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AND SUSTAINABLE DEVELOPMENT**

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DEVELOPMENT**

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PART ONE

THE CONCEPT OF SUSTAINABLE DEVELOPMENT

1. The world should be viewed as a single human-settlement system, because human settlements provide the living and working environment for almost everybody in the world. Human settlements are the prime generators of the wealth which provides the capital for all human activities. Human settlements are the great engines for the social improvement which is the ultimate purpose of all development. Sustainable-development policies can best be implemented through the vehicle of human-settlements management.

2. The transformation of raw materials into goods, the application of resources to the provision of services and the consumption of energy for industrial, commercial, transport and household use largely take place in human settlements. Human settlements can provide the framework for the conservation and recycling of non-renewable resources and the introduction of technologies using renewable resources.

3. Human-settlement systems should support freedom of choice in place of residence and place of work. Human-settlement systems should provide the technical and social services needed to improve the quality of people's lives. Physical planning of human settlements patterns at all scales is a requirement for integrating all the elements of settlements development and operation.

4. Human settlements are, at one and the same time, the means for bringing about desired social, economic and physical development and the indicator by which the quality of the desired development is measured.

I. HUMAN SETTLEMENTS AND SUSTAINABLE DEVELOPMENT

A. *Human settlements and development*

5. Although there is a large and rapidly growing body of literature about "sustainable development policies", little consideration is given to the human settlements aspects of such policies, and such literature as there is tends to concentrate solely on issues related to the quality of the living or working environment. Although there are clearly important issues, little attention is given to the economic and social role of settlements. Yet, human settlements have a central role in economic and social development and in managing interactions between the built and natural environments.

6. National and regional settlement systems are the framework within which economic activities operate, and the settlement system - cities, small centres and rural settlements and their interconnections - provides the spatial context for most capital- investment decisions. In most instances, rapid urbanization reflects the preference of investors for urban locations, especially because of the agglomeration economies achieved by locating there, and, over the past century, urban centres have taken the leading role in economic growth, providing the location and environment for the transformation of the world's economy. Worldwide, cities are the principal centres for new jobs, for innovation and for new or expanding economic opportunities, and it is through an increasingly interlinked system of cities, small urban centres and rural settlements that world production, trade and communication take place. Settlement systems also have an important role in agricultural development, since it is only through the urban system and its links with rural settlements that farmers can be supported by agricultural extension services, production inputs, credit support and storage, marketing and processing facilities. The settlement system also provides the means through which natural resources can be reached and exploited.

7. Settlement systems also have an important role in social provision: it is through the settlement system that both rural and urban populations obtain access to health care, education, communication facilities and emergency life-saving services. Settlements with concentrated populations (i.e., all urban centres and many large villages) also allow for economies in the provision of many kinds of infrastructure and services which improve health and the quality of the living environment - for instance, piped water, the regular removal of household and human wastes, and health care. Concentrated urban populations also provide better possibilities than dispersed rural populations for preserving natural landscapes and sites with important ecological functions (for instance, catchment areas, wetlands and zones of special significance in protecting genetic diversity).

B. *Human settlements and sustainable global development*

8. In essence, sustainable development means meeting the needs of the present generation without compromising the ability of future generations to meet their needs, and meeting human needs implies recognizing each person's right to a standard of living adequate for health and well-being, including adequate access to food, clothing, shelter, medical care and necessary social services (as stated by the Universal Declaration of Human Rights). This Declaration and subsequent United Nations documents have also stressed that development goals should include the right to choice and participation in representative governmental structures. In the context of sustainable development, human settlements management seeks not only the achievement of good living and working environments but also the attainment of economic, social and political goals, by making optimum use of the global natural-resource base and life-support systems. Thus, "sustainable settlements development" brings together two strands of thought about the management of human activities - one concentrating on developmental goals (including a concern that the poor receive an equitable share of the benefits of development), the other on achieving those goals without damaging the planet's life-support systems and without jeopardizing the interests of future generations.

9. To avoid compromising future generation's needs, consideration must be given to the use of three different kinds of planetary assets:

(a) *The finite stock of non-renewable resources* (for instance, fossil fuels and other mineral resources). Some of these resources (especially the fossil fuels burnt for heat and power) are "consumed", and so finite stocks are depleted with use. Others are not "consumed", since the resource remains in the waste - for instance, metals used in producing goods - and, to some extent, can be reclaimed and recycled. However, recovery can often be difficult and expensive, and can never be complete, so that depletion does take place.

(b) *Renewable resources. Human use of many renewable resources has no finite limit* - for instance, tapping solar power does not deplete the resource - but, for many renewable resources, the resource is only renewable if the natural systems on which it depends are not overexploited. Food crops and forestry products are only "renewable" if the soil, water and other elements of the natural systems on which they depend are not themselves depleted.

(c) *The capacity to absorb pollutants and other harmful by-products of development* processes. The two most widely discussed global threats arising from human activities are the depletion of the atmospheric ozone layer (which filters out harmful radiation from the sun) and possible climatic imbalances caused by emission of "greenhouse" gases. However, localized threats to air resources, water quality and land capabilities are just as important and have an immediate and direct impact on the great bulk of the world's population.

Although there are other important aspects of global sustainability, such as the preservation of genetic diversity, preventing a depletion of planetary capital in regard to the resources noted above remains the most important consideration in sustainable human settlements development.

C. Human settlements and sustainable local development

10. There is clearly a central role for human settlements in achieving sustainable development nationally and locally. It is only through rational and considered management of all aspects of settlements, including mobilization of the resources used in their construction, operation and maintenance, in the provision of services to meet the needs of their citizens and in the treatment, recovery and recycling of their by-products, that sustainable development can be realized. This applies at the individual-settlement level and at the national and subnational settlement-system level.

11. A settlement can be judged on four sustainable-development criteria:

(a) *The quality of life it offers to its inhabitants;*

(b) *The scale of non-renewable resource use (including the extent to which secondary resources are drawn from settlement by-products for re-use);*

(c) *The scale and nature of renewable resource use and the implications for sustaining production levels of renewable resources;*

(d) *The scale and nature of non-reusable wastes generated by production and consumption activities and the means by which these are disposed of, including the extent to which wastes impact on human health, natural systems and amenity.*

With respect to the final point above, public authorities have responsibility for providing infrastructure and services to ensure a good-quality living and working environment, and a large part of this responsibility is connected to waste management - drains for wastewater, sewers (or latrines and septic tanks) to remove sanitary wastes, services to collect and dispose of solid wastes etc.

12. The key role for national governments is to establish:

(a) *The institutional structure within each settlement, to provide and maintain basic*

infrastructure and services to meet local needs and priorities;

(b) The regulatory and incentive structure to allow local and subnational (regional) governments to encourage sustainable levels of resource use, including incentives not to use resources with negative ecological impacts and a regulatory framework to allow authorities to penalize polluters;

(c) An "enabling" framework to encourage the initiatives of individuals and organizations (for instance, non-governmental organizations, non-profit foundations and municipal authorities) to improve housing and living conditions or in other ways to contribute to goals of reduced resource consumption or waste.

These matters should be dealt with in the context of national policy on resource use and on preservation of ecological balance.

D. Human settlements and sustainable living environments

13. The goal of sustainable development is to ensure that everyone has a secure living environment which promotes health and well-being and whose provision does not require an unsustainable level of resource use or degradation. Although there are serious problems of homelessness and inadequate living conditions for some people in developed countries, the great proportion of those living in environments which are neither life-sustaining nor developmental is in the developing countries, where people tend to be poor, ill-educated and particularly vulnerable to natural and man-made hazards. Increasing numbers of health studies show the extent to which low-income groups' lives are dominated by ill health, disablement or premature death, but, while poor people in Europe and North America suffer more ill health and premature death than rich groups, in developing countries, the problem is large-scale and severe; a high proportion of the population is poor, and their health problems are very severe. In developing countries, the poor use virtually all their resources on daily necessities (especially food) and have a very limited capacity to pay for housing or basic services (including health services), so, if the government does not ensure there is an effective health-care system and that everyone can find accommodation with potable-water service, sanitation and cooking and washing facilities, poor groups will continue to suffer from easily preventable disease, disablement and premature death.

14. Problems in human living environments can be considered at four scales - the house and workplace; the neighbourhood, village or district; the city; and the country or subnational region:

(a) Within the house and workplace, hundreds of millions of people are exposed to pathogens or toxic substances with serious impacts on human health - for instance, pathogens from human excreta in water supplies, toxic chemicals used in the house or workplace with no safeguards, and smoke or fumes from fires and stoves which cause or contribute to serious respiratory problems.

(b) At the neighbourhood, district or village scale, problems centre on the large numbers of people exposed to pathogens or toxic substances:

(i) Household and, on occasion, industrial solid wastes dumped around houses, which contain pathogens and also attract disease-causing agents (e.g. rats, flies) because of no municipal service to remove garbage;

(ii) Pools of dirty water around houses, because there are no drains or sewers, and house sites contaminated with excreta.

At this scale, there is also the problem of unsafe housing sites - for instance, settlements built on steep hillsides or on sites subject to flooding or on sites in other ways exposed to risks of natural disasters.

(c) At city scale, problems usually centre on:

(i) High levels of air pollution. In cities with high concentrations of heavy industry, industries are usually the main polluters; in many cities, congested streets, poorly

maintained motor-vehicle engines and (often) high levels of lead additive in petrol contribute to air pollution; thermal power stations burning high-sulphur coal or oil are also contributors. In some cities, household use of wood or coal as a main fuel is a contributor to pollution and to associated respiratory problems.

(ii) High levels of water pollution. One cause is lack of sewers and drains and of plants to treat sewage, because many large and small urban centres have no sewerage system at all. Another cause is industrial liquid wastes, most of them dumped in contravention of regulations.

(iii) Toxic/hazardous industrial and commercial wastes disposed of in water bodies or on land sites without special provision to deal with them.

(iv) Inadequate systems to dispose of wastewater and to control flooding.

There is, often, little or no incentive for industry and commerce to cut down polluting emissions, since few are penalized, and the penalties, when finally imposed, are so small as to be little deterrent.

(d) At the national or subnational level, many problems arise from the interaction between cities and their rural hinterlands. Rural inhabitants and the rural resource base can suffer from impacts of city-based activities or city-generated wastes. Among the most common examples are:

(i) Destruction of coastal and estuarine fisheries as a result of water pollution from city-based enterprises;

(ii) City water supplies taking priority over farmers' water needs;

(iii) Air pollution arising from city-based industries damaging vegetation (for instance, contributing to acid rain) and disrupting natural systems.

There can also be problems of solid wastes from city enterprises being dumped on poorly prepared and maintained landfill sites because, in most cities, there is little or no separation of toxic wastes from those which can be safely disposed of in landfill, and there is no proper management of landfill sites. The result is contamination of water used by farmers or rural households for their own consumption. Deforestation can arise from demands for wood and charcoal from urban households and businesses.

E. Conclusion

15. The purpose of development is to improve human well-being. The expansion of national economies, the creation of job opportunities, the production of goods and services, and the improvement of institutional structures are not ends in themselves but merely means of providing people with access to the basic necessities of food, clothing and shelter, and a life of dignity, self-respect and free choice. The important measures of development are not industrial output, gold reserves or (especially) military capability but health, education and housing standards, and the right of every citizen to political choice and to participation in all decisions which affect his or her quality of life.

16. All development, however, requires the use of resources. Renewable resources - capital, human skills, agricultural produce, hydropower etc. - can be replenished and enhanced, but non-renewable resources - fossil fuels, minerals, air etc. - once depleted or damaged cannot be restored. Therefore, sustainable development requires the husbanding of non-renewable resources, through efficient use, recycling and replacement by renewable resources, so as to preserve the life-support systems of the planet for future generations. Action in this respect has to be taken at the national level, even when the goal is global, e.g., protection of the "global commons", and is agreed on in international protocols.

17. At the national level, one of the great obstacles to rational allocation of resources, so as to achieve sustainable development, has been the lack of an integrating framework for decision-making on intersectoral

resource-use priorities and a co-ordinating mechanism for implementation of decisions, once taken. Human settlements management, however, is a vehicle for

comprehensive evaluation of sectoral inputs to the development process and, particularly, for primary and secondary distribution of resources. Since the purpose of human settlements management is the improvement of people's living and working conditions, it directly links development goals with sustainable methods of achieving them.

II. LINKING HUMAN SETTLEMENTS AND SUSTAINABLE RESOURCE USE

A. Settlements and resource use

18. Human settlements contribute to two central development goals - productive, innovative economies and high-quality living environments - while also providing an important mechanism for sustainably managing natural-resource use. Human settlements, and the activities they contain, depend on three kinds of natural resources - renewable resources (for instance, food crops, timber products, water sources); non-renewable resources (for instance, fossil fuels, other mineral resources); and the capacity of natural systems to absorb wastes generated by production and consumption. Renewable resources are generally only renewable within finite levels of exploitation; for instance, crop yields cannot be maintained if soil fertility is seriously damaged, while the volume of water a settlement can draw from an aquifer, river or reservoir also has limits, if the supply is to be sustained. The aim of sustainable development in establishing a balance between human settlements development and natural-resource use, is to meet development goals while ensuring that the use of natural resources and systems does not deplete the planet's carrying capacity for future generations.

19. It is within urban centres that most of the world's resources are consumed or transformed into products. Thus, urban centres (urban systems) demand a high input of resources - water, fossil fuels, and raw materials - both for production and for meeting inhabitants' consumption demands, but most of these resources originate in rural areas. Therefore, production decisions taken by urban-based enterprises are a powerful influence on the form and content of natural-resource exploitation in rural areas; many of the most rapid ecological changes are taking place in the still semi-rural regions surrounding cities. There are so many links between rural and urban areas that "sustainable urban development" and "sustainable rural development" cannot be considered in isolation. The more populous and spread out the settlement and the richer its inhabitants, the greater its demand on resources and the larger the area from which these are drawn.

20. Urban centres are also the location for the generation of most wastes arising from production and consumption. Because of the present inadequate management of settlements, such wastes, which cause air, land and water pollution, have serious impacts on the health of inhabitants, but their impacts also stretch beyond settlement borders. Water needed for industrial processes, residential use and commercial activities is usually returned to water bodies at a quality lower than that originally supplied: this not only represents a hazard to human health but also can also damage vegetation (and farmers' livelihoods) in surrounding areas. Solid wastes collected from city households and businesses are usually disposed of on land sites around the city, with inadequate provision to protect groundwater sources from contamination: furthermore, in most cities, a considerable proportion of all solid wastes is not collected and also finds its way into water bodies, adding to pollution.

B. Links between sustainable resource use and human settlements management

21. Settlements can provide high-quality living environments for all their inhabitants without requiring unsustainable levels of resource use. The meeting of "basic needs" (food, shelter, water supply, drainage, sanitation, waste removal, health care and education) for all the world's inhabitants does not imply an unsustainable level of resource use. In particular locations, there can be specific problems - for instance, a shortage of water resources - but techniques and technologies to limit water consumption or to re-use or recycle water can usually overcome such problems.

