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## CHAPTER II

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## CHAPTER II

### THE ENVIRONMENT AND DEVELOPMENT CONNECTION

#### A. INTRODUCTION

1. The future of humankind depends on the continued development of human societies and the conservation and enhancement of the ecological base for this development. In a broad sense this would be accepted by decision makers everywhere. Yet, in practice, developmental policies pay insufficient attention to ecological factors and environmental policies to economic compulsions. The main features of economic policy are largely oriented towards the pursuit of economic growth and environmental protection appears mostly in the form of supplementary and, often, peripheral, measures in projects, programmes and plans.
2. The root of the problem lies in the fact that the conceptual structures that underlie decision making do not take full account of the environment-development connection. When, sometimes, this connection is recognized it is in a partial context like the link between meat demand and tropical deforestation. A characteristic feature of economics and ecology is their emphasis in the interconnectedness of the phenomena they study, the systems nature of their subject matter. A partial analysis of the environment-development connection, however impressive in its own right, will remain ineffective. What is needed is a broader approach, that integrates the subject matter of economics and ecology in a systems framework.

3. Development is a wide concept and involves not merely quantitative increases in production but also changes in economic structure, societal organization and cultural values. However economic factors play so dominant a role in development policy that the primary task is to incorporate environmental factors in a central way in the analysis of economic development.
4. The physical environment impinges on economic development because the flow of productive inputs is constrained by the stock of resources and the processes of production and consumption necessarily generate wastes. A wider conception of the development process integrates these considerations in a unified framework. Thus food production and a deteriorating land base, fertilizer use and nitrate pollution, the burning of fossil fuels and air pollution, the growth in material use and resource scarcities become parts of the same problems, the effects of the same causes. Such an integrated view is essential for finding sustainable solutions not merely for environmental problems but also for developmental questions. In what follows the Commission presents such an integrated view of developmental and environmental trends over the past few decades. It does this because a better understanding of the past is an essential basis for finding sustainable solutions for the future.

B. GROWTH, DEVELOPMENT AND THE ENVIRONMENT

5. The processes of economic growth and population expansion are a source of pressure on the natural environment and, conversely, environmental stresses constrain the possibilities of growth and development. However these relationships are not fixed. Much depends on the content of growth, on the type of technology used and on the manner in which the crucial linkages are managed. A synoptic picture of some but not all of these linkages is given in Figure 2.1. The most important point about this chart is that the linkages between developmental and environmental variables operate in both directions and from sector to sector.
6. The logical starting point for describing the environment-development system is the growth in demand which arises from population growth and increases in purchasing power, both of which have been exceptionally high in the post-war world. From the point of view of the environmental impact there are five components of this increase in demand which are of particular importance:
  - (i) foodgrains and other staple foods;
  - (ii) milk products, meat and fish;
  - (iii) paper and other wood products;
  - (iv) automobiles and household appliances;
  - (v) energy.



Agriculture and Forestry

7. World consumption of cereals, which account for the major part of food intake, particularly in the developing world, more than doubled between 1950 and 1984. The two major factors underlying this increase are (a) in the developing countries, an increase in the direct demand for cereals because of population growth and income increases and (b) in the developed countries, rising requirements of grain for animal feed which accounts for one-third of world cereal consumption.
8. The balance between food production and population is the central element in the ecological concept of "carrying capacity". This concept cannot be applied uncritically to human societies where technological interventions and interregional trade can greatly increase or decrease the "carrying capacity" of a region. However, in most developing countries, a persistent shortfall in food production relative to requirements indicates an ecological imbalance. It also implies a major developmental failure since a rapid rise in food production is important both for raising rural incomes and for sustaining a larger non-agricultural work-force.
9. The actual record<sup>1/</sup> of per capita food production since 1961 is presented in Table 2.1. At the global level food production has grown a little faster than population; but there are many regions where this is not the case and, where, like sub-Saharan Africa, they happen also to be areas of poverty, the people in these regions lack the means to purchase the surpluses

**TABLE 2.1**  
**INDEX OF PER CAPITA FOOD PRODUCTION**

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	1961-64	1971-74	1981-84
<u>WORLD</u>	100	107	112
North America	100	106	121
Western Europe	100	116	131
Eastern Europe and USSR	100	124	128
Africa	100	97	88
Near East *	100	103	107
Far East **	100	101	116
Latin America	100	101	108
CPEs of Asia ***	100	111	135

\* An FAO grouping that includes West Asia plus Egypt, Libya and Sudan

\*\* An FAO grouping that covers South and South-East Asia excluding the centrally planned economies of Asia.

\*\*\* An FAO grouping of Centrally Planned Economies of Asia which covers Arina, Kampuchea, North Korea, Mongolia and Vietnam.

Source: Based on FAO (1973), FAO (1979) and FAO (1985)

available elsewhere. Moreover in these and in more prosperous regions there often is a food-population imbalance in poor households. Many such households in developing countries are subsistence farmers who are

unable to feed adequately the rising numbers of family members from the limited resources at their command.

10. The principal difficulties posed by the acceleration in population growth rates are at the household and regional level and not so much in terms of a global imbalance. If the population of developing countries had grown at say 1 per cent rather than at over 2 per cent between 1950 and 1985 there would have been 1250 million fewer people which, at the average consumption level prevailing in the developing countries, would have reduced cereal demand by less than 20 per cent. However, a lower rate of population growth would also have meant fewer persons to feed in poor households and poor regions and the gains from this could have been truly substantial for these households and regions.
11. Family size is determined to a large extent by social and cultural factors. But economic compulsions also play an important role. In peasant households with substantial land holdings family size may be large to provide labour for cultivation. In resource-poor households large family size may be a form of insurance for old age. In urban families, family size may be smaller because the mother needs to work or because of the cost of living space. Because of these, and other similar linkages, demographic change is closely linked to the level and pattern of economic development. The developed countries went through their demographic transition many decades ago and have low population growth rates. The developing countries are still in the midst of transition. Mortality rates have fallen

in all areas and, in most, the fall in birth rates has begun but has not yet gone far enough. In some regions like sub-Saharan Africa population growth rates are still rising; but in most parts of Asia and Latin America population growth rates have started to decline.

