, greater decentralization of responsibility may be appropriate, in order to deliver greater power of choice to those intimately concerned with and knowledgeable about local settings. Another appropriate adjustment may be between governmental budgets at any level of Government and family budgets – the direction depending upon judgments about net environmental impact. Again, the shift may be between public and private enterprises. Finally, the nature and direction of the adjustments required may change as knowledge and understanding of the environmental effects of different methods of production and patterns of consumption improve with time, experience and research.

C. Choice conflicts

The above measures will not eliminate conflicts of

3. *The control of resources within a country.* No less important than the international control of natural resources in relation to environment is the relationship between the two *within* a country. The issue of disparity among regions within a country in terms of resource use is analogous to the disparity among countries discussed above. In the case of very poor countries, part of the explanation lies in their pattern of development during the colonial period when physical space and the accompanying infrastructure were organized to facilitate export and import; lines of transport and communication therefore tended to inhibit integration of the national space and instead facilitate its integration with the outside world. Part of the explanation for the disparity also lies in differences in their factor endowments and in the differences among regions in terms of their influence on the policy-makers in the country.

Where the developed regions also happen to be those with high resource endowments, this encourages wasteful consumption in them, and the gap between them and the other regions. Where the natural resources are produced in backward regions and consumption takes place in developed regions, the situation is not dissimilar to that existing between a rich oil-consuming country and a backward oil-producing country. A major policy issue in both cases is where to locate the processing industries, which create jobs and increase income but also pollute the environment.

A second issue arises with respect to the ownership and control of natural resources within a country. As already noted, many of these resources, particularly mines and plantations, are owned by large multinational enterprises. In several countries there are also private firms owned by the nationals of the country, but these are usually small in scale and poor in skills and resources, and are usually run without any regard for the conservationist and safety practices prescribed by national legislation. Because of their overriding concern with profit generation, they are badly placed to orient their activities towards social needs and the minimization of environmentally harmful effects. Indeed, these enterprises, like the multinationals and perhaps more so, are often in the forefront of those interests which resist stringent environmental regulation by Governments.

In theory, public enterprises should be in a better position to take social and environmental considerations into account. However, how well they perform this task will depend on the way in which social and governmental objectives are defined, and also on the degree of consciousness among politicians, officials and managers of public enterprises of the long-term and indirect effects of resource use on the environment and on the biosphere in general. Governments which seek to emulate the "development path" of today's rich countries may end up with similar patterns of resource use and environmental impact.

The question of ownership and control is highly

relevant in the case of land, which is by far the most important resource in most poor countries. In part of Asia, Africa and Latin America most agricultural land is owned by a privileged land-owning group, and a large part of the rural population is composed of small-holders, tenants, and the landless. As a consequence, the land owned by the rich remains underutilized while the excessive use of land owned by the poor causes soil erosion. The ownership of large parcels of urban and suburban land in many developing countries by speculators makes it difficult for Governments to undertake rational land-use planning and meet basic housing needs. The distribution of water, probably the second most important resource in the countryside in most poor countries, is also similarly controlled by the dominant sections of the population, particularly water drawn by private pumps, which often leads to unplanned and excessive use of ground-water and a drop in the water table in the area.

5. Improving environment-related choices

Two fundamental questions emerge from this discussion.

(a) Is the preference of the human population, as revealed through its collective decisions on economic activities, for a world in which improved well-being is accompanied by a viable environmental ecosystem? Judging by present behaviour, the answer appears to be "No".

(b) Is there then the hope and the possibility that future decisions can be improved in this regard? Both the scope and the opportunity for such improvement undoubtedly exist, and it is likely that the progress required in this regard will be achieved.