22. The key policy issues in the industrialized countries are delinking of improved quality of life and increased resource consumption, and control of pollution. Although there are no serious "material limits to growth" on consumption levels, there is some evidence that the energy input to such consumption levels cannot be sustained by fossil fuels (which account for virtually all such energy inputs today), without potentially causing serious disruptions to global climate. The fact that only a small proportion of non-renewable resources is

recovered or recycled after use in developed countries suggests considerable potential for reducing demand on natural-resource stocks and natural systems. Also energy conservation in buildings, industrial processes and road vehicles, and adjustments to the private/public-transport balance could greatly reduce energy demand, without lowering living standards. Technical solutions and a considerable part of the policy framework for implementation exist; what is in doubt is governments' willingness or ability to implement these known solutions.

23. Most developing-country settlements make a comparatively small call on the world's finite stock of natural resources and the capacity of its natural systems, but this is essentially the result of the poverty of the majority of inhabitants. Low incomes for the majority imply low consumption of mineral resources, if most expenditures have to be made on food, clothing and shelter. However, extension of developed-country consumption levels to the majority (rather than the minority) of the world's population might imply scarcities in some renewable and non-renewable resources and could change the probability level of damaging climatic change. Governments in developing countries can foresee these problems and encourage resource conservation, recycling and reclamation now, by supporting the use of innovative technologies and by developing integrated settlements management procedures which take sustainability into account in decision-making.

24. A national framework for promoting sustainability in natural-resource use needs an appropriate national legislative, regulatory and fiscal framework within which to encourage individuals, communities and businesses to contribute to meeting sustainable development goals. However, the key public actor for implementation has to be local government. The national framework should include support for schemes to:

- (a) Conserve, recycle, reuse or reclaim materials or energy currently discarded or wasted;
- (b) Identify and put into use unused or underutilized resources;
- (c) Implement pollution-control measures and adjustments to pricing structures, so that these contribute to sustainability and to development goals;
- (d) Forge partnerships with low-income groups and their community organizations, to address housing and environmental-health problems.

In all these matters, the key public actor must be local government, based on representative and participatory involvement of all community members.

25. There must also be a framework which allows the integration of policies and actions on rural and urban development, because "urban" and "rural" policy can no longer be treated as separate and independent. The breakdown of the rural/urban distinction in developed countries has been evident for decades, but the distinction between rural and urban areas is equally obsolete in developing countries - even in those where agriculture and forestry are still the main sources of livelihood for a high proportion of the population. In developing countries, sustainable urban development complements sustainable rural development, since it is only through the urban system and its links with small settlements that farmers can be reached with agricultural-extension services, production inputs, credit and storage, marketing and processing facilities, and it is only through the urban system and its links with small settlements that government can increase the proportion of the rural population reached with health-care, educational, and other community services.

26. Such policy directions also imply the need for new kinds of "enabling" institutions widely distributed within each country. If the number of local initiatives by citizens and community organizations in support of sustainable development goals are to be multiplied manifold, people need easily accessible institutions to which they can turn. Also, the policy framework must provide support and incentives to encourage the development of community-based organizations: it is here that local non-governmental organizations can contribute significantly as technical advisers, as trainers and as institutions which help community organizations negotiate with power structures and financial institutions for resources.

C. Population and sustainability

27. The world's poorest 2 billion or so inhabitants make very small demands on the world's supply of non-renewable resources. Their consumption activities generate very little waste and make little impact on the absorption capacity of natural systems. However, their consumption of certain renewable resources is high, and poor rural people are often blamed for overexploiting the soil or forests on which their livelihood depends. Yet, over-exploitation is linked far more to inadequacy in the size of land-holdings than to their cultivation practices: it would be accurate, in most countries, to say that it is inequitable land-owning structures which cause poor people's over-exploitation of land. Population growth only becomes a problem where societies fail to implement structural changes to allow poor groups adequate bases for their livelihoods.

28. What needs stressing is the complementarity between sustainable development and a reduction in population growth rates. Increasingly, urbanization of societies seems to be accompanied by lessened demand by low-income households for large families. This argues for a policy of speeding up urbanization as an aid to achieving sustainability. Secure livelihoods for poor groups, combined with improved shelter conditions and basic services, are likely to bring down still further population growth rates.

D. Sustainable settlements

29. The role of human settlements management in promoting sustainable development includes:

(a) Devising settlement and neighbourhood plans which lead to resource-efficient and affordable transport patterns, e.g., by promoting short-distance access in preference to long-distance mobility;

(b) Developing programmes for economizing on the use of non-renewable energy sources and for adapting settlements to the use of renewable energy systems;

(c) Providing water-supply, sanitation and waste processing/recycling systems which meet basic needs in a resource-conserving manner;

(d) Promoting the use of indigenous building materials and appropriate construction technologies, *inter alia*, by revising building and planning codes and supporting small-scale production processes.

These technical requirements are dealt with in separate chapters which detail action recommendations which can be taken up by developed and developing countries and the international community. Greatly improving the quality of life for the rapidly growing populations of developing countries cannot be achieved by following the same energy-consumption and resource-use patterns as those of developed countries. A global approach to sustainable development requires both developed and developing countries to adopt new policies, and technologies and new settlements management practices.

30. The technical requirements for a sustainable settlement can be defined with present knowledge, but the institutional means for applying known techniques are notably lacking. Each society must develop its own response to its own ecological problems, and it is in this context that democratic and participatory local governments and community organizations appear not only as a goal of sustainable development but also as a critical means of reaching it. Such institutions provide the means for resolving conflicts over who has the right to use resources and they can act as originators of ideas for improving quality of life.

31. Sustainable development needs the contributions that local people, citizen groups, businesses and governments can make to realistic development plans and to the mobilization and use of local resources, but it also needs managers and professionals trained to work within such a framework. For city governments, there are, at least, four key policy requirements: (a) Respond to citizen demands for basic infrastructure and services, and ensure there is an effective legislative and regulatory system to protect citizens from exploitation by powerful sectoral interests;

(b) Penalize polluters and charge both households and businesses, which benefit from public investment in infrastructure, the full price of services;

(c) Give special attention to reducing air pollution and fuel consumption by road vehicles, through a judicious mix of taxes and physical restraints on private vehicles and the development of efficient, cost-effective public transport;

(d) Provide the framework within which city-generated wastes can be handled effectively, including the control and monitoring of disposal of toxic wastes.

There is both an institutional and a human-resource problem to be overcome in meeting these requirements. First, settlement administrations at present largely lack the powers and resources to deal with these issues, and, secondly, local-government staffs are poorly trained for and lack the orientation to community accountability which would contribute to a serious attempt at meeting these responsibilities. Central-government support to improve this situation will be needed.

E. Sustainable settlement systems

32. Ultimately, it is the settlement system within a country, not individual settlements, which make up the physical framework for resource consumption. Natural-resource consumption is not only reflected in consumption for goods, services and movement within settlements but also in the consumption for the movement of people, goods and information between settlements. The physical links between settlements provide the means for obtaining access to many resources and transporting them to centres of demand, and changes in natural-resource availability (or price) will affect settlement systems.

F. The international framework for sustainability

33. If consumption levels comparable to those enjoyed by the richest countries (and by the richest households in poor countries) are extended to the bulk of the world's population, carrying capacities of natural systems would be severely strained. Therefore, achievement of sustainable development at a global level might depend on negotiated settlements which limit any country's use of a natural resource or exploitation of a natural asset in a way which is judged to deplete the planet's capital stock. Such international agreements would have profound political implications for development, in that they imply constraints on particular countries' and people's consumption levels, and on particular countries' capacity to use their own fossil-fuel reserves or other natural resources. Cost to national economies would be very considerable, if limits were placed on rights to use natural-resource reserves.

34. Poor developing-country citizens might find it difficult to share developed-country concerns over the greenhouse effect, the depletion of the ozone layer and other global environmental issues. Questions of survival 20 or more years into the future have little relevance to those having difficulty surviving today. Even leaving aside the question of which countries are mainly responsible for the depletion of resources and the damage to life-support systems, the developed countries cannot hope to promote long-term perspectives on sustainable development in developing countries when so many developing-country citizens are suffering enormous short-term problems of mere survival and when their own societies are so profligate in the use of resources. There are fundamental issues to be resolved, e.g., terms of trade and transfer of technologies, which go beyond settlements management, before human settlements can play their full role in a sustainable development scenario.

III. PHYSICAL PLANNING OF URBAN AND RURAL SETTLEMENTS

A. The significance of physical planning for sustainable development

35. Sustainable development means satisfying present needs without compromising the ability of future generations to meet future needs. This means that development planning must be concerned not only with improving the quality of life for all now but also with ensuring that the achievement of this goal does not place excessive burdens on natural resources nor cause irreversible damaging changes to global ecological conditions. Future generations must be left with the same development capabilities as are enjoyed by the current generation.

36. Physical planning is the organization of the physical components of development in order to contribute to the satisfaction of the present and future needs of society. Thus, physical planning is an essential component of sustainable development, and the ability to plan is important in satisfying sustainable development goals. Yet, there is ample evidence from all countries, developed and developing, that total disregard for economy in the use of land and natural resources, lack of concern for the future physical needs of settlements and lack of care for a semblance of spatial order and rationality in the settlement development over the past four decades are now taking their toll. Nowhere are these problems more evident than in the largest and most rapidly growing urban agglomerations of the world (the so-called "megacities"), most of which are located in the developing countries.

B. Planning for sustainability: difficulties and rewards

37. Planning is an expression of prudence and foresight. Individuals plan their lives with varying degrees of intensity and continuity, and "success" is judged by the way planned actions have been carried out. The same criterion can be applied to settlements: as a rule, the most successful settlements are those which are capable of planning their future and making prudent provision for the satisfaction of their future needs. Advanced societies place much emphasis on regional and urban planning: physical planning is a fundamental feature in highly successful economies, such as those of Japan, the Netherlands or Sweden. Physical planning is also taken very seriously in the newly industrialized countries and areas, particularly in Hong Kong, the Republic of Korea and Singapore. The opposite is true in declining, struggling or predominantly rural-based economies where, for whatever reason, the need for physical planning, particularly municipal planning, is considered a luxury, a disturbing obligation or a bureaucratic exercise.

38. Settlements are the result of the actions and interactions of vast numbers of people through time: they are also the result of substantial communal and cumulative investments. Thus, they are extremely complex undertakings, vastly more important than the sum total of individual actions. Physical transformations of the living and working environment have fundamental effects on the well-being of people, on the productivity of a settlement system's economy and on the preservation of natural resources. These transformations can occur in a haphazard, "spontaneous" way, or they can be "planned" over time, with varying degrees of comprehensiveness. The justification for physical planning is that these effects can be benign, productive and equitable, if actions are consciously and rationally envisaged, guided and/or controlled over space and time through some agreed form of decisional process, rather than allowed to occur fortuitously. The importance of settlements for the lives of all the people who live in them makes it essential to leave as little as possible to chance or to the unchallenged discretion of individual economic groups, established elites, powerful governmental agencies or municipal bodies.

C. Sustainable land-resource management

39. Physical planning is an instrument for optimizing the use of land and other natural resources and guiding present and future physical development. The lack of a land policy, which is an essential attribute of a sustainable physical plan, inevitably creates situations where development takes place with no provisions for

basic public infrastructure. The lack of a supply of serviced land is a guarantee for the growth of substandard settlements, for excessive expenditures when regularization and upgrading have to be undertaken, for high degrees of exploitation in the provision of essential services, such as drinking water, and for poor and deteriorating health conditions of low-income populations.

40. Rural land resources have been subjected to such intense pressures that the vital balance between them and the various life forms which land supports is in critical jeopardy. These pressures on rural land resources arise from population growth which directly or indirectly triggers one or more of the following reactions:

(a) *Intensive utilization of existing agricultural land.* Pressures of population on land resources have resulted in intensified utilization of agricultural land. This has resulted either in fertility degradation or in indiscriminate use of fertilizers and other chemicals to preserve the productivity of the soil. It has been established that the use of mineral fertilizers can upset the balance among plant nutrients, particularly in tropical soils.

(b) *Extension of agricultural development into fragile fringe areas.* The inability to accommodate a growing number of people in existing agricultural areas, even with intensified farming, has led to the bringing into cultivation of marginal areas hitherto considered unsuitable for rural settlements. Most of this agricultural extension has been poorly planned and controlled, and, in many cases, unsuitable patterns have upset delicate ecological balances, with resultant resource degradation and multiple unforeseen impacts.

(c) *Deforestation.* Cutting of tree cover for agricultural extension and firewood supplies is an important source of land degradation in various parts of the world. Shifting cultivation practices, unregulated bushfires, conversion to pasture land for cattle-rearing - often leading to overgrazing or overstocking - are other sources of land degradation through deforestation.

(d) *Loss of vegetation cover.* This has manifested its most devastating effects in the developing countries. Meteorologists estimate that vegetation loss must affect an area of 250,000 square kilometres before climatic changes occur, but this area has been exceeded several times over in several parts of the world. About 40 per cent of the countries of sub-Saharan Africa have experienced extreme drought and desertification in recent years, resulting in massive displacements of population.

(e) *Desertification.* The primary cause of desertification is over-exploitation of land and its vegetational cover through overcultivation, overgrazing and poor irrigation and cultivation practices. These problems arise from rural population pressures on land and its resources, and the encouragement of urban migration should be undertaken, to reduce the danger of further degradation.

(f) *Mining operations.* These can be a serious source of land degradation. Various forms of mining, quarrying and mineral exploration and exploitation, particularly open-cast mining, have scarred and degraded the land, particularly where no measures have been taken to restore or rehabilitate the land after exploitation. Unrestored mining scars can cause flooding and consequent erosion of topsoils.

41. The urban land resource is limited and, therefore, scarce. Consequently, urban land is fiercely competed for by various uses and users. Pressure on the resource is enormous, persistent and continuously mounting. The environmental issues in urban-land-resource management largely derive from its limited nature and scarcity and the enormous demands being made on it for various uses.

(a) *Land-use allocation.* Urban land requires to be allocated to residential, industrial, commercial, institutional, social, cultural, recreational, transport and other settlement uses. Not only is appropriate and adequate quantitative allocation of land resources required for each of these uses but the assigned locational pattern of these uses should be such that compatibility and complementarity among functions are achieved and negative environmental impacts from them minimized. Such allocation does not necessarily mean a rigid separation of various land uses into different "zones".

(b) *Land accessibility.* Accessibility to the urban land resource by increasing urban populations is another issue in sustainable urban-land-resource management. As a result of the high growth

of urban populations, a large majority of these populations do not have easy access to urban land for shelter or other desired uses. The inevitable result is extensive spontaneous development encroaching on rural and peri-urban agricultural lands, as well as on urban open spaces. Recent estimates have put the proportions of urban populations living in such settlements at between 40 and 50 per cent on average, and slums and squatter settlements in developing-country cities are estimated to be growing at about 8 per cent annually. It is the inability to obtain access to urban land by various groups that leads to chaotic development, land speculation, occupation of marginal and ecologically fragile lands and the worsening of the environmental conditions of disadvantaged and economically vulnerable groups.