12. The food requirements of the poor are not the only, perhaps not even the primary, factor underlying the increase in world food production. The rising demands of the more affluent are as important. However this increase was not so much for basic staple foods but for other food items like sugar, fats and oils, milk products, meat and fish. Since 1950 the world consumption of these has increased more than the direct consumption of foodgrains. Even today the greater part of world consumption of these food items takes place in the developed countries.
13. From an ecological point of view the rising demand for milk, meat and fish is of particular importance. Animal protein is preferred to vegetable protein in many societies and accounts for a rising proportion of food consumption as incomes increase. The fulfilment of this demand has been a major feature of agricultural growth in the developed countries. In Europe for instance meat production increased more than three-fold between 1950 and 1984 and milk production nearly doubled.<sup>2/</sup> There was also a substantial increase in meat production for exports particularly in the rangelands of Latin America and Africa. World meat exports have risen from around 2 million tonnes in 1950-52 to over 11 million tonnes in 1984.<sup>3/</sup>

14. The production of milk and meat requires the maintenance of a large global livestock population which in 1984 amounted to about 1.4 billion cattle and buffaloes, 1.6 billion sheep and goats and 0.8 billion pigs, whose combined biomass is well in excess of the biomass of human beings.<sup>4/</sup> The feed energy required to maintain this livestock and to produce milk and meat was met largely from forage. However feedgrain requirements also increased, particularly in the developed countries, and led to a sharp increase in the production of cereals like corn.
15. Fish is a major source of animal protein in many parts of the world. Currently 85-90% of the world catch comes from the sea. The world catch of marine fish increased from 24.7 million tonnes in 1950-54 to 67.9 million tonnes in 1970-74. Thereafter the catch has increased far more slowly to reach a level of around 75 million tonnes at present.<sup>5/</sup> There is already some evidence that the traditional fishing ground of the developed countries are over exploited or close to their maximum yield.
16. The growth in food production over the past few decades unprecedented in human history. It has been secured both by an extension of the production base in the form of an increase in cropped area, number of livestock, number of fishing vessels, etc. But more than the extension, the growth is due to a phenomenal rise in yields per hectare of land or, in the case of meat and milk, per animal. The systematic application of genetics to plants and animals, the increase in fertilizer use, the expansion of irrigation and other technical improvements in crop and animal husbandry are the factors that account for this increase in yields. However the growth in agricultural production has led

in many cases to ecological damage that could undermine the future potential for agricultural growth. Hence the question is whether these increases can continue and, even, whether they can be sustained.

17. A part of the post-war growth is due to the expansion in the area under cultivation mainly in the developing countries of Asia, African and South America which in the case of foodgrains has been a little over 50 per cent in the past three and a half decades.<sup>6/</sup> A part of the increase in area has come from subsistence farmers whose food requirements have gone up because of rising population. In many forest areas the cycle of shifting cultivation has shortened to such an extent that the forests are being destroyed. In many dry areas cultivation is being extended to marginal lands. In many hill areas crop cultivation is being undertaken on steep slopes with increasing risks of soil erosion. In many river valleys, areas chronically liable to floods are now being used for agriculture. Much of this pressure from subsistence farmers arises because the best land is in the hands of larger commercially oriented farmers.
18. The pressures arising from commercial agriculture are of a different nature. In the nature of things a profit or production maximizing farming unit will not extend cultivation to low productivity lands. However commercial pressures can and often do lead to inappropriate cropping patterns and practices. In many cases official policies, particularly those relating to agricultural subsidies, have reinforced this tendency. Sugarcane is often cultivated in irrigated areas where the water is better used for other crops; land which should be used for tree crops is given over for field crops; the variety in the cropping pattern may be greatly reduced. Commercial pressures also lead to a

more intense use of the land with a reduction in fallow periods and the pressure to maximize yields lead to high levels of fertiliser and pesticide application and inappropriate water use.

19. The impact of agricultural expansion on forest cover is one major source of resource-stress in the developing countries. In tropical Asia, 1.8 million hectares of closed forest were deforested every year between 1976 and 1980 mainly for the expansion of crop cultivation.<sup>7/</sup> In many cases this arose from official programmes of planned transmigration to relieve the pressure on land elsewhere. Similar processes are at work in Latin America, particularly in Amazonia. The pressure from shifting cultivation is a major factor in Africa and Latin America. Worldwide ranching is estimated to deforest about 2 million hectares every year, the bulk of this being in Latin America.<sup>8/</sup> One of the factors behind this conversion has been the need for cheaper sources of beef to meet the demand for fast foods in the USA. In many areas the trees which protected cropped areas from wind erosion have disappeared.
20. The processes of desertification are more complex and depend as much on weather fluctuations as on agricultural practices. However the pressures from subsistence food production, commercial crops and meat production in arid and semi-arid areas have contributed to this process. About 29 per cent of the earth's land area is subject to varying degrees of desertification, slight, moderate and severe, and an additional 6 per cent is classified as extremely severe. The area degraded to desert-like conditions continues to grow at

6 million ha annually. The countries most severely affected by desertification are in the Third World, the worse hit being those in the Sahelian-Sudano zones of Africa.<sup>9/</sup> Several studies have suggested a link between policies on pastoral development and desertification in this region.

21. A major problem spread throughout all agricultural areas, is of soil erosion. Soil formation is a lengthy process and under normal agricultural practices it may take as much as 40 years to form one cm of topsoil. In many parts of the world the rate of topsoil is now well in excess of the rate of formation which is leading to a decline in the usefulness of land in these parts for agricultural purposes.<sup>10/</sup> Much of this deterioration is man-made. Deforestation, the removal of wind shelter-belts, crop cultivation on steep slopes, inappropriate cropping practices and overcultivation are increasing the effects of water and wind erosion. The pressure on land quality is not limited to marginal areas. Commercial pressures and the compulsions of mechanisation lead to single-crop cultivation and the abandonment of crop-rotations that could maintain the binding capacity of the soil. Irrigation is a major factor making for agriculture prosperity but half of all irrigation schemes face problems of salinization, alkalization and waterlogging. In many irrigated areas, excessive groundwater withdrawals have led to a lowering of the watertable. The decline in land productivity is often sought to be corrected by increasing application of fertilisers and this has led in some areas to the nitrate pollution of water bodies. The growing dependence on a single crop, often a single seed variety, has increased the potential loss



from pest attacks and led to a growing use of pesticides and the consequential problems of pest resistance and pesticide poisoning.