There are three essential problem areas which must be successfully addressed in order to ensure that the environmental costs of essential increases in well-being are reduced to levels consistent with the continuing well being of successive generations. These are:

(a) To improve the understanding of the environmental costs and benefits associated with any spending option and hence the rationality of the actual choices made by every spending unit, including the family, the private or public enterprise, the national Government, and the international agency;

(b) To shift, through penalty and reward systems and where possible through structural change, income and the control of resources from those spending units who abuse the world's resources and its environment to those who will use them more beneficially or conserve them for future generations;

(c) To increase the consideration given to environmental effects by those decision-making bodies which have the authority or influence to adjust the conflicts among spending units which will inevitably continue to arise, and to improve the means available for resolving conflicts at

income, and employment, may be established and absolutely safeguarded against infringement, whatever the apparent economic benefits of the infringement might be. The standards to be guaranteed in this way may be expected to rise steadily with increasing world or regional income and with the growth of man's sense of responsibility for the welfare of his fellows.

Most policies, programmes and projects will survive the "prohibited activity test" and will require judgments of a more sophisticated nature. Here the second means of rationalizing resource use, that of applying a set of criteria against which related activities may be judged, is an obvious starting point. The criteria that should govern future decisions affecting resource use and the quality of life are still in the process of definition, and it would be pretentious at best to suggest that an unequivocal set is available. Indeed, there is an urgent need to establish a mechanism for the continuous review, extension, and refinement of those few criteria in which there is now a reasonable degree of confidence.

In any event, the purpose of such criteria must be two-fold: to determine (a) whether all benefits and costs associated with the project (taken here as including policies and programmes as well as actual projects) have been considered and (b) whether the project promises to modify the existing pattern of man's activities in environmentally constructive directions.

The following types of questions are pertinent to any assessment of the comprehensiveness of evaluations:

(a) Is there an on-going and effective programme for informing the population of new knowledge about patterns of economic activity, their effects on resource use and their possible present and future consequences?

(b) Do the prices and costs that govern private and public enterprise decisions reflect the full environmental benefits and costs which can be ascribed to the enterprises?

(c) Is the period of time considered in evaluating a project sufficiently long (or the discount rate sufficiently low) to take adequate account of its consequences for future generations?

(d) Has the risk to the living standards of future generations through the land been considered and adequately weighted?

(e) Have risks as estimated by private and public enterprises or decentralized units of Government been adjusted to reflect social considerations or the differences in risk assessment compensated for, so that decisions on resource use are not unduly biased by private fears of such things as nationalization and loss of influence?

(f) When a project encroaches upon others or confers benefits upon them, domestically and internationally, have such costs and benefits been fully considered in its assessment?

(g) Is there a means built into the project to compensate others for costs borne by them or to seek reimbursement for benefits others may receive?

(h) Have the costs of preventing encroachment effects been weighed against the costs of compensation?

Questions relevant to changes in man's activity patterns, which involve value judgments and hence are perhaps more likely to cause controversy, include:

(a) Will the project induce constructive changes in the life styles of families, public and private enterprises, and Governments, judged against the yardstick of wasteful and irrational use of resources?

(b) Will it diminish differences in income? In particular, will it provide basic living requirements for larger numbers of people? Will it improve income-earning opportunities for the lowest income groups?

(c) Will it discourage the development and choice of patterns of technology which are wasteful of resources?

(d) Will it increase the global rationality of resource use by ensuring that social and environmental considerations enter into the decision-making processes of those who control resource use — whether through public ownership, other forms of social control, or the modification of market prices, taxes and subsidies?

The process of refinement, extension and specification of the questions in the preceding paragraph must bring to the surface many of the value judgments about desirable directions of change which are now implicit in them. There is, however, another stage through which surviving proposals must pass — the stage of comparison. Many projects are competitive with each other, either because one pre-empt resources from another or because one serves ends which would negate the justification for another.

The need for comparison suggests that each project which reaches this stage should be quantified, in so far as possible, in dimensions which can be standardized and compared. The technique of cost-benefit analysis is one such method. If quantification and standardized measurement can be extended to every attribute of the project, priorities can be established with precision. It is more likely, however, that quantification will only narrow the range of attributes over which judgment must be exercised in making any comparison. The element of judgement which has always played an important part in natural resources exploitation will therefore continue to do so. Thus man sits in the final seat.