(c) *Land servicing.* Appropriate and adequate servicing of urban land has become a serious issue in achieving sustainable urban development. Arising from the rapidity and spontaneity of urban growth over the past few decades, the shortage of resources to attend to this growth and the unplanned manner in which this growth has occurred, much development is not adequately serviced with necessary utilities. The percentage increase in the built-up areas of many cities has been over 100 per cent in the past 20 years, and it has been impossible to plan for and extend essential services. This, in addition to the usually high intensity of land use in informal settlements, leads to degradation of land resources. The result has been deterioration of living and working environments in urban areas.

42. There is need for each country to prepare and implement a national plan (even on a perspective basis) for land-resource utilization: development within the framework of a planned local, regional or national physical plan is an effective way of protecting and managing land resources. It is within the over-all context of advance planning that effective protection and optimum use of environmentally sensitive land resources is possible. In the context of a national plan, land should, as far as possible, be allocated to its optimum sustainable use, and neither human settlements nor other types of developments should be permitted on ecologically fragile lands.

43. Encouragement of high-density urban settlements and of settlement consolidation in some rural areas could be an effective mechanism for protection and management of land resources. High-density settlements would enable land to be conserved and made available for future uses: they would also help minimize the despoliation of lands characteristic of some current unnecessarily low-density developments. A concentrated settlement pattern would also economize on the provision and installation of necessary infrastructure, which would make for a healthy living and working environment.

44. Policies and programmes aimed at rationalizing inefficient land-tenure systems and practices should be evolved and put in place, and measures to effectuate such rationalization expedited. This rationalization should involve, in the main, the individualization of rights and titles to land and the provision of legal instruments to enable transactability of such rights. Rationalization of land-tenure systems is a prerequisite for effective management and protection of the land resource.

D. Making physical planning sustainable

45. If physical planning is to contribute to achieving sustainable settlement development, it is essential for planning to be "sustainable". One of the reasons for past failure of physical planning, particularly at the municipal level, is that, in most countries, physical planning has been developed as a system of procedures imposed from above, almost exclusively concerned with limitations and regulations, unnecessarily complicated, unrelated to the needs and programmes of other public agencies, ignoring the requirements of the formal and informal private sector, and rarely submitted for approval by those it was meant to serve. These drawbacks can be overcome by concentrating on a number of positive features: planning can and should be decentralized, participatory, responsive, accountable, realistic and imaginative:

(a) *Physical planning should be decentralized.* This means that as little regulation and control as possible should be exercised at higher levels of government, and, where the situation demands it, municipal planning should be decentralized to small units of local government.

(b) *Physical planning should be participatory.* The hard choices which planning entails can be implemented only if all actors (public agencies and authorities, potential investors, financial institutions, community institutions, citizen groups and individual citizens) exercise a common

responsibility in making them, and only if a consensus is reached on the fact that these choices are meant to benefit the entire population. There must be mechanisms for the discussion and review of all aspects of regional development plans and municipal plans.

(c) *Physical planning should be responsive.* It cannot be a formal exercise exclusively concerned with "urban form" or isolated development projects. It must focus on high-priority issues and, primarily, on the satisfaction of fundamental needs of the most vulnerable groups balanced against the protection and wise utilization of land and other natural resources.

(d) *Physical planning should be accountable.* The preparation and implementation of plans involves a great deal of resources, and citizens from whom these resources come, have the right to be informed on a regular basis on the methods employed and the results achieved, and to judge the performance of planning institutions accordingly.

(e) *Physical planning should be realistic.* Often plans fail because fundamental conflicts are not resolved or even considered, or because they are totally unco-ordinated with municipal and private-sector investment plans, or because they are founded on over-optimistic assumptions about future resource availability. These three factors (conflict, investment and resource availability) should always be taken into account.

(f) *Physical planning should be imaginative.* Realism and pragmatism do not exclude imagination. It is often hard for underpaid public managers and planners to be inventive and forward-thinking, but it is likely that the often-advocated changes for municipal reform, strengthening of local government etc. will come as a product of creative thinking and experimentation rather than top-down reform and deconcentration rather than genuine decentralization. One area which will require attention is public entrepreneurship (the ability to capture for the citizenry at least part of the benefits of urban development and increased wealth) and the ability to plan for public/private partnerships in the implementation of physical plans.

PART TWO.

SECTORAL ASPECTS OF SUSTAINABLE HUMAN SETTLEMENTS DEVELOPMENT

46. The construction sector must have sufficient capacity to carry out all the settlement works necessary for national development. Sustainable capacity-building in the sector should be based on the optimum use of indigenous resources and of appropriate building technologies. Building regulations must be adapted to local needs and affordability levels.

47. Water supply is essential to life and to all forms of development. However, the great bulk of the people in developing countries does not have access to sufficient quantities of safe drinking water. Furthermore, water sources throughout the world are being polluted by agricultural residues, household wastes and industrial effluents to the point where the costs of water service, particularly to urban residents, are being raised above affordable levels. Lack of water is an enormous obstacle to competitive industrial growth on which the policies of most developing countries depend.

48. Sanitation and waste-management services are essential to the protection of human health and settlements amenity. The present inefficient and unco-ordinated methods of handling wastewaters, sanitary wastes, household garbage and industrial refuse must be replaced by an integrated system which deals with these human settlements by-products primarily for recycling as secondary resources.

49. The production and consumption of energy is basic to all human activities. The burning of biomass and fossil fuels for energy is the single greatest polluter of the global atmosphere and an important cause of negative health impacts and of damage to the natural and man-made environments. The raising of living standards in the developing countries must envisage a manifold increase in the consumption of energy, and this increase must be achieved without further damaging the biosphere through the use of clean technologies and renewable sources in such a way as not to jeopardize the quality of life of future generations.

50. Transport services are essential for socio-economic development; the movement of goods between and within settlements is indispensable for the generation of income; and free and affordable movement of people to carry out their jobs, to obtain health, educational and other services, and to enjoy recreational opportunities is a fundamental requirement of modern life. The impact of transport-infrastructure development and of transport operations on life-support systems and on amenity has to be evaluated in a human settlements context.

IV. CONSTRUCTION-SECTOR POLICIES FOR SUSTAINABLE HUMAN SETTLEMENTS DEVELOPMENT

51. Construction has a dual-faceted role in achieving sustainable-development goals. First, construction provides the direct means for the development, expansion, improvement and preservation, through maintenance, of human settlements. Owing to its strong links with other sectors of the economy, construction activity generates increases in production, employment, income and savings, and, thus, promotes development and economic growth. Sustained output of the construction industry is, therefore, vital to the achievement of national socio-economic development goals, including human settlements development goals, but it depends, amongst other things, on the continued availability of physical resources. The fact that non-renewable resources are in limited supply and that even renewable resources can only be replenished by nature over time imposes limits on the pace of construction that can be sustained in the long term. Secondly, construction can contribute to the degradation of the environment, through physical disruption and chemical pollution caused by construction activities. The rapid increase in the volume and complexity of construction, since the early 1950s, and the resource-demanding nature of modern technology have imposed severe stress on the biosphere, through depletion of the natural-resource base, degradation of fragile eco-zones and increases in chemical pollution, underscoring the urgent need for improving construction practices through appropriate policy initiatives and related measures.

A. Sustaining the natural-resource base

52. Building materials constitute the single most important construction input in developing countries, accounting for nearly two thirds of the resources used in the production of shelter and infrastructure. This imposes enormous demands on the natural-resource base of these countries and on the ability of the construction industry to convert available raw materials into construction resources that are durable and can be afforded by the people. Many developing countries are fortunately endowed with natural resources for the production of basic building materials, e.g., bricks, blocks, aggregates, lime and other binders, that can sustain human settlements development, particularly, production of shelter for low-income groups. Yet, local building-materials industries in many of these countries fail to exploit their abundant natural-resource endowment and continue to engage in the production of energy-intensive materials that often draw upon non-renewable resources.

53. Notable among the factors that hinder exploitation of indigenous resources are the lack of data on local deposits, use of inappropriate technologies, and poor institutional and financial support for the industry. Even though small-scale technologies provide the best option for the exploitation of local deposits, have the necessary flexibility to operate in proximate markets (thus reducing energy use in transport), and can function with little capital and with locally available semi-skilled labour, use of these technologies has been hindered by the lack of elementary infrastructure and the inability of local entrepreneurs to access formal sources of investment credit. So far, few countries have made any significant or sustained effort to promote building-materials production, based on their natural-resource endowment and appropriate technology. This is, mainly, because of the lack of an effective and coherent strategy, at the national level, for expanding the indigenous building-materials sector.

54. The industrialized countries, in contrast, are consuming natural resources at a pace that is clearly unsustainable in the long term. Construction industries in these countries mainly rely, for material resources, on energy-intensive, high-temperature process industries, producing steel, aluminium, copper, glass, ceramics and chemicals. Vast amounts of energy are thrown away in waste gas streams; yet, appropriate legislation could promote conservation of waste energy in building-materials production, through available heat-recovery methods. The move away from the use of traditional building materials in industrialized countries is another reason for high energy use, as these materials are now known to have the lowest gross energy requirements. Indiscriminate use of non-renewable tropical hardwoods is depleting tropical rain forests, but, so far, construction industries in developed countries have shown only modest interest in

switching to alternative timber sources and materials. There is also considerable untapped potential for recycling of used materials and waste, which can effectively reduce the current demand on natural resources.

B. Arresting environmental degradation

55. A fundamental requirement of sustainable development is that the harmful side-effects of the development process, particularly of construction activities, must not exceed or overload the assimilative capacity of the biosphere, so that the process of development can be sustained. The spontaneous and, often, uncontrolled pace of human settlements development in many developing countries makes it particularly difficult to control the attendant degradation of living conditions. For example, the increasing spread of human settlements into fragile eco-zones is rapidly destabilizing natural eco-systems in many developing countries. Occurrences of floods, landslides, mudslides etc., caused by construction on delicate hillslopes, wetlands etc., testify to the vulnerability of the environment to intervention by human activities. Appropriate land-use policies and planning, specially aimed at eco-sensitive zones, would be required to reverse this trend.

56. The highly dispersed character of construction activities in most developing countries makes it difficult to monitor the physical disruption caused by construction. There is a growing concern, in many developing countries, about increasing land dereliction, caused by quarrying of sand and gravel, extraction of brick clay etc., which ultimately reduces the available land for human settlements development. The degradation of the marine environment, caused by coral mining for production of building lime, and the disruption of wildlife habitats and watertables, by excavations, etc., is now attracting increasing attention of physical planners and coast-conservation authorities.

57. Pollution caused by construction activities, particularly by the building-materials industry, is a topic that needs urgent attention. In 1979, quarrying and the construction sector accounted for 8 per cent of the cost of clean air to American industry: production of cement, lime and bitumen claimed a significant share of this pollution. Cement production, in particular, contributes to "greenhouse" pollutants, through emission of carbon dioxide during the calcining stage, and of airborne particulates. Excessive dependence of building-materials industries on the use of firewood in developing countries adds significantly to carbon dioxide emission and production of "greenhouse" gases. The use of alternative locally available fuels, e.g., rice husks, and promotion of gasifiers would not only improve energy efficiency of the production processes but also reduce "greenhouse" pollutants.

58. There is an urgent need to control the use of building materials that produce negative environmental impacts. Construction industries are significant users of CFCs (chlorofluorocarbons), mostly used in air conditioners, in insulation products and in fire-extinguishing systems. CFCs are detrimental to the ozone layer. Their use will be phased out by 1995 in view of the Montreal and London protocols. The use of asbestos products in developing countries is, however, continuing.

C. The policy framework

59. Sustainable development requires a policy framework for the construction sector that effectively addresses the twin requirements of sustainable management of construction resources and control of degradation of the biosphere caused by the adverse impacts of construction. Within this framework, implementation measures could include tariff protection to fledgeling industries, tax concessions and other incentives, increasing emphasis on labour-intensive and clean technologies, upgrading of skills and entrepreneurial capacities, and a ban on indiscriminate extraction of raw materials. Institutional strengthening and promotional measures will be equally crucial for implementation of a sustainable construction-sector policy. These should mainly aim at developing local capacities for the best use of the natural-resource endowment and for pollution abatement. Special emphasis should be given to indigenization of factor-inputs, formulation of appropriate specifications, standards and building regulations, and organization of demonstration projects to popularize innovative techniques and products.

D. Recommendations

60. Implementation of the policy framework will call for concerted and complementary action at national level, in both developed and developing countries, supported by international co-operation. Some recommended areas of action are described below.

1. By developing countries

1. Formulate a coherent strategy, at the national level, for indigenization of factor-inputs in the construction sector, in order to optimize the exploitation of the natural-resource endowment. This would reduce import-dependence and improve affordability of construction outputs by low-income groups.

2. Expand technical-support programmes and incentive schemes for improving the production capacity and economic viability of small-scale and informal operatives who can make use of indigenous materials and methods.

3. Redirect research efforts in national research and development institutions towards the development of energy-efficient, clean technologies which can operate at a small-scale, using indigenous factor-inputs.

4. Promote appropriate standards, specifications and other regulatory measures, with a view to supporting clean, energy-efficient technologies and environmentally sound utilization of natural resources.

5. Formulate appropriate land-use policies and introduce planning regulations specially aimed at protection of eco-sensitive zones against physical disruption by construction activities.

2. By developed countries

1. Introduce legislation and financial incentives to promote recycling of energy-intensive materials in the construction industry, and conservation of waste energy in building-materials production, through available heat-recovery methods.

2. Introduce regulatory measures, e.g., certification and eco-labelling schemes for the restricted use of such non-renewable natural resources as tropical hardwoods in construction.

3. Use economic instruments, e.g., product charges, to discourage the use and consumption of construction materials and products which create pollution during their life cycle.

3. By the international community

1. Support national initiatives of developing countries to achieve sustainable development,

through:

(a) Local capacity building for environment-impact assessment of construction activities;

(b) Transfer of low-waste and non-waste technologies and clean technologies for building materials production;

(c) Transfer of appropriate technologies for resource management in construction, particularly, for non-renewable resources.

2. Promote multilateral funding to meet environment-protection expenditures, related to human settlements development, that cannot be independently financed by developing countries.