22. The new seed-fertilizer technology which underlies the spectacular increase in agricultural productivity, developed in response to the specific compulsions of agriculture in the developed countries and was focussed as much at economizing on labour as on improving land productivity. Its successful application required a base of scientific and technological skills, a developed system for technology extension and other services for farmers and a high degree of commercial orientation in farm management. In the developing world the new technology worked where these pre-conditions could be created; but this could not be done everywhere.
23. Inequalities emerged as ecologically disadvantaged areas and land poor rural masses could not benefit from these advances, and governments in most developing countries were unwilling or unable to correct this through redistributive measures. As a consequence, despite rising food production, hunger and malnutrition continued and, in some parts, even increased. At the global level the gap in agricultural technology widened. For instance, the average level of foodgrain productivity in Africa in relation to European productivity declined from roughly one-half to about one-fifth over the past three and a half decades.<sup>11/</sup> Even in Asia, where the new technology spread particularly rapidly, productivity in relation to European levels declined. Similar "technology-gaps" have emerged within countries.

24. The environmental hazards posed by the new agricultural technology can be managed and contained with appropriate policies. The difficulty is that in the search for quick production increases and short-term profit these so-called "side-effects" are ignored. But even more than this, the truly difficult problems lie in the agricultural systems that are outside the mainstream of commercial development in marginal areas and marginalized households.
25. The impact of agricultural expansion on forest-cover has been described earlier. But the pressure on forests also arises from other sources. The growth in the demand for paper and timber is one major factor. World consumption of paper has grown nearly fourfold since 1950 and amounts to about 186 million tonnes at present.<sup>12/</sup> The greater part of this is consumed in the developed countries, but with rising incomes, growing literacy and an expanding population the demand for paper in the developing countries is increasing rapidly.
26. Similar pressures are at work in timber production. The rising demand for tropical timber has led many countries endowed with large forest resources over-emphasize the timber harvest, largely for export but also for local industries, at the expense of other potential benefits. Another source of pressure on forests has arisen not so much from rising incomes as from rising population and that is the demand for fuelwood. At present 110 million people live in areas where fuelwood needs cannot be satisfied, even with overcutting and another 1300 million areas where needs can only be satisfied with overcutting.<sup>13/</sup> As forests recede rural people, especially women, have to walk several kilometres a day in search of fuelwood.

The burden this places on them is dictating the number and quality of their meals and threatens nutritional security. In some cases, they are using biomass as a source of domestic energy, depriving food production of this input.

27. Forests play a major role in the stability of the world's ecosystems and the loss of forest cover is leading to a high degree of environmental stress in many areas. An increase in the run-off of rainwater, soil erosion, landslides, siltation of reservoirs are some of the effects that can be seen. But besides these physical effects the loss of forests is destroying the livelihood base of many forest-dwellers who, over the centuries, have developed a way of life that uses the forest but does not destroy it. Nor are the effects of deforestation only local in character. A large-scale loss of forest cover could contribute to global climatic change. Another effect with a global impact is the loss of plant and animal species, a matter for particular concern in the case of tropical forests.
28. The environment development connection in agriculture and forestry is very much a two-way link : rising demands lead to rising production but in a manner that erodes the resource-base and thus endangers the very basis for the increased production. Moreover the process works in such a way that though the requirements of the affluent are met, the livelihood base of many poor producers is destroyed or severely reduced and this, in turn, leads to a further pressure on the resource base.

Industry and Energy

29. The environment-development connections which arises from the rising demands for energy and manufactured goods are a little different. The resources concerned are predominantly non-renewable and the environmental effects generated are of concern not so much because they erode the productive potential of the resource base but because of their wider effects on health and property. But even here the central issue is the long-term sustainability of the vast increases in production in the post-war period.
30. At the global level the consumption of commercial energy increased more than threefold between 1950 and 1983. In the developed countries the greater part of the increase in consumption took place before the mid-seventies and arose to a large extent from the massive increase in the use of automobiles and modern household appliances. Thirty years ago the ownership of these consumer durables was widespread only in the USA; but since then this phenomenon has spread to virtually all the developed countries. In 1983 the consumption of motor gasoline (used mainly in passenger cars) and residential energy demand accounted for 37 per cent of energy consumption in the OECD countries.<sup>14/</sup> With the growth in industrial production and the rising importance of energy use in agriculture, the indirect demand for energy has also grown rapidly, particularly in the developing countries.
31. Industrial production has expanded more than six-fold since 1950 and the share of developing countries in this production has increased from 7.8 per cent of value added in manufacturing in 1963 to an estimated 11.3 per cent in 1985.<sup>15/</sup> From an environmental

point of view three groups of industries are of particular significance: those based on metallic and non-metallic mineral resource, those based on forest products and chemicals and related industries. In practically all of these industries the greater part of the expansion took place in the fifties, sixties and early seventies in the developed countries. Today the focal points of growth are increasingly in the developing countries.

32. The increase in world industrial production has led to a somewhat slower rate of expansion in mineral production up to 1979. Since then the output of minerals has fallen sharply despite the modest but positive growth in industrial production.<sup>16/</sup> The experience of the eighties may well be rather special but even on a long-term basis at the global level the mineral intensity of industrial production has declined due to a variety of factors.

- First, the leading edge of industrial expansion in developed countries is shifting to sectors which are far less material and energy intensive than the traditional areas of manufacturing activity.
- Second, the growth in the industrial demand for minerals and agricultural materials has been reduced by the development of synthetics
- Third, various technological innovations and the growing inventory of metal products have made it possible to rely to a greater extent on the recycling of old materials.

- Fourth, there have major reductions in the material and energy requirements for most industrial products and processes.

33. The net result of these developments is that the fear of resource exhaustion, which was one of the early concerns of the environmental movement, have tended to recede into the background. In fact, for most minerals, the level of reserves is now higher than what it was in the fifties. This is mainly due to improvements in methods of exploration and advances in mining technology. There is also little evidence of rising real costs of mineral extraction except in some local contexts. By and large resource depletion has not been a major feature of the energy-industry-environment interaction until now.
34. Energy production and use, industrial process and mining activity impinge on the environmental not merely through their impact on mineral reserves but also through their capacity to degrade other resources like air, water and land. In many ways this latter type of impact is of greater concern because industry often treats these other resources as free goods and hence, may well pay less attention to conserving their quality as it would to the conservation of the resources which enter the production process and the profit calculus more directly.

35. A wide class of environmental problems arise from the emission of various pollutants into the atmosphere. At the global emission of carbon dioxide measured in terms of carbon, have increased from 1.6 billion tonnes in 1950 to over 5 billion tonnes in 1984.<sup>17/</sup> Around three-quarters of these emissions emanate from the developed countries. Similar long-term estimates for other pollutants are not available. However it has been estimated that global man-made emission of sulphur dioxide grew at about 5 per cent per year during the seventies and reached a level of  $196 \pm 30$  million tonnes per year.<sup>18/</sup>
36. The health problems arising from air pollution are due mainly to the concentration of emissions in major urban areas and industrial centres. Trends in urban air pollution are discussed later in the context of the link between human settlements and the environment. However there are certain effects of air pollution which are not localised but affect a broad region or even the globe. The two which are of greatest concern are the problem of acidification and the risks arising from what is called the green house effect.
37. During long distance transport in the atmosphere, emissions of sulphur oxide, nitrogen oxide and volatile hydrocarbons which arise mainly from fossil fuel combustion undergo chemical reactions and are transformed into sulphuric and nitric acids, among other things. Subsequent precipitation, sometime thousands miles from the point of emission threatens forests and the life-sustaining properties of waterbodies.

38. Acidification has a very direct impact on productive resources. Several thousand lakes in Europe and North America have registered a steady decrease in pH levels to the point where they no longer support fish life. The same acids attack stonework and corrode metal structures causing billions in damage annually. It enters drinking water supplies, liberates potentially toxic metals such as cadmium, lead, mercury, zinc, copper and aluminium, and poses risks to human health. Up to now, the greatest damage has been reported over Eastern and Western Europe, which are currently receiving more than one gramme of sulphur on every square metre of ground each year. There was little evidence of tree damage in Europe in 1970, but as of now an estimated 5-6 per cent of all European forest land is affected. Evidence of acidification in some newly industrializing developing countries is now beginning to emerge.<sup>19/</sup>

39. The other general effect of air pollution that is of great concern arises from the greenhouse effect. Upon combustion, fossil fuels emit the gas carbon dioxide, which accumulates in the atmosphere. The cutting and burning of forests adds to this carbon dioxide load on the atmosphere. The pre-industrial concentration was 280 parts of carbon dioxide per million parts of air (by volume - ppmv). This concentration reached 340 ppmv in 1980 and is expected to increase to 560 ppmv between the middle and the end of the next century. Other gases are also accumulating in the atmosphere, principally, chlorofluorocarbons (used as aerosol propellants in spray cans and in refrigerators as a coolant); methane (rising from wet, reducing soils,



e.g. rice-paddies, or from the earth's surface, especially where oil or gas is exploited); nitrous oxide (derived from the breakdown of nitrogenous fertilizers and from the exhaust gases of motor vehicles); and ozone (generated by industry and internal combustion engines).<sup>20/</sup>

40. The principal consequence of the concentration of greenhouse gases in the atmosphere could be a rise in global mean temperatures in the first half of the next century. A recent conference of experts called by ICSU, UNEP and WMO has concluded that a global warming of 1.5 - 4.5<sup>0</sup>C could come about causing the sea level to rise from 25 - 145 cm, which would inundate low lying coastal cities and agricultural areas particularly in river deltas.<sup>21/</sup> Many countries could expect their economic, social and political structures to be severely hit. This would be accentuated by the effects of changing climate on inland crops, forests and ecosystems.
41. The pollution of waterbodies is another major area of concern. Water is a major input in the production of energy and industrial products. In Europe and North America the use of water for such purposes has grown roughly four-fold since 1950 and accounts for one-half of total water-use. The quantity of water used by industry in these two continents is six times greater than the water used for drinking, sanitation and other household purposes.<sup>22/</sup> Only a small part of this water is used up and the bulk of it is returned to rivers, lakes and local seas. But the water that is returned is not unchanged and carries with it a load of thermal pollution, noxious chemicals and a variety of other substances that reduce greatly the value of the river or lake or local sea for other uses. The growing amounts of urban wastes and the nitrate and phosphate

laden run-offs from agriculture have compounded this problem. The pollution of water bodies leads not merely to a loss of amenity but also to health damage, loss of fishing resources, a reduction in irrigation potential, etc.

42. The growth of industrial and energy production and associated technological changes have created a major problem of toxic waste disposal. The best known case is that of the development of nuclear power which has created a new environmental problems of radioactive wastes. The spent fuel inventory of the 285 operating reactors in the market economies has risen ninefold since 1970 and amounts today to 56,600 tonnes of heavy metal. There are another 60 operating reactors in the socialist countries with a substantial but unknown radioactive spent fuel stocks.<sup>23/</sup> The problem of hazardous wastes also arises in many other areas particularly in the chemical industry. In many cases these wastes are transported to distant sites for disposal and often transfrontier movements are involved.
43. The growth of modern industry is based on technologies which involve large interventions in nature and in recent decades the scale of these interventions is increasing. Massive dams impound a large proportion of the river flow and most of these large dams have been built after 1950. Huge open cast mining projects gouge up thousand of hectares of earth and generate waste material in terms of millions of tonnes. As plant sizes increase the emission of pollutants into the atmosphere and into water bodies also becomes concentrated. The technologies developed for such large scale projects are oriented mainly towards cost

reduction and their impact on air, water land and other elements in the local environment are corrected, if at all, by a variety of add-on measures.

44. Another difficulty with the orientation of industrial technology in recent decades has been an insufficient attention to risks, particularly long-term risks. The problem of toxic wastes has been referred to above. Another example is provided by the production of synthetic substances which are not biodegradable and which, therefore, will accumulate in the biosphere. Many chemicals are introduced with very inadequate tests for toxicity and side effects.
45. The growing sensitivity to environmental problems has stimulated the development of technologies that conserve resources, clean up effluent streams and reduce pollution. But much of this work is not part of the mainstream of technology development and technology choices are still dominated by cost and profit considerations. A broader technological approach that integrates resource productivity, pollution prevention and waste management has yet to emerge.