Construction issues related to sustainable development and action at different levels

Construction-related issues	Action at Industry level	Action at Institution level (R&D institutions etc.)	Government action at national level
Natural resource management:			
1. Lack of adequate exploitation of natural resource endowment in developing countries	Employ small-scale labour-intensive technologies for use of local deposits.	Direct R&D effort to develop appropriate technologies for the exploitation of locally available natural resources.	Provide tax-incentives to small-scale operatives to promote increased use of locally available natural resources.
	Enhance product quality of local building materials to stimulate increased consumption.	Formulate appropriate standards, specifications, etc., for increased use of indigenous building materials.	Formulate appropriate building regulations that permit use of locally available building materials. Organize demonstration projects to popularize use of locally produced building materials.
2. Increasing use of non-renewable resources (e.g. excessive reliance on firewood, use of tropical hard-wood, etc.)	Use locally available alternative fuels, e.g., rice husk, wood wastes, straw, peat, etc. in building-materials industries in developing countries.	Develop and popularize appropriate gasifier technologies, to improve energy efficiency in building-materials industries.	Provide tax-incentives to the industry for use of low- and non-waste technologies.
	Substitute use of tropical hardwoods by secondary species of timber and other materials.	Intensify research and development effort in the areas of low- and non-waste technologies.	Provide funding support to R&D effort in the areas of low and non-waste, and energy-efficient technologies.
	Recycle used and waste materials, particularly energy-intensive materials.	Standardize eco-labelling practices for wider use of labelling schemes to restrict use of non-renewables.	Introduce economic instruments such as product charges to discourage use of non-renewable and energy-intensive materials. Remove distortion in the pricing structure (e.g. subsidies etc.) that encourage use of non-renewables.
Pollution abatement and control:			
1. Lack of awareness of the links between construction and health.	Use advertising and other forms of publicity to create awareness among users about the environmental quality of product.	Provide information to industry on available clean and environmental technologies for enhancing quality of products and processes.	Introduce environmental information system (as done by the European Community) to gather baseline data on environmental impact of construction activities. This would facilitate planning action at national level.
	Take the lead in compilation of information to aid selection of materials on the lines of Rosehaugh Guide (1990)	Establish a framework for dialogue between different interest groups and promote co-ordinated action.	
2. Inadequate implementation of pollution control measures.	Use available appropriate pollution abatement and energy-efficient technologies that reduce emission of "greenhouse" gases.	Increase research effort relating to emission abatement and clean technologies.	Speed up technology transfer in the area of pollution control by providing detailed information on global markets, standards and technologies to the industry (on the lines of NETT programme in Europe).

Provide directives to the industry (similar to Construction Products Directive, 1988) to ensure minimum health and safety standards in building products. Also introduce product charges to restrict use of CFCs, etc. in construction.

V. WATER-SUPPLY POLICIES REFLECTING SUSTAINABLE DEVELOPMENT PRINCIPLES

61. Water, like air, is indispensable for human existence. It is also an essential ingredient for many of humanity's productive activities that lead to development. The continued availability of adequate freshwater resources of acceptable quality is, therefore, a prerequisite for sustaining life and development. The total supply of water neither increases nor decreases and is believed to be precisely the same now as it was 3 billion years ago: it is reassuring that water, unlike other natural resources, is not depleted through consumption. The world's freshwater resources are, however, threatened by two factors. First, they are being subjected to rapidly increasing demand and, secondly, they are being degraded by pollution and saline intrusion. Nowhere are these forces more strongly in operation than in developing countries: the availability of safe water in these countries is fast becoming one of the most important factors limiting socio-economic development, a crucial visible indicator of the quality of the environment and a cause of national and international social conflicts.

A. *Economic significance of water resources*

62. The extent to which water resources contribute to national wealth and productivity is little appreciated. All productive sectors of national economies, be they agriculture, industry, mining or services, rely on water for their operation. Just as agricultural productivity is increased through crop irrigation, industrial productivity is dependent on the availability of water: goods produced in areas of limited water availability are costly and, consequently, non-competitive in international markets.

63. Another way in which water resources impact on national productivity is through their effect on the health of the population. Over 80 per cent of all diseases and over one third of deaths in developing countries are caused through the ingestion of contaminated water, and as much as one tenth of each person's productive time is said to be sacrificed to water-related diseases. The economic burden of water-related disease and ill-health, caused, in large part, by consumption of poor-quality, contaminated water, is indeed very great.

64. In this context, it is of the gravest concern that approximately 55 per cent of rural populations and 40 per cent of urban populations simply lack access to adequate quantities of safe water. Many health problems are linked to water - its quality, the quantity available, the ease with which it can be obtained and the provisions made for its removal, once used - and these problems are most critical in urban low-income areas where the only water available is heavily contaminated or must be purchased from vendors at exorbitant prices. In terms of health, the quantity of water used is just as important as the quality: if all they can obtain is expensive water, the poor economize by reducing water consumption, an outcome which takes an immediate toll of health. The cost of health care and of productivity losses due to ill-health and death can be used to argue the need to improve water supply and sanitation, but these are only economic indicators; they cannot adequately measure the cost of human suffering and the lowered quality of life suffered by billions of the world's poor.

65. While freshwater resources contribute to national wealth and productivity, the deterioration of their quality can retard economic productivity in two ways - first, by increasing the cost of potable water (authorities are obliged to go to remote sources to abstract water of acceptable quality) and, secondly, by demanding large investments for the cleaning up of water bodies to improve their quality. Both phenomena can present an undue burden on developing economies. In China, for example, it is estimated that the introduction of environmental measures and controls to arrest present-day environmental pollution will cost over 5 per cent of the gross national product and, if embarked upon, will cause recession in the overall economy. Besides the economic burdens, the natural process of restoring water bodies can be protracted - the River Thames in the United Kingdom took over a century to restore - and the loss of amenity value in the interim years is one that cannot be adequately assigned a monetary value.

B. Water availability

66. Although 70 per cent of Earth's surface is covered by water, most of it is saline: about 97 per cent of the world's water is contained in the world's oceans. Even the 3 per cent that is fresh is not all readily available; much of it is either locked in glacial ice or stored deep underground beyond the reach of contemporary technology to abstract. In addition, the global distribution of available freshwater is not even: in many areas of the world, limited precipitation, high population density or both make available freshwater barely adequate for - or present substantial limits to - human uses. Large interannual fluctuations in precipitation are already causing large-scale, region-wide problems and resulting in the emigration of environmental refugees, such as occurred during the 1987 drought in Ethiopia.

Table 1. Average annual availability of freshwater (surface and groundwater) in selected countries

	Total availability (cubic kilometres)	Per capita availability (thousand cubic metres per person)
Water-rich countries		
Iceland	170	685.48
New Zealand	397	117.53
Canada	2 901	111.74
Norway	405	97.40
Nicaragua	175	49.97
Brazil	5 190	36.69
Ecuador	314	31.64
Australia	343	21.30
Cameroon	208	19.93
USSR	4 384	15.44
Indonesia	2 530	14.67
United States of America	2 478	10.23
Water-poor countries		
Egypt	1.00	0.02
Saudi Arabia	2.20	0.18
Barbados	0.05	0.21
Singapore	0.60	0.23
Kenya	14.80	0.66
Netherlands	10.00	0.68
Poland	49.40	1.31
South Africa	50.00	1.47
Haiti	11.00	1.59
Peru	40.00	1.93
India	1 850.00	2.35
China	2 800.00	2.58

Source: International Institute for Environment and Development and World Resources Institute, *World Resources 1987* (New York, Basic Books, 1987), table 81.1, pp. 268-269, and table 23.1, pp. 314-315.

67. The mismatch between the location of people and water is illustrated in table 1 which classifies 24 countries as water-rich or water-poor, based on the annual per capita availability of freshwater runoff resulting from precipitation falling within a country's borders. As populations and economic activities grow, many developing countries are rapidly approaching conditions of water stress, where estimated water demand matches maximum annual renewable freshwater resources. Under such conditions, countries will experience

difficulties in ensuring self-sufficiency in meeting agricultural and industrial water needs, i.e., they will experience problems of water security. There is also a theoretical technical water barrier beyond which point, given contemporary technical know-how, it will not be possible to harness further quantities of renewable freshwater resources - this barrier occurs around a point where per capita availability is below 500 cubic metres. Countries which have traversed this barrier, such as Saudi Arabia, are reliant on high-technology, high-cost processes, such as desalination, for water supply or attempt to reduce the gap between demand and availability through recycling wastewaters, as is the case in Israel which recycles 40 per cent of its wastewaters in a bid to bridge the water gap. Deficits in water availability are particularly concentrated in rapidly growing cities of the developing countries where supplies are at best unreliable and intermittent, and satisfying urban water deficits implies large-scale transbasin transfers of freshwater resources, with inherent environmental problems.

C. Water demand

68. The distribution of water demand among the various sectors is dynamic and changes with national economic-development policies. Globally, 73 per cent of water demand is for crop irrigation, 21 per cent for industry and 6 per cent for domestic consumption and recreational needs. These proportions, however, vary from region to region, as may be seen in table 2. In general, as countries industrialize, a greater proportion of the water demand is from industries. Industries in Eastern Europe, for example, account for up to 80 per cent

Table 2. Sectoral withdrawal of freshwater by country (percentage)

Country	Domestic/commercial	Industrial	Agricultural
Developing countries			
Algeria	23	5	72
Botswana	8	17	75
China	6	7	87
Cape Verde	8	0	92
Egypt	7	5	88
Ghana	44	3	54
India	4	3	93
Mauritania	2	0	98
Turkey	24	19	58
Uganda	43	0	57
Developed countries			
Albania	30	60	10
Austria	20	77	3
Bulgaria	14	15	71
Belgium	11	88	2
Czechoslovakia	24	72	5
Finland	12	86	1
France	17	71	12
Germany, Federal Republic of	12	87	0
Ireland	11	83	6
Netherlands	5	64	32
Poland	17	62	21
Switzerland	37	57	6
United Kingdom	21	79	1
Yugoslavia	17	75	8

Source: The World Resources Institute, *World Resources 1988-89* (Washington, D.C., 1988), table 21.1, pp.318-319.

the water demand is from industries. Industries in Eastern Europe, for example, account for up to 80 per cent of the region's use of freshwater; by contrast, industry in Ghana accounts for only 3 per cent of the country's total use of freshwater. As developing countries increasingly rely on industrialization for economic growth, water demands in urban areas will not remain at present levels but will increase exponentially. Failure to meet this demand will increase the cost of producing goods and, thereby, damage already threatened national economies in the developing countries.

D. Environmental impacts of water development

69. Although the proportion of water utilized in human settlements is modest in comparison with other uses, such as agriculture, the uncontrolled use of water for human settlements can have far-reaching negative impacts. These impacts can vary from the direct degradation of contiguous water bodies receiving untreated wastewaters to desertification and the upsetting of ecological balances around remote dam sites (see box 1). Such negative environmental impacts translate not only into reduced national wealth but more importantly into reduced economic wealth of countries in the long term.

Box 1. Examples of environmental impacts of freshwater development and use
NORTH AFRICA: Small dams and new wells to supply human settlements are also used for livestock watering and bring with them the risk of sharp increases in herd size and consequent overgrazing, soil erosion and eventual desertification in and around the settlements.

CHINA: Household wastewater discharges and other effluents from thousands of industries of all sizes that have sprung up in and around Shanghai, a city of 10 million, have grossly polluted its main drinking water source, the Huangpu River. As a result, there is no choice but to construct a water-transmission main, moving the present water intake upstream, at a cost of \$US450 million, while precisely how the pollution problem in Shanghai should be solved remains an enigma.

THAILAND: Over-extraction of groundwater from below Bangkok city, primarily for supply to rapidly growing industries, coupled with unfavourable ground conditions, is causing parts of the city to sink at a rate of 10 cm a year and contributes to serious annual flooding. As a result, even the simplest structures require quite elaborate pile foundations during construction. Other large rapidly urbanizing cities, demonstrating similar strains of over-exploitation of groundwater, include Cairo, Dakar, Mexico City of Sao Paulo.

SRI LANKA: The construction of the Victoria Dam in the hill region of Sri Lanka not only destroyed large numbers of diverse species of flora and fauna but changed micro-climate in the region and all but destroyed a large proportion of the lucrative cinnamon cultivation.

E. Water quality

70. The quality of water affects its usefulness. Many, for lack of choice, are obliged to drink water of unacceptable quality: in China alone, 40 million still drink high fluoride water, and some 60 million drink alkaline water. From the point of view of health, however, it is biological quality that is most important in developing countries. Affecting biological quality is the inadequate disposal of human wastes: over two-thirds of the population of developing countries lacks access to sanitary means of disposing of human wastes. Other human settlement by-products, such as solid wastes, also impact on water quality either directly or through the percolation of residual liquids into the groundwater.

71. Globally, approximately two thirds of the pollution affecting water quality is due to agricultural activities, with the remainder of the pollution resulting from by-products of human settlements, such as traffic emissions, construction, household refuse, industrial discharges and urban run-off. In developing countries, where chemical-dependent agriculture is not common, approximately two thirds of water pollution is caused by human settlements by-products. The lack of pollution-abating infrastructure, such as sewer systems, and of

controls over industrial discharges has transformed most of the watercourses passing through Asian cities into little more than open sewers.

F. Special concerns

72. Urbanization heightens the relationship between available water quantity and water quality. Groundwater still remains the largest and least contaminated accessible water resource in most countries. However, as impermeable surface areas increase with urbanization, opportunities for groundwater recharge are reduced, and a lowering of the groundwater table results. The over- abstraction of groundwater, which causes watertables to decline, increases opportunities for saline intrusion and the concentration of pollution. As a result, cities are faced with the mounting cost of water shortages, water treatment, well deepening and development of remote new sources. Safe water is, therefore, increasingly only available at a premium.

73. The cities of developing countries, therefore, face a dilemma: they have limited means with which to expand the supply of water and maintain its quality but they need to expand water- supply services to meet the ever-increasing needs of industry and to support the population which makes up the industrial workforce, if economic growth is to be sustained. The result is that urban authorities have both assumed a *laissez faire* attitude to water pollution and accepted the right of industries to be provided with water supplies on a first-priority basis. This policy, first, threatens local water resources and, secondly, deprives the urban poor of access to even the minimum quantities of safe water essential for survival. There is consequently an alarming widening of the gap between water demand and supply - between consumption and potentially available safe water resources - in many of the urban areas of developing countries.

74. Although urban areas of developing countries only accommodate a third of the total population, they, nonetheless, produce two thirds of the gross national product. With so much of developing countries' output depending on the efficiency of urban centres, the supply of adequate freshwater will play a crucial role in eliminating bottle-necks to economic expansion and improving potential to compete in international markets. Given that the process of industrialization and urbanization is far from consolidated but is, in many cases, only in its infancy and advancing rapidly, integrated water-resource management that takes account of the needs of all sectors will be a high-priority consideration in ensuring the continued growth of developing economies.

G. Water-management strategies

75. First, the sound management of water resources will need to embody the concept of equity and give priority to the satisfaction of basic needs. Secondly, it is imperative that existing facilities be optimally utilized and maintained, so that water losses are minimized and available supply capacities are fully used. Thirdly, there is a need to give emphasis to water- demand management, through techniques such as water-saving plumbing fixtures, flow-control devices, educational programmes and progressive tariffs based on the marginal cost of water. Fourthly, water-resource management must redress the disproportions in investment for water-supply and wastewater- removal infrastructure. In the context of this last point, there is considerable scope for reusing wastewaters for a variety of purposes, to the potential benefit of sustainable-development practices.