#### Human Settlements

46. The changing structure of economic activity has led to major shifts in the distribution of population within countries. In the developed countries the major transitions have already taken place and the striking feature in recent years has been the deconcentration of urban areas in many developed countries and the shift of population to rural areas and smaller settlements. In developing countries the transition is still under

way. Between 1950 and 1985 the urban population in the developing countries increased by about 850 million and a growing percentage is now residing in large cities of over 1 million.<sup>24/</sup> These cities attract migrants for a variety of reasons. One of these is the dominant role that these cities play in the national economy, particularly in the growth of modern industry and services. Because of this dominance, migrants are attracted to cities by the prospects of employment, better education, better health, etc. Another factor is the gradual erosion of the livelihood base in the rural hinterland because of population growth and ecological stress.

47. Urbanisation is a necessary consequence of the growing diversification of Third World economies and is not, in itself, undesirable. In fact, in many developing countries, this process may well be essential to reduce the pressure of population growth in rural areas. The real difficulty is that the pace of urbanisation is much faster than the capacity to cope in the formal structures of urban administration. Shortages of housing, water supply, sanitation and mass transit services are widespread. A growing proportion of urban populations live in slums, many of them in environmentally vulnerable areas exposed to air and water pollution and industrial hazards. In many a Third World metropolis there are in fact two cities. One is a city of those who derive their income from the more formally organized part of the economic systems and enjoy standards of housing, water supply, sanitation, road space and greenery comparable to, or even better than in a developed world city. The other is the city of those who derive their livelihood from a

complex of informal economic activities, who derive little benefit from the formal structures of urban administration and who meet their basic needs for housing, water supply, etc essentially through self-help.

48. The environmental problems of urban areas arise not just from the concentration and growth in population but from the nature of the economic base in many cities. The widespread use of motor vehicles and the burning of fossil fuels gives rise to the problem of air pollution. The growing awareness of the effects of polluted air on human health, property and the environment has led to control measures and reduced emissions of some of the principal pollutants and cleaner air over some cities. The available evidence suggests a sharp decline in emissions of sulfur dioxide, particulate matters and nitrous acids in most developed market economies.
49. Developing countries have witnessed a steady deterioration in the quality of their air with all its attendant effects. Air pollution has reached dramatic levels in many major Third World cities. Thus sulfur dioxide concentrations exceeded WHO guidelines for exposure limits in Sao Paulo, Rio de Janeiro, Santiago, Tehran and Manila during the period 1973 - 80. The same is true for concentrations of suspended particulate matter in Bombay, Delhi, Calcutta, Jakarta, Tehran, Kuala Lumpur, Bangkok, Sao Paulo, Santiago and Hong Kong.<sup>25/</sup> Similar problems have arisen in the case of water and in many cities high concentrations of heavy metal have been found in drinking water supplies. What is disturbing is that these problems

have arisen long before these countries have reached developed countries levels of industrialization and transportation development.

50. Problems of living space and a habitable environment are perhaps less acute in rural areas. The principal source of pressure there is population growth. Every year the rural areas of the Third World have to accommodate about 30 million new inhabitants. Even at an "urban" density of 400 per sq. km. this would require 7.5 million hectares of land and in many areas the requirements are substantial enough to eat into agricultural land. Moreover with growing size many rural settlements are facing problems of drinking water supply, sanitation and even water pollution (e.g. from nitrates) which are similar in nature if not in magnitude to urban problems.

#### The Notion of limits

51. The two-way interaction between environmental constraints and developmental possibilities have led to many assessments which put great stress on the physical limits to growth. Some early assessments argued strongly that available sources of energy, essential raw materials and food would run out and that these supply limits, along with overwhelming pollution, would inhibit and eventually halt economic growth. However the content of growth has changed and material demands are not increasing as rapidly as the early assessments suggested. Hence most recent assessments, have concluded that growth can continue for the foreseeable future without encountering fundamental limits at the global scale.

52. There is no one unique limit to growth. There are a variety of constraining factors and, amongst these resource limits are not necessarily the most important. Moreover the limiting factors may operate only in some regions though certain global limits cannot be ruled out. For example the capacity of the ecosystem to absorb emissions of carbon dioxide and several radiatively active trace gases may well be exceeded. However the content of economic growth and development has and will continue to confront ecological limits at the regional and local scale. The real challenge is to understand these limits and reorient development patterns so that they work with rather than against the compulsions of ecology.

C. INTERDEPENDENCE AND EQUITY

53. Ecological constraints are intimately bound-up with institutional constraints. Where the content of current and projected development exceeds ecological limits, it does so often because institutional barriers prevent them being managed together. It is economic, trade, tax, fiscal, agricultural, energy, transport and other policies that most influence the content of development. Yet, structural and other barriers usually ensure that they are ecologically blind. The greatest difficulty lies in the fact that the reality of ecological and economic interdependence is not reflected in the procedures for decision making and the framework of institutions and the most lasting solutions to environmental and developmental problems lie in measures which correct this. There are basically three reasons for this inadequacy: (a) the

inadequacy of mechanisms to articulate the common interest, particularly at local level (b) the deepening of intersectoral linkages and (c) the growing role of the international economy.

The articulation of the Common Interest

54. Ecological interactions do not respect the boundaries of property ownership and political jurisdiction, a fact which has been recognized for centuries in the way in which societies organize their economic activities. Traditional systems of agriculture involved a strong dose of community control over crop rotations, timing of sowing, irrigation or harvesting and a host of other practices. Rights to common property and traditional rights relating to water, forests land and air space were enforced. This enforcement of the "common interest" was not inconsistent with growth and expansion though it may have limited the acceptance and diffusion of technical innovations. With the upsurge of technical progress, the growing 'enclosure' of common lands, the erosion of common rights in forests and other resources and the spread of commerce and production for the market, the locus for decision-making shifted from the group to the individual. These processes completed long ago in the developed world are still under way in many of the developing countries.
55. Physical interdependence at the local level has, if anything, increased because of the technological features of modern agriculture and manufacturing. Decisions taken by one producer or consumer affect the well-being of his neighbours in a direct fashion and many examples can be given to demonstrate this:



- In a watershed, the land-use patterns of a farmer up the slope directly affect run-off and other conditions in farm lower down;
- The seed varieties, irrigation practices, pesticides and fertilizers used on one farm affect the productivity of neighbouring farms, a form of interdependence which is even more marked when holdings are small;
- The efficiency of a boiler installed by one factory determines its rate of emission of soot and noxious chemicals and affects all who live and work around it;
- The hot water discharged by a thermal power plant into a river or a local sea affects the catch of local fisherman.