76. While sound water-management policies are essential for economic development and urban growth, policies are not sufficient by themselves: developing-country managers must be provided with the tools and capacities with which to make such policies work. This will require the development of appropriate planning, implementing and management tools, the introduction of mechanisms to generate and manage increased revenue for water- resource development activities and the creation of a cadre of professionals and semi-professionals who can address such critical areas as water and waste management, pollution control, municipal finance, integrated water-resource planning and operation and maintenance of water-related infrastructure and services. These will, no doubt, be some of the areas where international assistance can best be focused in the present decade.

77. Supporting the above sustainable-development policies are the many potential lines of action, identified during the past decade, which should be consolidated during the coming decade. These include the promotion of a wide range of technologies that are both affordable and easy to maintain - such as hand pumps; the

establishment of community-managed water facilities, with due emphasis on gender-focused consultation and involvement in planning, implementing, operating and maintaining new facilities; the need for governments to work as enablers and facilitators of service provision, in close partnership with non-governmental organizations and private and community organizations; the wide use of information, education and communication strategies to maximize the benefits of basic services; and the improvement of methods for recovering the cost of service facilities through appropriate revenue-generation mechanisms.

H. Recommendations

1. Recommendations for all countries

1. Develop and utilize planning tools for environmentally sustainable water management, including risk-assessment and impact-evaluation methods, based on environmental accounting.
2. Undertake a detailed evaluation of national water resources and their quality, monitor how water quantity and quality change with time, and use these data in formulating national development plans.
3. Adopt an integrated and comprehensive approach to the management of water resources that takes account of the needs of all sectors of the economy, and establish an appropriate institutional framework and corresponding support mechanisms for this purpose.
4. Give due priority in national programmes to enhancing utilization of the capacity of existing facilities, through maintenance, upgrading and rehabilitation programmes.
5. Implement programmes to conserve water resources and manage water demand in human settlements, through protection of water sources, use of water-saving plumbing fixtures, appropriate pricing policies that reflect the true resource value of water, and public education.
6. Enforce water-quality standards and use financial instruments, based on the polluter-pays principle, to prevent water-quality degradation.

2. Recommendations for developing countries

1. In developing and using water resources, give priority to the satisfaction of basic needs.
2. Beyond basic needs, charge for water at its true marginal cost.
3. Establish programmes to protect groundwater and ensure its sustainable use through appropriate groundwater-recharge programmes.
4. Implement programmes to recycle and reuse wastewater in industry and agriculture.

3. Recommendations for the international community

1. Provide assistance to enable national governments to assess their water resources, to monitor water quality and to use this information in national development plans.
2. Provide training to support developing countries in building up their capacities to manage water resources, especially in the areas of technologies and techniques, data collection and information processing: special training and staff-exchange programmes, based on the principle of institutional twinning, could be established.
3. Transfer technologies needed to meet future water demands, as in the areas of desalination, rainwater harvesting, solar water-pumping and wastewater recycling.
4. Provide assistance in gathering and disseminating information on environmentally sound policies, techniques and approaches to managing water resources for development.

Actions required to provide sustainable and satisfactory water supplies in human settlements

Factor	Action at individual and household level	Action at neighbourhood or community level	Action at city or district level
Supplying sufficient safe water to meet basic human needs.	Public education; protection of traditional water sources and domestic water storage containers.	Mobilize and educate communities to ensure sufficient quantities of safe water are available to all. Ensure community involvement in lobbying for sufficient services.	Public authorities act as enablers and facilitators and work as partners with NGOs and private organizations to extend services to the unserved and under-served communities.
Managing water resources for development.	Increase awareness of the relationship between water pollution and its utility and the benefits of water conservation and source protection.	Adopt community-based approaches to watershed management especially micro watershed management in the vicinity of the community. Increase awareness financial instruments based upon the environmental problems associated with water-resource development for use in human settlements	Establish programmes to protect water sources through appropriate institutional, legislative and the principle of polluter pays. Undertake projects to ensure continuity in supply and quality of water at source through measures such as groundwater recharge.
Maximizing capacity utilization of existing water facilities.	Revert leakage and minimize wastage.	Create community management structure for water facilities where public maintenance is poor or non-existent.	Establish programmes to adequately operate and maintain existing facilities; mount leak detection and control programmes; and allocate sufficient funds for asset upkeep, upgrading and rehabilitation.
Funding limitations affecting progress in water supply coverage and demand satisfaction	Ascertain willingness, ability and mode of payment and conduct discussions aimed at providing services people are willing and able to pay for.	Establish community-based revenue generation mechanisms and create local capacity to collect and administer the funds.	Beyond basic needs, cost water at true resource value and marginal cost of development.
Implementing systems appropriate to local conditions.	Embody household and community involvement in system planning and implementation.	Determine community capacity to operate and maintain proposed system should this service not be provided by public authorities.	Use only those technologies which are appropriate under the local circumstances in terms of their cost, social acceptability and potential to be properly maintained
Reducing water scarcity.	Adopt techniques to conserve water at the household level through appropriate plumbing fixtures, flow control devices, public education etc.	Encourage the reuse of wastewater for purposes less dependent on water quality.	Recycle and reuse wastewater for agriculture and industry and for enhancing the human settlement environment.
Building capacity to plan and manage water resources.	Support public education on the importance of water for health and development and environmental problems of their improper usage	Provision of technical advice and training to communities to manage their micro watersheds and operate and maintain water infrastructure facilities.	Endow, and expand existing sector staff with adequate skills through appropriate training programmes and provide them with the requisite up-to-date management tools.

Reducing the negative environmental impacts of water development.

Inform householders of the proper usage of water and disposal there after.

Mobilize appropriate community action for watershed management; involve impacts that might result and take community participation in new water development programmes

Assess potential environmental impacts that might result and take corresponding mitigating action

VI. SANITATION AND WASTEWATER MANAGEMENT POLICIES REFLECTING SUSTAINABLE-DEVELOPMENT PRINCIPLES

78. Sanitary wastes and wastewaters are potentially hazardous to health and are likely to cause adverse impacts on the environment, if effective sanitation and wastewater management policies are not implemented. Sewage contains pathogenic viruses, bacteria, protozoa and helminths as well as suspended solids and biodegradable organic matter. Lack of sanitation in a community undoubtedly gives rise to increased costs for curative medicine and reduced productivity, as well as lowering the quality of life generally. Uncontrolled discharge of urban sewage and industrial effluents has the potential to contaminate potable water supplies and to make surface waters unfit for the many uses which might otherwise be taken advantage of by the public. Yet wastewater contains nutrients which might be beneficial in agriculture, and the water alone has a value, especially in arid areas, if wastewaters are collected, treated and used for crop irrigation, aquaculture or industry.

79. Sanitation systems are an essential component of infrastructure in human settlements and are a cost-effective investment in preventive medicine. The environment has a natural capacity to assimilate waste materials, but as the density of population increases, even bodily discharges cannot be released without a risk to public health and damage to amenity. In rural areas, excreta disposal is the principal sanitation issue in relation to human health and must be provided, along with a safe and plentiful water supply and health education, if mortality (particularly infant mortality) and morbidity levels are to be reduced. However, both health risks and potential damage to living conditions are greatest in densely populated urban areas without adequate sanitation provision: stormwater drainage and sewerage, including low-cost sanitation systems, are vital in urban centres, if epidemics are to be avoided and amenity is to be preserved. As urban water supplies improve, wastewater disposal becomes critical, if expected health benefits are to be achieved, but, with safe water supplies, effective sanitation systems, control of domestic and industrial wastewaters, and complementary public-health education, the quality of life in rural and urban communities will be enhanced, and investments in curative medicine will be minimized.

A. Sanitation

80. Progress in the provision of sanitation to rural and urban communities in developing countries has not been as rapid as expected over the period of the International Drinking Water Supply and Sanitation Decade, 1981-1990. Sanitation provision has lagged behind water supply, and rural sanitation has received much less attention than urban sanitation, resulting in a huge backlog of under-service in the rural sanitation sector. If programme implementation continues at the current rate, the population without sanitation in the year 2000 will be around 2.3 billion, and this situation would be incompatible with the objectives of "Health for All by the Year 2000" and the Global Strategy for Shelter to the Year 2000. To allow the maximum number of people to be served per unit of investment, low-cost appropriate sanitation technologies must be widely introduced. There is still a tendency among decision-makers in developing countries to prefer advanced technology, on the assumption that low-cost appropriate technology is inferior, but current appropriate sanitation technologies are not inferior to the conventional systems widely used in industrialized countries, and decision-makers must come to realize that high-cost sophisticated systems are neither necessary nor affordable and are, often, inappropriate.

81. Provision of appropriate sanitation will achieve the objectives of protecting public health, by preventing the spread of disease through the faecal/oral route, and of improving the quality of life, not only through improved health status but also by segregating polluting wastewaters from the community environment for safe disposal. However, for the benefits of sanitation to be fully realized, all sectors of society must be adequately served. This means that great emphasis must be placed on the provision of sanitation (along with water supply) in rural communities and in urban slums and squatter areas. Low-income groups living in these communities are now poorly served with sanitation, and institutional attitudes preventing progress must be changed. Investments are to benefit the whole population. Once all sectors of the population in a country

are served with a basic level of sanitation, incremental improvements can be made, as economic development provides funding and/or as public perceptions change.

82. To achieve full coverage will require a significant acceleration in programme implementation in most developing countries, and attention will have to be given to the impediments which have limited progress over the past decade. In the past, patterns of investment and revenue-generation have left much to be desired, in general, and have adversely affected the sustainability of sanitation programmes, in particular. Measures will have to be taken to bring about institutional improvements, increased public awareness, community responsibility, women's participation, application of low-cost and appropriate technologies, integration of water supply and sanitation with other sectors, innovative approaches to cost recovery, improved arrangements for operation and maintenance, and private-sector involvement.

83. Communities must be involved in future projects and take the initiative in financial matters, if they are to identify with sanitation systems. International lending banks and bilateral agencies are now willing to accept low-cost sanitation technologies and community involvement in sanitation programmes, and are, even, requiring community responsibility for operation and maintenance. Realistic standards and specifications for materials, equipment and workmanship must allow the involvement of communities and the participation of the informal sector in sanitation projects.

B. Industrial effluents

84. Economic development will be accompanied by industrial development and large volumes of industrial effluent will be generated. Many industrial effluents will have serious impacts on settlement conditions if not controlled, and some will have health implications through the presence of toxic chemicals. In many countries, industrial growth has been allowed to occur without effluent control, and pollution has reached serious proportions in urban areas. The apparent conflict between industrial expansion and pollution control has created situations where potable water supplies have been heavily contaminated, surface waters have been ruined for any use other than waste disposal, and quality of life has become unsatisfactory over large areas. Changing social attitudes to pollution are likely to force governments to control industrial emissions in the future, in both developed and developing countries.

C. Wastewater

85. Community wastewater management can be developed in an incremental way over time. Those communities now without any provision must be served first with basic installations: too often in the past, there has been inequity in the provision of services, and low-income rural and urban communities now make up the large proportion of under-served populations in developing countries. Careful choice of level of service, in relation to the demand situation, and use of low-cost appropriate technology are mechanisms for improving the rate of coverage. Adoption of simple systems, without imported equipment and able to be maintained by the communities themselves, is desirable. Such systems will reduce the reliance of communities on skilled technical support from governmental agencies and increase their sense of ownership and responsibility.

86. The resource value of wastewater is often overlooked in water-resource planning. Apart from the great general value of the water in arid or water-short regions, urban sewage contains nutrients in the forms of nitrogen, phosphorus, organic matter and trace elements. With proper control of the health risks involved, sewage effluent can be used in agriculture to irrigate crops, used in aquaculture to produce a fish crop and used in industry. Many urban areas have been landscaped using treated sewage as irrigation water.

D. Implementation

87. For sanitation and wastewater systems to be effective and sustainable, community involvement in decision-making as well as in project implementation is vital. The role of women is particularly important, because home hygiene is predominantly in their hands, and they must be given instruction on the health aspects of water supply and sanitation. Wherever possible, the opportunity for the community to benefit economically from installation programmes should be considered. One way in which this might be achieved is through the

development of informal-sector component-manufacturing centres. Provision of start-up finance and training will usually be necessary, but the result will be socially beneficial and financially advantageous.

88. The provision of sanitation and wastewater services is usually a governmental prerogative, and institutional deficiencies have often been a constraint on progress. Fragmentation and unclear delineation of management responsibilities among too many governmental agencies have been a great impediment in the past, and lack of integration with national development planning has resulted in low priority being given to the sector. There is an urgent need for intersectoral collaboration in the provision of infrastructure to rural and urban communities and for the creation of co-ordinating agencies. The need for national plans has never been more crucial, and such plans should not overlook any opportunity for adopting unconventional approaches or involving new participants in programmes. A bottom-up approach to sanitation and wastewater programmes is likely to result in sustainable systems, and involvement of the private sector might be of value in increasing resources and in accelerating the rate of coverage. Inputs from multilateral and bilateral agencies, non-governmental organizations, governmental agencies at all levels and recipient communities must all be co-ordinated within the framework of a national plan. A key factor will be human-resource development at all levels, requiring international assistance.

89. Information transfer has also been identified as a weakness of existing systems, and countries need to set up collaborative information centres and arrange for the two-way flow of information. To provide information on experience, projects should be subjected to evaluation for their technical, financial and social performance against expectations. Advantage should be taken of successful experience from other countries, and poor performance of systems should be taken into account in future programme planning.

E. Recommendations

1. Recommendations for all countries

1. Develop and utilize planning tools for sustainable waste management, including risk assessment and impact-evaluation methods, based on environmental accounting.
2. Undertake a detailed evaluation of sources of wastes and their impact on the environment, especially the human living environment, and prepare a comprehensive, time-structured and affordable national plan to abate, if not eliminate, urgent problems associated with sanitary-waste management.
3. Prepare an inventory of national industries and of the quantity and nature of wastes they produce, and develop and enforce standards for waste discharges: develop financial and legal instruments for enforcement, based on the polluter-pays principle.
4. Incorporate in national operational programmes the recycling and reuse of sanitary wastes and wastewaters in both agriculture and industry.
5. Provide incentives for the development and use of low-waste and non-waste technologies in industrial processes and in sanitary-waste management.
6. Increase awareness of the ecological and health hazards of inadequate waste disposal.

2. Recommendations for developing countries

1. Give priority to the provision of basic sanitary waste-disposal facilities to low-income populations.
2. Redress disproportions in investment between water-supply and sanitation infrastructure.
3. Develop national programmes for the provision of sanitary-waste-disposal facilities, based on the wide use of upgradable low-cost technologies, on the use of innovative forms of revenue generation, on community and, particularly, women's participation and on non-governmental organization and private-sector involvement.

3. Recommendations for developed countries

1. Develop policy, legislative and institutional instruments to arrest transboundary transport and discharge of pollutants and, in particular, the transport of toxic wastes to developing countries and the dumping of untreated sewage and sewage sludge in oceans.

4. Recommendations for the international community

1. Provide training support to developing countries, to build up their capacity to manage wastes, emphasizing technologies for reducing, treating and disposing of all forms of waste, and the enforcement of standards and procedures for pollution control.

2. Provide assistance to enable national governments to assess waste problems and to define comprehensive programmes to address these problems.

3. Transfer appropriate technologies for waste management, especially technologies that favour waste recycling and reuse, and low-waste and non-waste technologies for industrial processes.

4. Provide assistance in disseminating information on waste-management approaches.

Links between sanitation provision and government action at different levels to improve health and living conditions

Sanitation issue	Action at individual and household level	Public action at neighbourhood or community level	Action at district level	Action at individual level
Lack of public concern for poor sanitation.	Organization of health education at the family level, particularly to women.	Provision of health education visitor for each community.	Support for health education and provision of appropriate training and information packages.	Technical and financial support for health education and public awareness campaign including public services, broadcasting, television and posters.
Funding limitations affecting progress with sanitation programmes	Discussions with households on need for cost recovery and community participation.	Action to organize community involvement and cost recovery.	Support and advice for neighbourhood implementation of basic needs policy and cost recovery.	Policy modification to move rapidly to basic needs approach to sanitation provision with full cost recovery.
Inappropriate systems for functioning.	Organization of community involvement in system planning and implementation.	Integration of community participation with governmental and other inputs.	Development of standard replicable designs using proved low-cost appropriate technology.	Revision of national legislation, regulations and codes so as to allow adoption of low-cost appropriate technology and community participation.
Shortage of trained personnel to operate systems	Support for household initiative in operating and maintaining systems.	Provision of technical advice and training to households on operation and maintenance of systems.	Provision of teams of technicians to provide special service requirements.	Improvement of national and regional training programmes and develop appropriate

systems.

Sanitation systems not integrated with water supply programmes.

Advise households, and particularly women, on the health and environmental benefits derived from water supply, sanitation and home hygiene in combination.

Provision of information personnel support for household awareness campaign.

Integration of water supply, sanitation and health education personnel and planning.

curricula.

Change national policy to provide financial support primarily for integrated programmes on water supply, sanitation and health education.

Absence of community benefits from sanitation programmes.

Training of capable household members to participate in informal sector production of components of sanitation systems and implementation of schemes.

Organization of informal sector groups to produce sanitation system components and be involved in system construction.

Provision of financial and training support for informal sector involvement in sanitation programme.

Revision of policies for community involvement and informal-sector development.

Water supply and sanitation not integrated with other sectors of community development.

Inform households of the benefits of water supply and sanitation as an important component of other sector developments.

Provision of information on water supply and sanitation as health and environmental attributes of all sector development programmes.

Arrange for access of water supply and sanitation specialists to review all sector development programmes.

Policy modification to encourage health, rural and agricultural development programmes to incorporate water supply and sanitation.

Lack of private-sector involvement in sanitation programmes.

Encourage private-sector firms involved in sanitation to employ local residents.

Organization of public- and private-sector inputs into sanitation schemes.

Local authority encouragement of private-sector participation in planning, financing, implementing and maintaining sanitation systems.

Policy development to allow public-sector participation in sanitation programmes along with other sector developments.

Repetition of errors in the provision of sanitation.

Training of householders to respond positively to questionnaires and other forms of information collection method.

Encouragement of neighbourhood representative committees to insist on project assessments and participate in them.

Training of project evaluation teams to carry out technical and socio-economic assessments and utilization of the results.

Requirement to evaluate completed projects should be supported by financial provisions.

Poor information collection and transfer.

Training of householders to participate in information collection process.

Involvement of neighbourhood representative committees in information collection.

Arrange for the dissemination of information received by national information centres and feed local information to them.

Support the development of national information centres on water supply and sanitation and require participation in international information transfer networks and TCDC.

VII. SOLID-WASTE MANAGEMENT POLICIES REFLECTING SUSTAINABLE-DEVELOPMENT PRINCIPLES

90. Solid waste is unwanted material that is not discharged through a pipe. It consists of domestic garbage and other discarded materials, wastes that are swept up from the streets, and unwanted items and materials of many kinds from commercial and industrial enterprises: these items are usually referred to as refuse. It also consists of particulate matter discharged into the atmosphere.

91. While rural settlements generate some modest quantities of solid waste, the problem is predominantly an urban one. As cities grow, the problems caused by solid waste become enormous. Wastes that are not removed from urban areas pose risks to health and degrade the living environment. Refuse collection is costly in terms of human and financial resources, but failure to collect waste also has an economic cost associated with it. Similarly, failure to deal with airborne particulates has economic and social costs.

92. Quantities of refuse are increasing, placing a greater strain on disposal facilities. In many parts of the world, solid wastes are disposed of in such a way that long-term damage to amenity results. The continuing introduction of new materials is an ongoing challenge, and there are large numbers of materials used in modern industrial processes that must be handled, treated and disposed of with great care, if serious pollution of air, water and land is to be avoided.

A. The importance of solid-waste management

93. Solid wastes can cause serious and long-term pollution of land, air and water. Large areas of land in or near urban areas have been spoiled by careless dumping of waste, and soil on many disused industrial sites has been made unusable and toxic by the careless deposition of process wastes. Housing near past and current disposal sites has been threatened by explosive gases that are generated by decomposing wastes. Water resources have been dangerously contaminated by leachate (water that has percolated through layers of solid waste, picking up toxic and polluting chemicals on its way). Air is polluted by particulates in effluents and by smoke from burning refuse, and even large modern refuse incinerators produce toxic gases when plastics are burned.

94. Refuse affects the health of the community. Flies, mosquitoes, rats and cockroaches all breed in refuse. These creatures all spread diseases, so that reducing their numbers improves the health of the public: they also spoil food, and the bites of rats and mosquitoes can be a serious nuisance. Labourers and scavengers who have close contact with wastes run the risk of cuts, infections and infestation by parasites. Piles of refuse encourage indiscriminate defecation; in a clean environment, people are likely to seek out a proper latrine. All these facts clearly demonstrate the importance of sustainable and satisfactory removal of refuse.

95. Every day, large tonnages of useful materials are dumped or buried as refuse. However, some materials, such as metals, plastics and paper, could be reprocessed into useful products. Organic material derived from the soil can be returned to the soil. Energy can be produced by burning either the wastes themselves or the gases they produce when they decompose. Private companies and public bodies, whose objective is to dispose of waste as quickly and cheaply as possible, might not be concerned with the economics of resource recovery, but it is in the interest of humanity as a whole to ensure that potentially valuable resources are not buried in the ground, causing pollution, when they might be usefully employed in the economy.

96. The costs of solid-waste collection and refuse disposal are so large that there is no excuse for poor management. Collection vehicles and other equipment are expensive to purchase and operate, and large workforces are employed, so that the extra expenses incurred by weak supervision or the acquisition of inappropriate equipment can be a significant item. The refuse-collection service of a settlement touches every household, and the co-operation of every household is needed, if the system is to run efficiently: every

household will know if the collectors come as planned or fail to come, and the competence of a local administration might be judged primarily by the performance of the refuse-collection system.

B. International differences

97. One of the hindrances to efficient solid-waste management is the failure to take into account the large differences in conditions from one place to another. The system for managing solid waste that is appropriate in one country might be unworkable in another; there are also variations between large cities and small towns within one country, and variations within a city, between industrial areas, commercial areas, low-density residential areas, apartment blocks and unplanned areas.

98. These differences are caused by a number of factors, principally:

(a) Differences in the nature of the waste - composition and density - and differences in the rate at which it is produced;

(b) Economic differences - in some countries a capital-intensive system is economical and reliable, whilst in others a labour-intensive system is cheap and effective;

(c) Climatic differences - for public health reasons, decomposable refuse must be collected frequently in hot climates;

(d) Differences in attitude and expectation - as mentioned above, the co-operation of the public is essential, so the service must meet the requirements of the local people;

(e) Differences in architecture, planning and social customs.

It is not difficult to find examples of where these differences have been overlooked, and the management of solid waste is, thereby, rendered ineffective.

99. Several reasons can be identified for these failures to implement appropriate systems:

(a) Political leaders in developing countries feel that it is important to have the most modern or best system (meaning a sophisticated, capital-intensive system that they have observed elsewhere) and they insist on introducing systems designed for different conditions, so that these systems fail to perform adequately;

(b) Consultants from other countries recommend systems with which they are familiar, without taking account of local conditions;

(c) Aid agreements supply vehicles of an unsuitable type, size or make.

Usually, the mistake is to focus on the means (e.g., collection vehicles) rather than on the desired result, i.e., a clean and healthy settlement and the recovery of natural resources.

C. Disposal options

100. The most widespread method of refuse disposal is depositing on land; this can be done in a way that causes minimal pollution and restores the land to a useful condition (sanitary landfilling), but it is cheapest simply to dump the waste, and this is the method that is still used in many countries, with consequent degradation of air, water and soil. There is a need to develop an intermediate method which reduces the breeding of flies and rats, and is non-polluting, for areas where proper sanitary landfilling is deemed too expensive.

101. Incineration is often seen as an attractive alternative to land disposal, because it appears clean and safe. In some situations, it might be the best disposal route, but there are also cases where incinerators

have been built and have proved to be totally unsuitable. Incinerators are expensive to build, expensive to operate and expensive to maintain, but they are not suited to certain types of refuse. Also, a landfill site is still necessary, to dispose of ash and unburnt residues, and to accept the waste when the incinerator is not operational. However, in some cases, incinerators have been a good solution, reducing haul distances for collection vehicles and recovering heat energy from the wastes, without causing unacceptable levels of air pollution.

102. Resource recovery is the obtaining of economic benefit from the waste. The resource that is recovered could be energy, raw materials, reusable products or a new product formed from the waste. An additional benefit is that the quantities of waste to be disposed of are reduced, as some of the material is returned to the economy.

103. Two very important considerations in resource recovery are separation (of the useful components from the rest of the waste) and transport. The simplest method of separation is at source - the household placing different materials in different containers - but this degree of co-operation cannot be achieved everywhere. Sophisticated plants to separate waste into its components have been built, but none has been entirely successful - generally some form of manual sorting is necessary. Transport costs have an influence on the economic viability of resource-recovery schemes, so that, in many cases, only the wastes from large urban centres can be used.

104. Much of the organic content of domestic solid waste can be turned into compost - a soil conditioner that improves the structure of the soil and complements artificial fertilizers. Many compost-producing factories around the world have not been successful because there has not been sufficient support from the agricultural sector. It is not the responsibility of the waste-disposal industry to improve the quality of agricultural soils; in many cases, a guaranteed market at a guaranteed price is required. Where this is not provided, there is a likelihood that mountains of unsold compost will arise.

105. It is generally true that industrialized countries practise less resource recovery than developing countries, because rich people tend to discard rather than repair. Many of the world's poor make a living by searching for items that can be reused or sold - this scavenging is very effective in minimizing the amounts of valuable materials that are disposed of, but scavengers run the risk of infection and injury, and, when they work on refuse tips, they are a hindrance to municipal disposal operations.

D. Industrial wastes

106. Industries produce large quantities of waste, a large proportion of which is inert and harmless. However, there is likely to be a small component that is hazardous, and these wastes require special care and attention, to prevent their causing severe and long-lasting harm to the public. Much of the legislation and concern about toxic wastes has been a result of potential or actual tragedies; management of toxic wastes is perhaps the paramount example of the dictum that prevention is better than cure.

107. Waste disposal is often one of the least of the concerns of industrialists: they are principally preoccupied with products and profits. Unless strict controls are imposed, most managers will be happy to accept the cheapest solution for the removal of waste, without asking questions about its impacts, with the result that dangerous materials are left in places where children have access to them or where the health of the general public is put at risk. Furthermore, most industries will take the cheap course of discharging particulates into the atmosphere, without worrying about the social costs incurred. Two strategies can help to minimize risk: the first is education of the public, so that it will not tolerate such hazards, and the second is a system of monitoring enterprises that produce hazardous wastes, so that a check is kept on their discharge.

108. Disposal of hazardous wastes poses many problems. There is great demand for the products of modern technology, but no one wants the wastes, arising from the manufacture of these products, to be disposed of in the vicinity of their homes. Some chemicals require expensive equipment for their disposal, such as special incinerators which maintain a very high temperature over a long time. Environmentalists have successfully prevented some dumping of hazardous wastes at sea and some incineration processes, but the waste is continually being produced, and the problem will not go away.

109. New materials continue to be produced, and, with them, come new disposal problems. The growing variety of plastics causes problems for incinerator operators: the increasing use of coatings in printing makes the recycling or composting of paper difficult. CFCs in discarded refrigerators need special care: PCBs in electrical switchgear and transformers are a similar cause for concern. Every effort must be made to minimize quantities of industrial wastes. Industries must be encouraged to recycle rather than discard, and, sometimes, the waste from one industry can be the feedstock of another. Many wastes can be treated on-site to make them safe.

110. Besides the range of solid and hazardous wastes that are produced as by-products of manufacturing processes, industries also discharge a range of gaseous and particulate matter into the atmosphere, causing air pollution. Instances of air pollution in developing countries have increased sharply with industrialization, and their occurrences coincide with stagnant and persistent air conditions in densely populated areas. Illness and mortality from respiratory causes have, consequently, increased dramatically in many rapidly industrializing urban settlements. While physical apparatus, such as particulate removers and gas scrubbers, remain the most viable method of reducing emissions at source, much can also be done by way of good land-use planning in the process of urbanization.

E. Institutional aspects

111. Some of the problems associated with solid-waste management are caused by fragmentation of responsibilities between different organizations (for example, one body being responsible for cleaning roadways, whilst another is responsible for open drains) or a failure to co-ordinate between ministries (as in the case of composting). Provision of water-supply and sanitation services should be linked to solid-waste management. In many situations, the private sector can play a vital role in refuse management, but its operations must be carefully prescribed and well supervised. Small-scale collections schemes at the community level have been very successful, because of their accountability and their good match between service level, community requirements and affordability.

112. Human-resource development in this area needs urgent attention. High levels of technical competence are demanded, and, in some cases, considerable management skills are called for, but, in many cultures, solid-waste management has a very low status, with the result that few resources are devoted to it. Solid-waste management is a challenging and important field, but it will not attract professionals of sufficient calibre unless it is recognized as such and supported by sufficient training.

113. As in many sectors, the raising of revenue poses problems. Where domestic refuse services are charged directly, individuals might refuse to pay and discard their wastes in unacceptable ways; the collection of scattered wastes from streets and open ground can be very costly. The method of revenue collection must be tailored to the consciousness of residents and their ability to pay. In some cases, a two-tier system is appropriate, where a basic service is provided to all, and a superior collection system can be paid for directly.

F. Recommendations

1. Recommendations for all countries

1. Develop and utilize planning tools for environmentally sustainable solid-waste management, including risk-assessment, impact-evaluation and economic-costing methods, based on environmental accounting.