56. It is not that there are a set of villains and another set of victims. That may be the case in some instances. The more general situation is described by the "isolation paradox". Everyone would be better off if each one takes into account the effect of his decision on others. But each one is unwilling to assume that the others will behave in this socially desirable fashion and hence everyone continues to pursue a narrow self-interest. The only mechanism available to compensate for this isolation is the authority of the community or the government, local or national. Through command and control mechanisms, promotional programmes, taxes and subsidies, governments can try and enforce the common interest.

Legislative standards and strict liability legislation can enforce responsibility for harmful side-effects. But these are essentially "add-on" measures which act to regulate or compensate for what are, in effect, unwelcome developmental trends and unwise policies. There is often a "knowledge" gap in that traditional methods of technical and economic monitoring and analysis cannot reveal the facts of interdependence. But above all there is a "willingness" gap particularly when the measures required limit the gains of the local power structure.

57. Beyond the local level physical interdependence may not be as all pervasive but, with the growing scale and concentration of productive activity, there are, what could be described as large-scale externalities. Air moves horizontally and there are regional and even global pollution effects e.g. acid precipitation and the accumulation of carbon dioxide in the atmosphere. There are more than 200 international river basins and a large number of shared seas. Conflicts over the use of such shared resources and trans-border water pollution are common. The enforcement of common interest suffers in many such cases because there is often a large difference between the boundaries of political or administrative jurisdiction and the area of impact. Energy policies in one jurisdiction lead to acid precipitation in another. The emission of effluents into a river in one country leads to a reduction of amenity in another. The fishing policies of one littoral state affects the catch of another. When such problems occur within countries an effective national government could connect the gap between area of impact and administrative jurisdiction. But when

the problem arises between nations there is no such supranational authority and the common interest can only be articulated through international co-operation.

58. The articulation of the common interest would perhaps be an easier matter if all developmental and environmental problems had solutions which would leave everyone better off. But this is seldom the case and there are gainers and losers. Many problems arise from inequalities in access to resources. An unequal structure of land ownership can lead to over-exploitation of resources in very small holdings with harmful effects both on environment and development. At the international level monopolistic control over resources can drive those who do not share in them to suboptimal exploitation of marginal resources. A differential capacity to commandeer "free" goods and common property locally, nationally and internationally is yet another manifestation of the unequal access to resources. The asymmetry is also evident in the distribution of losses from developmental failures and environmental deterioration.
59. As a system approaches ecological limits there is a sharpening of inequalities. Thus when a watershed deteriorates a poor farmer suffers more because he cannot afford the ameliorative measures which a more prosperous farmer can. In cities when air quality worsens, the poor, who tend to live in more vulnerable areas, suffer more health damage than the rich who, even in extreme situations, can protect themselves by moving to more salubrious areas. When mineral resources are depleted, late-comers to the industrialization process lose the benefits of low-cost

supplies. Even with global effects, the wealthier nations are better placed financially and technologically to cope with the effects of possible climatic change. Hence the inadequacy of the mechanisms for articulating the common interest is linked to the relative neglect of economic and social justice within and between nations.

#### Intersectoral Linkages

60. The growth in physical interdependence between producers and consumers has been accompanied by a growing interaction between sectors of productive activity. Decisions about production, input use, product design, pricing, etc. in one sector impinge, more and more, on the options available in other sectors. The most direct manifestation of this is in the growth of intersectoral transactions by way of input purchase and output sale.
61. Traditional agriculture is a relatively self-contained system based largely on home produced seeds and manures and animate energy. Modern agriculture is very different in that it uses substantial amounts of commercially produced energy (mainly electricity and petroleum for running pumps, tractors, harvesters, etc.) and large quantities of industrial products (fertilisers, pesticides, agricultural machinery). In some countries this growing interaction between agriculture and industry is being reflected in an increasing involvement of industrial corporations in agricultural activities and, conversely, the establishment of industrial facilities by co-operatives

or associations of agriculturists. At the same time the more traditional connection in which agriculture is a source of raw materials for industry is being diluted by the widening use of synthetics.

62. The energy-industry connection is changing with a strong tendency towards a decline in the energy-intensity of industrial production in the developed countries. This is due to changes in industry-mix and improvements in efficiency. In the developing countries however, the gradual shift of the industrial base towards the basic material producing sectors is leading to an increase in the energy intensity of industrial production. Within the industrial sector the interconnection between different industries is increasing both through input-output linkages and through changing patterns of ownership. The blurring of industrial boundaries is particularly marked in key areas of technological advance like electronics and materials science.
63. The changes in intersectoral connections create patterns of economic and ecological interdependence that are generally not reflected in the institutional arrangements for policy formulation. These tend to be based on standard sectoral divisions which define the structure of public administration and business organization. The pricing of energy provides one example. Typically decisions on energy prices are determined separately for say electricity, petroleum and coal by the producing companies or by some controlling authority. The method used is generally some variant of a cost-plus pricing rule. Such an approach tends to neglect the substitution efforts

engendered by price uses, the impact on using sectors, the implications for long-term energy policy and a host of other considerations. Similar arguments apply to other sectorally determined policies.

64. The sources from which environmental and ecological problems arise are seldom limited to one sector. The root causes of deforestation for instance lie in energy policy, agriculture policy, industrial policy and trade policy among other things. Sectoral organizations tend to pursue sectoral objectives and treat the impact on other sectors as "side-effects" which they will take into account only if they are compelled to do so. Hence the impact on forests will seldom be a major factor in the orientation of public policy or business activities in the field of energy, industrial development, crop husbandry or foreign trade. Many of the environmental and developmental problems that confront us have their roots in this sectoral fragmentation of responsibility for a highly interrelated set of problems.