2. Undertake a detailed evaluation of sources of domestic, commercial and industrial solid wastes, and of their impact on the environment, especially the human living environment in rapidly growing settlements, and prepare a comprehensive, time-structured and affordable national plan to abate, if not eliminate, the urgent problems caused by inadequate solid-waste management.

3. Prepare an inventory of national industries and of the quantity and nature of solid wastes they produce, and enforce standards for their disposal of wastes: develop financial and legal instruments for standards enforcement and for the promotion of waste exchange among compatible industries.

4. Promote within national solid-waste management programmes, the conservation of national resources, through the recycling and reuse of solid wastes.

5. Provide incentives for the use of low-waste and non-waste technologies in industrial processes.

6. Increase awareness of the ecological and health hazards of inadequate solid-waste disposal and of the role that physical planning of human settlements can play in dealing with the environmental impacts of waste production.

2. Recommendations for developing countries

1. Give priority to serving unserved areas before services are improved in areas already served: this entails the development of appropriate approaches for managing solid wastes generated in hard-to-serve low-income informal settlements, through applied research.

2. Adopt, as a national strategy, the use of a two-tier system, where a basic service is provided to all (taking appropriate advantage of community involvement, particularly, women's involvement, innovative forms of revenue generation, community-based system management, and non-governmental, private and informal-sector involvement) and a superior collection system is offered that can be paid for directly, through private services, where appropriate.

3. Establish management systems for improving the performance of solid-waste management services and disposal practices, especially those related to hazardous wastes.

4. Establish special programmes to upgrade and improve the living and working conditions of waste management personnel.

5. Upgrade solid-waste disposal practices, with the aim of reducing their negative impacts, including the use of sanitary landfilling instead of open dumping and the use of apparatus, such as particulate removers and gas scrubbers, on emission stacks.

6. Integrate the planning and implementation of solid-waste management programmes with other environmentally related programmes, such as the provision of water-supply, sanitation and drainage services.

3. Recommendations for developed countries

1. Develop policy, legislative and institutional instruments to arrest the transboundary transport and discharge of pollutants and, in particular, the transport of toxic wastes to developing countries.

2. Establish programmes to monitor disused landfill sites and develop ways of reclaiming these sites for other uses.

4. Recommendations for the international community

1. Provide assistance to enable national and local governments to assess solid-waste problems.

2. Provide training support to developing countries, to build up their capacities to manage solid wastes, especially in the area of technologies and techniques for reducing, managing and disposing of all forms of solid waste.

3. Transfer technologies for solid-waste management, especially those technologies that favour waste recycling and reuse, and low-waste and non-waste technologies for industrial processes.

4. Provide assistance in gathering and disseminating information on environmentally sound approaches to solid-waste management.

Action required to provide sustainable and satisfactory solid waste management in urban settlements

Factor	Action at individual and household level	Action at neighbourhood or community level	Action at city or district level	Action at national level
Prevention of flybreeding. (Flies lay eggs in moist garbage or faeces. After hatching and larval stage, pupation occurs in the soil. Adults emerge after a minimum of eight days after eggs are laid, the time depending on the temperature. Flies take germs from faeces to food).	No food waste to be dumped ground surface. Garbage to be stored in covered container or buried. No garbage to be kept on the premises for more than 4 days in hot climate, or 7 days in temperate climate. No human or animal faeces to be left in the open.	on Surveillance of the neighbourhood to ensure there are no sites for fly breeding.	Maintaining a refuse collection from all parts of the settlement at such a frequency that refuse is disposed of before any developing flies can reach the adult stage (twice a week in hot climates). Ensuring that, as much as possible, refuse is stored in containers, and never dumped on soil.	Guidelines and specific advice should be given regarding the choice of solid-waste collection systems and equipment. Performance data for collecting agencies to be kept and monitored to show areas of special need. Priority to be given to purchase of spare parts for collection vehicles. Public education on control of houseflies.
Cleanliness of streets and public places. Prevention of rat breeding. (Wastes left on the streets set a low standard of public cleanliness so that conditions deteriorate. Piles of refuse provide shelter for rats.)	All solid wastes and litter to be placed in the appropriate container. Children to be taught never to drop litter. No solid wastes of any sort to be left lying around within or outside premises to pay..	Monitoring use of communal storage facilities. Making arrangements for vacant land to be kept clean. Organizing a community door-to-door collection of refuse if there is the need and willingness public areas.	Ensuring a regular and efficient collection of all kinds of solid wastes. Providing litter bins in main streets and public places and ensuring they are emptied frequently. Regular sweeping of the streets and	Education through schools and media to encourage concern for the urban environment. Legislation to penalize littering. Competitions to reward the cleanest community. Provision of advice on the control of rodents.
Prevention of air pollution. (Burning of refuse is only acceptable in sparsely populated rural areas; elsewhere it causes unacceptable levels of air pollution. Refuse collection vehicles cause air pollution if they are particularly noisy and by means of their exhausts.)	No wastes to be burned within the urban area.	Informing residents that they should not burn wastes in the open, and ensuring that this regulation is adhered to.	Supervising the collection of refuse to ensure that no labourer sets fire to refuse. Selecting and maintaining vehicles so that their exhaust emissions do not pollute the air (especially in alleys). Minimizing the noise produced by vehicles and labourers, especially at night or early in the morning. Monitoring and maintenance of incinerators.	Involvement in purchase process for any incinerator to ensure that resources are available to keep it in good condition (especially exhaust gas cleaning equipment). Similarly, monitoring of selection of vehicles.- Legislation to prohibit open burning in urban areas. Providing advice on management of land-fills to reduce risk of fires. Monitoring of incinerator emissions.
Maintenance of open drains. (If drains are not kept clean they cause ponding of stagnant water in which mosquitoes can breed. It is difficult to remove refuse from drains. Solid wastes in drains cause blockages and flooding.)	No wastes to be thrown or swept into open drains. Drain outside front of dwelling to be kept clean. No ramp or cover to be built over drain without official sanction.	Organizing residents and shop owners to clean the part of the drains in front of their properties. Providing drain cleaning tools if necessary.	Maintaining drains in good structural condition. Ensuring that open drains are not covered by access bridges to such an extent that they cannot be cleaned. Ensuring that open drains are kept clean. Regularly emptying gullies subsurface drains.-	Education through schools and media to increase awareness of breeding habit of mosquitoes, and the reason why refuse should never be put in of drains. Legislation to prohibit dumping in drains. Institutional arrangements to unify responsibilities for drains and street sweeping.

Prevention of accidents and injury. (Refuse collectors can be injured by trying to lift containers that are unusually heavy, or by sharp objects. Traffic accidents are another hazard to both public and workers.)	No unduly dense wastes (such as building rubble) to be placed in containers for domestic waste. Sharp items (such as broken glass) to be wrapped in several layers of paper.	Locating communal waste storage facilities so that residents using them, labourers emptying them, and pedestrians passing them are in no special danger from passing traffic.	Training all employees in safe handling of wastes, road safety and driving safety (especially reversing procedures). Ensuring all municipal vehicles are well maintained. Providing protective clothing and safety equipment.	Publication of training materials to promote safe working habits. Surveillance of accident statistics. Provision of appropriate health care for employees. Setting and supervising minimum standards for vehicle maintenance.
Regular and reliable removal of wastes from urban areas. (Regular removal, and prompt and proper disposal of solid wastes are essential steps in the control of houseflies. Uncollected refuse accumulates in the street.)	Prompt payment of waste collection charges, and compliance with instructions of refuse collection agency.	Monitoring collection frequency and informing the responsible authorities if collection is more than a day late.	Selection, operation and maintenance of vehicles so that there are always enough to collect all the solid waste. Supervising work force closely. Making regular collection from all of the inhabitants a high priority. Investigating and punishing for illegal dumping.	Publication of guidelines on minimum service levels. Provision of training and advice for refuse collection agencies. Determination of contract procedures regarding private enterprise waste management.
Reduction of waste quantities. (Minimizing the amounts of solid wastes to be collected and disposed of reduces the costs of these operations, and reduces the pressure on disposal facilities.)	Co-operation with waste recycling schemes. Using minimum packaging plastic bags when shopping. Flattening boxes and containers whenever possible reduce volume.	Facilitating recycling by providing storage space and giving other appropriate support.	Support for resource recovery schemes. Investigating the potential for new schemes (such as pilot trials for separation at source).	Providing incentives and advice to industry to encourage waste reduction. Legislation requiring maximum use of returnable containers.
Minimizing reuse of wastes. (Resource recovery reduces amounts of wastes to be handled, conserves natural resources, and reduces imports of raw materials.)	Co-operation with waste recycling schemes. Keeping recyclable elements separate from each other. Using products made with recycled materials whenever possible.	As above	As above. Purchasing policies should favour recycled goods. If compost is available, it should be used in public parks.	Development grants and tax incentives for resource recovery initiatives. Possibly support for prices of secondary materials to provide stability. Co-ordination with agriculture ministry to exploit full economic benefit of composting.
Environmental problems of modern materials. (New products and materials are constantly being developed, and sometimes the environmental consequences of their use disposal are not apparent until years after their introduction.)	When an environmental problem associated with a particular product or material is identified and publicized, individuals should seek to find an alternative that does not pollute, or, if that is not available, reduce their usage.	Environmentally aware individuals and groups should try to inform others about the hazards of any particular product and encourage them to modify their consumption habits.	Informing all appropriate staff about the material and how it should be used and handled. Modification of purchasing policies (if appropriate). Introduction of special disposal arrangements (if appropriate).	Publicizing hazards more acceptable alternatives. Tax or other incentives to favour the production or import of less harmful alternatives. Legislation prohibiting the use of the particular product (if or feasible) and requiring satisfactory disposal.
Management of disposal sites. (Disposal should be managed so as to control flies. Avoiding such sites unless access is authorized. Teaching children about hazards of disposal sites. Preventing trespassers or vandals.)	No particular responsibilities.	Solid waste should be disposed of according to the best practicable means. Advice should be sought as to how to minimize pollution and	Development of landfill operation procedures compatible with economic and climatic	

mosquitoes and rodents, and to minimize water and air pollution. Landfills are dangerous places because of heavy machinery and hazardous items.)

to the authorities.

nuisance. Facility should be monitored regularly.

conditions. Monitoring and advising on pollution control. Oversight of disposal policies and purchasing. Training. Licensing of incinerators and sites.

Upgrading socio-economic conditions of scavengers. (Scavengers who spend their days sorting through solid waste in containers or on disposal sites, looking for items they can sell or use, have a precarious existence.

Individuals can improve the efficiency and conditions for scavengers by keeping re-usable items separate so that they can be collected without sorting through mixed waste.

Communities might help scavengers by providing separate storage for useful materials, but such action might encourage others to operate at this level so that the plight of the original scavengers is made worse as their supply of is reduced

Scavengers are commonly seen as a disruptive and uncontrollable group. Refuse management authorities have no statutory duty to engage in social work. The first step should be to discuss with the scavengers what their needs are.

Any intervention should be well thought out and discussed fully with the scavengers themselves. Any changes to their conditions should be in small steps. In most cases, ways should be sought of stopping this activity and providing alternative opportunities for income generation.

Management of hazardous waste. (Some industrial wastes are toxic and dangerous, and so should be handled very carefully to avoid exposing employees and the public to danger, and to prevent pollution. Disposal of such wastes is expensive, so industrialists may be tempted to look cheaper, illegal methods.)

Seeking and following instructions from responsible authorities regarding the disposal of any hazardous materials (such as biocides, inflammables, acids, asbestos). Reporting any illegal dumping and any suspicious containers.

Alerting the authorities if any industrial waste is deposited in the area. Advising residents as to whom to contact if they wish to dispose of any material that might be hazardous.

An inventory of all industrial processes should be held, and a close watch should be kept on the generation and disposal of all hazardous wastes. Disposal of heavy electrical equipment and asbestos should also be controlled. All hazardous waste should be disposed of according to government guidelines.

Development and implementation of an administrative system to record all passages of hazardous wastes, and to document their transport and disposal. Legislation to penalize severely any infringement. Preparation of safe handling and disposal procedures for all relevant wastes. Incentives to encourage processing and reuse. Training and licensing of all with responsibilities in this field.

Transboundary movement of wastes (Some international shipments of toxic wastes have posed a serious threat to water resources and public safety; the sending country has sought a cheap solution to a difficult disposal problem, and the receiving country foreign exchange without concern for the effects.)

Members of the public should inform the environmental protection authorities of any suspicious or unusual deposition of wastes (usually in drums).

No special action

Staff to be kept informed on environmental issues and procedures. Operation of disposal sites to be monitored closely to ensure that unauthorized wastes are not deposited there.

Legislation prohibiting and prescribing penalties for unauthorized handling or depositing of special wastes. Control of ports to detect any imports or exports of waste. Training and support of inspectors to monitor disposal operations.

Increasing investment in waste management. (Improved standards of waste management generally necessitate more spending on both human and physical resources. Some of this extra money might come from private sources in the form of fees paid directly to the operators.)

Payment of taxes and charges without delay. - directly by the recipients of

In some cases it might be appropriate for communities to organize a local primary collection service, paid for municipal and district budgets. the service.

Waste management needs to be given a higher priority in some areas and this will involve a larger share of it may be possible to charge directly for commercial and industrial collections.

Any attempts to upgrade waste management practices must be accompanied by the extra funding required. Care must be taken to invest wisely because wrong choices will lead to unsustainable solutions.

VIII. SUSTAINABLE ENERGY SYSTEMS FOR HUMAN SETTLEMENTS

A. *The role of energy in the development process*

114. An adequate supply of animate and inanimate energy is essential to human development: energy consumption is a measure of human welfare, and there is a close relationship between energy consumption and economic development. Achievement of sustainable global development, therefore, implies realization of a sustainable energy future, especially in meeting transport, industrial and household demands. Continuation of past patterns of energy-resource use, without due regard to ecological impact, could lead to a resource-consumption crisis. The profligate production and consumption patterns of certain countries threaten the welfare of the rest of the world, because of the inability of developing countries to obtain sufficient energy to improve their state of development at an affordable cost. For countries with low per capita energy consumption to follow the energy-use pattern of high per capita energy countries is to hasten the energy and environmental crisis, i.e., to create an unsustainable future. The goal of a sustainable future, therefore, imposes an obligation on all countries to implement an energy strategy which does not jeopardize the development potential of developing countries: amongst other implications, this might require high-energy-consuming countries to reduce their per capita consumption of energy, especially of fossil-fuel energy.

115. The overall problem is how to meet the future energy needs of a growing global population, taking into account the potentials of non-renewable and renewable primary-energy sources, and emerging global ecological problems. Current energy paths are dependent on the use of coal, oil and natural gas. Their replacement by other sources of energy would be a time-consuming and expensive process which would also introduce new risks and additional limitations. However, by 2010, the build-up of "greenhouse gases" might require, *inter alia*, some management of the worldwide use of fossil fuels. In such a situation, energy paths that reflect a continuation of current use patterns could not support the development aspirations of developing countries.