#### The Role of the International Economy

65. Economic interactions at the national level are regulated by a vast array of policy instruments. The intention generally is to use them for sound long-term ends, though in practice short-term considerations, immediate conflicts about gains and losses and international pressures dominate. But even more than that, the very ability of governments to control the national economy is reduced by the growing interactions with the world economy and this is true both for developed and developing countries.

66. Foreign trade, particularly in primary products, shifts the locus of the environment-development connection from the national to the international level and carrying capacity and resource scarcities have to be assessed at global level. In a world where economic power is more equally distributed this shift in locus may well be beneficial and help to widen the possibilities for sustainable development for everyone. But in reality this is not the case and the gains from trade are very unequally distributed.

Growing Importance of Trade

(Exports as a Percentage of  
GDP/NMP)

	<u>1950</u>	<u>1982</u>
Developed Market Economies	7.7	15.3
Developing market Economies	15.5	23.8
Socialist countries of Eastern Europe	3.4*	16.6*
Socialist Countries of Asia	2.9*	9.7*

\* Percentages to net material product. (NMP)

Source: Based on UNCTAD (1985)

67. The role of foreign trade in relation to national income has increased for most countries in the post-war period. Certain major changes in the pattern of world trade have also taken place. First the trade in manufactured goods increased at a rate faster than the growth in primary product trade (other than fuel) and several developing countries emerged as major exporters of manufacturers. The second major change is the rising dependence of the developed market economies on fuel imports from developing countries which accounted for 43 per cent of consumption in 1980-81 against only 16 per cent in 1959-60 and even lower than that in pre-war years. The dependence of the developed market economies on other mineral imports from the developing countries also increased and the share of these imports in consumption increased from 19 per cent in 1959-60 to 30 per cent in 1980-81.<sup>26/</sup> Non-renewable resources like fuels and minerals are now far more important than tropical products and other agricultural materials in the flow of primary products from the developing to developed countries.
68. An important deviation from this general pattern is the pattern of world grain trade, which has changed greatly over the past few decades. In pre-war years, Europe was the only deficit continent and it met this deficit of about 20 million tonnes mainly from Canada and Argentina. The USSR, Asia and Africa were net exporters of cereals. At present the situation is very different. Net exports from North America have increased from barely 5 million tonnes before the war to nearly 120 million tonnes in the eighties. The grain deficit in Europe is much lower and the bulk of these exports are to USSR, Asia and Africa. Three countries, USSR, China and Japan absorbed half of this surplus and much of the rest went to relatively wealthy



developing countries e.g. the oil exporters of West Asia.<sup>27/</sup> However the food-population imbalance in some low income developing countries led to their becoming net grain importers a phenomenon that is most obvious in Sub-Saharan Africa at present. However the volume of grain imports by the Sub-Saharan Africa accounts for less than 10 per cent of the world grain trade, which is still rooted, not in Malthusian pressures in impoverished countries but on the operation of comparative advantage.

69. The trade in primary commodities affects not merely the concerned producing sector but the entire economy of many developing countries which depend heavily on this trade for their export earnings. This dependence has declined but is still high in Latin America and Africa. In the case of the least developed countries it is exceptionally high and, what is as important, it has not declined since the mid-sixties. The production and export of primary commodities can widen options and offer additional possibilities for sustainable development. but in practice these possibilities have been reduced by the fluctuations in pricing and earnings and the fact that exporters in developing countries are dependent largely on oligopolistic trade channels based in the developed market economies which limit their ability to influence the terms of exchange and their gains from trade.

Dependence of Developing Countries on Primary Product Exports  
Percentage  
Share in total merchandise exports

	1966	1982
Africa	86	62
America	84	52
Asia	57	22
of which		
Least developed countries	74	73

Source: UNCTAD (1984)

70. There are other types of ecological interdependence that operate through the trade mechanism. One element which is rising in importance, is the world trade in chemicals which was around \$140 billion in the early eighties. A large number of new chemicals enter world trade every year; some of them are banned or restricted in use in the originating country and quite a few are inadequately tested for short-term and long-term side effects.

71. The rising importance of foreign trade has been matched by the internationalisation of investment activity in the market economies. This process of internationalization clearly increases the economic interdependence between nations and the level and pattern of investment activity in one country becomes at least partly dependent on economic policies in either countries. Investments in resource based and pollution intensive activities also heighten the ecological interdependence between nations. But even more than direct investment, the internationalization

of investment has taken the form of a vast increase in bank lending and international bond issues particularly in the past decade. The debt crisis, which has had a profound effect on the environment-development situation in many developing countries is a reflection of this internationalisation of financial markets.

D. THE INADEQUACY OF CURRENT APPROACHES

72. The inadequate recognition of the environment/development connection and the weakness of the institutional framework for managing interregional and intersectoral linkages can be attributed to many causes. However one general factor underlies the ineffectiveness of current approaches and that is the lack of a conceptual framework which integrates economics and ecology. The dominant influence on decision-making structures at every level is the economic factor which shapes the policy response to problems of environment and development.
73. The root of the problem lies in the manner in which the processes of production and the interaction between man and nature are conceptualized in the analytical methods which influence public and private decisions. The environment appears in plans, programmes, projects and policies in the form of natural resource inputs and, sometimes, in the form of outputs of environmental "goods" or "bads". Apart from this the environment is treated as an external element that determines the relationship between inputs and outputs i.e. the productivity of natural resources. Such a representation does not really reflect the impact of production processes on the environment. For instance

the manner in which land and water are used to produce corn, influences the future relationship between these inputs and outputs. In this sense resource productivity and the production possibilities open to the decision-maker are not something external but are determined by the production process itself. A static view which treats the past as bygone and the future as irrelevant and focusses attention only on the current relationship between inputs and outputs misses out on a crucial element in the analysis of environment and development.

74. The history of production is also important for another reason and that is the irreversibility of many environmental processes. In irreversible processes costs and returns depend on the past and decisions taken today influence costs and returns in future. These irreversibilities are particularly important in resource based activities like mining, agriculture, forestry, etc. Thus, in underground mining, costs may be a function not merely of current output levels but of cumulative production to date. In agriculture the history of land use determines the productivity of land today. This notion of irreversibility is implicit in the classical concept of diminishing returns, a notion which has been lost in much of modern economics where production possibilities are generally formulated in terms of 'factors of production' whose supply can be increased at will. But irreversibility involves more than fixed factors of production and diminishing returns. It requires that the ecologists perception of natural processes as a set of interlinked and closed cycles should be reflected more fully in the representation of production processes used in economic analysis.

75. The inadequate treatment of production processes is reflected in the concept of national income which plays an important role in discussions of economic performance and policy. National income is defined as the sum of the value added in all processes of production, where value added is the difference between the value of the good and services produced and the cost of the goods and services used up in the process of production. This value added accrues as income in the form of wages or return to capital. From an environmental point of view the crucial problem with this concept is that it does not take full account of the impact of production processes on the stock of natural resources. Two examples can help to clarify this particular inadequacy in the concept.
76. The first example is from forestry. In national income estimates the income from forestry is defined as the value of timber and other forest products produced minus the costs of extraction. The costs of forest regeneration will be included in the costs of extraction only to the extent to which they are actually incurred. The loss of forest wealth does not play any direct role in these calculations. Thus a country in which forest production increases rapidly and forest cover declines equally rapidly is really living in its capital. Both the concept of national income and the measurement of growth based on this concept does not take this into account. It counts as income the returns from forest production but does not count as a cost the reduction in the stock of forest wealth. Similar criticism applies to the treatment of other natural resources.

77. The second example relates to the treatment of expenditures on pollution control or more generally on the maintenance of assets. In national income analysis the income earned in such activities is added to the total of national income. In reality all of this expenditure should be treated as a cost for maintaining the stock of natural capital and other assets. The conventional deductions for depreciations, which are taken into account, are not an adequate measure of this cost of maintaining the stock of capital, particularly natural capital.
78. The essence of the problem lies in the fact that income should be defined as that which one can consume or use for investment without depleting the stock of wealth. Moreover wealth itself should cover not just the assets shown in balance-sheets but also all the resources in the environment that contribute to human welfare. The present concept of national income and, for that matter, the concept of material product used in socialist countries, does not do this and hence leads to a misdirection of public policies relating to production and economic growth.
79. Another difficulty arises from the treatment of uncertainty in decision processes which is generally based on the idea that this uncertainty arises from factors external to the production process, from acts of god so to speak. However environmental analysis requires the notion of "technological" risk which depends on the choice of production techniques. Thus in decisions regarding the production of electricity the choice of a nuclear option may imply a very different

level of risk from that which generated by a hydel plant. Environmental uncertainty is largely a result of the choice of production processes. It cannot be conceptualized in terms of a god-given set of possible states of nature. The actual choices made change the set of states that is probable. In this sense uncertainty and risk have to be made a part of the analytical framework in an essential way. It is worth noting that a roughly similar argument also applies to states of technology.

80. Environmental analysis also involves what could be described as threshold effects. Up to a point a given change has little or no impact, but beyond some critical point the impact suddenly increases. This implies that the interaction between production processes and the environment may not be proportional or vary in a continuous way since there is an essential discontinuity of impact at the critical threshold point. The standard methods used in economic planning and policy do not take such threshold effects into account.
81. In certain cases a purely economic approach leads to a belief in the efficacy of "markets". From an environmental point of view there are at least two reasons for qualifying this belief in the ability of markets to give correct signals for optimising production:

- The first reason relates to what are called "externalities" which arise when decisions taken by one producer affect the production possibilities available to some other producer. The physical interdependence which operates through a shared environment provides many examples of such "externalities". In a market economy, where each individual takes decisions largely on the basis of self-interest, these wider social costs cannot be taken into account without some form of government intervention.
- The second reason, which in some ways is related to the first arises from the fact that many environmental resources like air and water have the characteristics of common property. In a system dominated by self-interest each individual will tend to over-exploit these public resources since the gains from self-denial will not accrue to him alone but to the community. The real problem here is the absence of any market or non-market mechanism for ensuring that common property is used in a fair and socially optimum way.

82. The evidence of market failure, not merely in the environmental context but also in terms of other social objectives is so widespread that practically every government intervenes in the operation of market systems through a variety of policy instruments. Unfortunately there is very little evidence to suggest that these policy instruments are used to correct environmental abuses. In fact in some cases they add to environmental pressures and widen the gap between economics and



ecology. One example is provided by agricultural subsidies in many developed countries which lead to environmental deterioration in these countries and reduce the options for a more optimal pattern of agricultural development in some developing countries. Another example is that of food subsidies in some developing countries which have led to ecologically sub-optimal cropping patterns in these countries.

83. The gap between economics and ecology is not limited to market economies. It also prevails in systems based on economic planning and extensive direction of production decisions by the government. Such planned economies may be able to take fuller account of intersectoral and interregional linkages in production. But the broader aspects of the environment-development connection are not adequately reflected in the methods used in the formulation of plans, projects and programmes.
84. Our capacity to successfully solve the developmental and environmental problems described earlier rests on a large extent on our ability to develop technologies, policies and institutions which help to reduce inequalities, increase production, conserve resources and avoid waste. As time passes man's interventions in natural processes will increase not decrease. Hence it is essential that the orientation of our efforts should be such that we take a holistic and systemic view and not be restricted in our vision by geographical or sectoral boundaries.
85. The most important point is to recognize that the environmental stresses that confront us today are a product of the level and pattern of world development. It is equally true that economic development is increasingly constrained by ecological factors locally and globally. The critical areas of interaction lie in

the population-food-land use chain, in the causes and effects of deforestation and in the links between fossil fuel and material use and the problems of pollution. In each of these areas the central issue is not that of limits to growth but of the measures required to change the content of growth and to ensure that the benefits of development are more widely shared.

86. This requires that environmental and developmental objectives not be separated and the two domains of policy-making be combined in one framework. The objective should be to pursue a development path that can be sustained on a long-term basis without running into resource scarcities or resource degradation. But this by itself is not enough. The fruits of development must be more equally shared and so also the self-denials required to sustain development paths over the long-term. The common interest of all must prevail over sectional interests and this will require a major change in political and economic institutions. Sustainable and equitable development in this broad sense must become the basis for a new consensus on environmental and developmental policy nationally and internationally. In the next chapter, the Commission outlines what it believes should be the principal features of such a consensus.

## NOTES TO CHAPTER II

N.B. The works cited here in abbreviated form are listed fully in "References for Chapters I - III".

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