116. In developing countries, population growth will have an important impact on energy availability, especially on the demand for traditional fuels, such as biomass. Energy conservation can play a role but only to the extent of making scarce and depletable energy resources available for an extended time. Hence, energy conservation alone will not suffice. Additional efforts towards developing new energy sources will be a strong factor in energy-resource sustainability.

B. *Energy use by sector*¹

117. A breakdown of energy use by different sectors in different regions is given in figure 1. Table 1 gives a global distribution of energy use and also shows the contributions of different forms of energy.

1. *Agriculture*

(a) *Developed countries*

118. In developing countries, the agricultural sector is estimated to consume just over 1.5 per cent of world energy. The main fuel is oil, supplemented by natural gas and gaseous fuels. The figure includes energy accounted for in industries related to agriculture - the manufacture of farm equipment, pesticides, fertilizers and fertilizer feedstocks.

¹Based on *World Resources 1988-89*, a report by the World Resources Institute and the International Institute for Environment and Development in collaboration with the United Nations Environment Programme (New York, Basic Books, Inc., 1988), table 7-4.

Energy demand by sectors, developing and developed countries (1985)

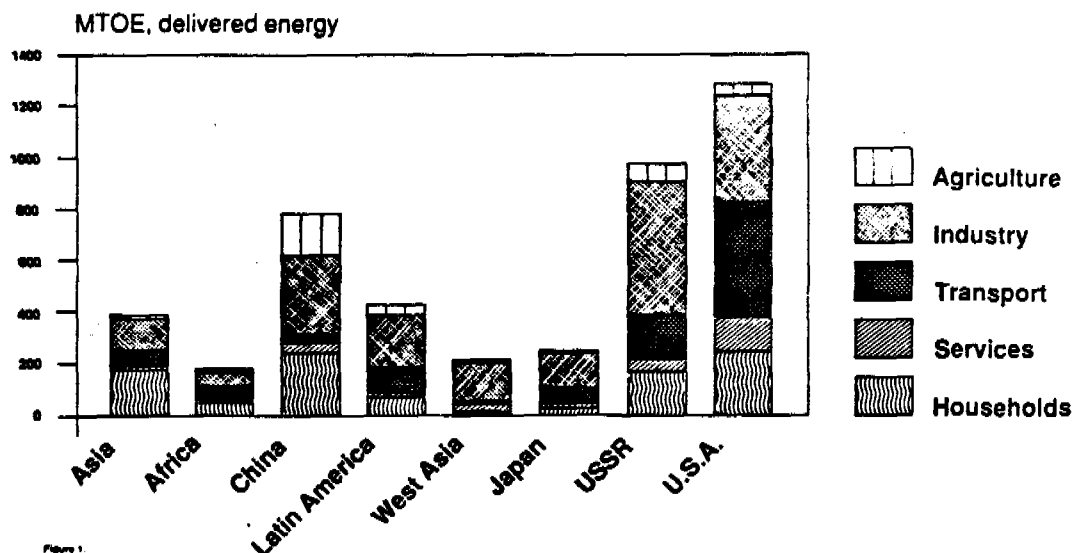


Figure 1

Source: Schipper, L., "Energy use in households", paper prepared for the Expert Group Meeting on the Use of Energy by Households, in Construction and in Production of Building Materials, with Emphasis on the Use of Energy Sources which are New and Renewable and that Minimize Pollution Problems, Nairobi, 1990.

(b) *Developing countries*

119. The agricultural sector in developing countries accounts for just under 1 per cent of world energy consumption. Oil is the main input in India, coal and other solid fuels in China, and fuelwood in Brazil. However, most rural areas in developing countries receive little or no commercial energy, most of the energy being animate or derived from animal dung.

2. *Industry and commerce*

(a) *Developed countries*

120. The combined industry and commerce sector is estimated to consume about 34 per cent of world energy production. In developed countries, the industrial sector uses more energy at the national level than any other sector, ranging from 37 per cent in the member countries of the Organisation for Economic Co-operation and Development (OECD) to 52 per cent in Eastern Europe. The main fuel in OECD member countries is oil (30 per cent of energy consumed in the sector) followed by coal (25.5 per cent), gas (24.5 per cent) and electricity (20 per cent). In Eastern Europe, the share of coal and natural gas is more important than that of oil, being together about 62 per cent of the energy consumed in this sector.

(b) *Developing countries*

Table.1 Sectoral energy consumption in developed and developing countries

Sector	Developed countries					Developing countries ^a					Total							
	Oil ^b	Coal ^c	Gas ^d	Electricity ^e	Other	Total	Oil ^b	Coal ^c	Gas ^d	Electricity ^e	Other	Total	Oil ^b	Coal ^c	Gas ^d	Electricity ^e	Other	Total
Agriculture	49.8	2.8	7.8	3.6	N.A.	64.0	19.1	16.7	N.A.	6.0	N.A.	41.8	68.9	19.5	7.8	9.6	N.A.	105.8
Industry/ Commerce	392.7	360.3	412.6	245.8		1411.4	91.4	229.8	44.8	75.0	N.A.	441.0	484.1	590.1	457.4	320.8	N.A.	1852.4
Household	205.5	155.5	338.6	241.2	N.A.	940.8	76.5	68.0	1.0	23.4	N.A.	168.9	282.0	223.5	339.6	264.6	N.A.	1109.7
Transport	928.0	9.7	2.2	7.3	N.A.	947.2	128.8	19.4	N.A.	1.0	N.A.	149.2	1056.8	29.1	2.2	8.3	N.A.	1161.1
Total	1576.0	528.3	761.2	497.9	-	3363.4	315.8	333.9	45.8	105.4	-	800.9	1891.8	862.2	807.0	603.3	-	4164.3

a Includes China, Indonesia, Republic of Korea, West Africa and Latin America.

Note: b Including other liquid fuels

c Including other solid fuels

d Including natural gas and gaseous fuels

e Including heat energy

Source: World Resources 1988-89, a report by the World Resources Institute and the Institute for Environment and Development in collaboration with the United Nations Environment Programme (New York, Basic Books, Inc. 1988)

121. In developing countries, the industry and commerce sector is estimated to consume 10.5 per cent of world energy production. It is the biggest consumer of commercial energy in Asia (62 per cent in China, 53 per cent in India, 50 per cent in Indonesia), and in Latin America the share of the sector is on a par with that of the transport sector (38 per cent, each), whereas in West Africa the share (20 per cent) is half that of the transport sector. Oil is the main source of energy, except in China and India where coal contributes about 70 per cent of the energy needs of the sector.

3. Transport

(a) Developed countries

122. Although the sector consumes 19 per cent of global energy, it is not a large consumer of energy at the national level, except in OECD member countries where its national share is 30 per cent. Elsewhere, the share

ranges from a maximum of 13 per cent in the USSR to a minimum of 7.6 per cent in the remaining countries. The main fuel in the sector in all countries is oil (97.5 per cent in OECD member countries and 64 per cent in Eastern Europe).

(b) developing countries

123. The transport sector of the developing countries is a small consumer of global energy (3 to 5 per cent), but there is a wide variation between different regions. In Asia, the sector is not a large consumer of energy (8 per cent of national energy consumption in China, 10 per cent in India, 14 per cent in the Republic of Korea). In Latin America, the share is 38 per cent, and in West Africa, 44 per cent. The dominant fuel in all countries is oil.

4. Household

(a) Developed countries

124. The household sector consumes 21 per cent of global energy. At the national level, its importance ranges from a low of 15 per cent in the USSR to a high of 31 per cent in the OECD member countries. The predominant fuel also varies, depending upon the country. In OECD member countries, natural gas and primary electricity are the leading sources of energy for the sector, followed closely by oil, and then coal (35 per cent natural gas, 30 per cent electricity, 26 per cent oil and 8.5 per cent coal). In Eastern Europe, coal and natural gas are the main sources of energy for the sector (55 per cent and 37 per cent respectively).

(b) Developing countries

125. The sector consumes 4.0 per cent of global commercial energy. Oil, in the form of kerosene, is the most important fuel for lighting and, to a lesser extent, cooking, in all the developing countries, ranging from 79 per cent in Indonesia to 51 per cent in China. Coal is an important commercial fuel in some coal-rich countries such as the Republic of Korea (59 per cent), China (43 per cent) and India (21 per cent). Biomass (fuelwood, agricultural waste and animal dung) is the most important source of energy for the poor. In India, the estimated amount of energy from this source is 104 MTOE, 58 per cent of total energy consumed in all sectors. Although data are not available for other countries, the consumption pattern is known to be similar.

5. Summary

126. The foregoing analysis shows that, at the global level, the industry and commerce sector is the largest consumer of commercial energy - 44.5 per cent of total global energy consumption. The household and transport sectors follow at about 26 per cent each whilst the agriculture sector consumes only 2.5 per cent. Hence, increasing energy efficiency, especially in the industrial sector but also in the household and transport sectors, will help considerably in reducing pressure on future energy demand.

C. Future energy demand

127. Future energy demand is conjectural, especially given the uncertain future of energy technologies and of development processes in Eastern Europe and the developing countries. Hence, it is impossible to predict sectoral demands in absolute figures. However, it is possible to analyse, to a certain extent, trends in developed and developing countries and to arrive at possible future scenarios.

1. Developed countries

128. According to one study,² primary energy demand is expected to grow at around 0.7-1.2 per cent annually until the year 2000, and 0.1-0.5 per cent annually thereafter. The shares of the various sectors (agriculture,

² Frost, J.R., and others, "World energy horizons 2000-2020", paper prepared for the World Energy Conference.

industry and commerce, transport and household) are expected to remain constant. These figures are based on the assumption of continued improvements in energy efficiency as well as a projected slowdown in economic growth in the developed countries. On this basis, the total energy consumption is expected to be between 3928 and 4258 MTOE in the year 2000 and between 4030 and 4750 MTOE in the year 2020.

2. Developing countries

(a) Agriculture

129. The world's population is expected to be over 8 billion by the year 2030, and the bulk of the population will be in developing countries. Agricultural modernization in the developing countries will, thus, be essential to feeding this rapidly growing population. To meet this demand, the Food and Agriculture Organization of the United Nations has called for a modernization effort so as to double agricultural production by the year 2000. This will require energy use in agriculture in developing countries to increase annually by 8 per cent. Use of mineral fertilizers will have to be substantially increased, and irrigation intensified. The sector will, thus, consume about 80 MTOE of commercial fuels annually by the year 2000, which is almost double current consumption.

(b) Industry and commerce

130. In order to meet the demands of growing populations, the developing countries will have to embark on a great industrialization

process. Assuming a continuation of the current trend of energy consumption in the sector, about 700-800 MTOE of commercial energy will be required by the sector in the year 2000.

(c) Transport

131. In most developing countries, the key influence on energy consumption by the sector is the growing number of vehicles. The growth rate in the number of vehicles has been exceeding the growth rate in GDP in all developing countries, and the trend is likely to continue, despite the high cost of oil. The sector would thus require at least 200-300 MTOE of energy by the year 2000.

(d) Household

132. Unless measures are taken to provide alternative fuels, the rural and urban poor will continue to depend on biomass fuels. This dependence has implications for sustainability, as the use of biomass is leading to deforestation, reduction of carbon-dioxide uptake of forests, soil erosion, desertification and irreversible loss of forest or savannah. There could eventually, be a total collapse of the energy-supply system for these segments of the population.

3. Summary

133. By the year 2030, global commercial energy requirements are expected to be in the range of 4500 to 5500 MTOE. With the projected population growth to 8 billion, however, the potential energy consumption could rise to over 11,000 MTOE. In the absence of concerted actions by all countries, it is most unlikely that the bulk of the developing countries' population would be in a position to afford the cost of the energy.

D. Energy resources

134. In the developed countries, oil is expected to remain the largest single contributor to energy production at around 30 per cent in 2020, compared with 38.5 per cent in 1985. The share of coal is expected to increase in the next century, and nuclear power to double between 1985 and 2020, whereas the contribution of gas is projected to decline from over 20 per cent in 1985 to around 15 per cent. The contribution of new sources of energy (solar, wind, alcohol etc.) is expected to rise to 1 per cent in the year 2000 and to around 3 per cent in 2020.

135. In the developing countries, solid fuels are expected to maintain a stable share up to 2000 but to decline a little between 2000 and 2020. Similarly, natural gas is projected to increase its contribution in the short term but to stabilize or, even, decline slightly by the year 2020. The share of hydro power is expected to rise from 10 per cent of total energy production to about 15 per cent, whilst nuclear energy's contribution is expected to reach 3-5 per cent by the year 2020. There is likely to be a significant and continued decline in the contribution of oil, from over 57 per cent in 1985 to 50-54 per cent in 2000 and 41-43 per cent in 2020. Similarly, the contribution from non-commercial fuels is expected to decline to below 20 per cent of total energy.

136. An audit of non-renewable and renewable energy sources shows that there are varying degrees of exploitation of these sources of energy. Of all the non-renewable energy sources (petroleum, natural gas, coal) coal and natural gas are the least exploited, especially in developing countries: until now, petroleum has been in predominant use worldwide. Hence, the availability of commercial energy does not appear to be an issue even for the long term. The crucial issue would be affordability, by developing countries, of commercial-energy supplies. However, owing to a combination of factors, such as eventual depletion of sources, increasing difficulties of exploitation of deposits and environmental degradation, it has become generally accepted that attention needs to shift to environmentally acceptable forms of energy. In this context, renewable energy forms come to the fore as complements to and/or substitutes for non-renewable sources in meeting localized and/or low-intensity demands for energy, e.g., in various domestic and industrial uses. Of the renewable forms of energy, biomass is the source most widely used by the urban poor and by rural populations in developing countries. In Asia, the most commonly used biomass is animal waste, whereas, in Africa and Latin America, it is woodfuel.

1. Energy pressure points

137. The crisis points in future energy use are different for developed and developing countries. In the first group of countries, the main concerns are the cost of energy, ecological impacts of energy production and use, and reduction of dependence on imported fuels. Nevertheless, except for the highly uncertain global warming factor, energy problems are not likely to reach crisis proportions. Developing countries are already facing an energy crisis in two forms. First, their development efforts, aimed at improving the lot of their populations, have, so far, been geared to the use of oil as a source of energy, but, with the rapidly increasing costs, most countries are now facing the prospect of not being able to afford it. Their main hope appears to be in the rapid diffusion of new and renewable technologies. Secondly, in the absence of an alternative affordable fuel, the rural and urban poor have no choice but to continue using biomass fuels, notwithstanding the depletion of the resource which could have catastrophic end-results.

2. Ecological impacts of the use of the resources

138. The use of non-renewable sources of energy (fossil fuels) causes pollution problems associated with emissions of carbon dioxides, nitrogen oxides, methane (when gas is burnt as a fuel) and particulates. Burning of biomass increases the carbon dioxide emissions in developing countries, and other direct consequences of burning woodfuels are increased desertification and land erosion which, in turn, lead to climate change. An indirect, but, nevertheless, possibly harmful effect is that, if trees are felled and not replaced through replantation, there is a reduction of carbon dioxide uptake of forests and, hence, an increase of carbon dioxide in the atmosphere.

3. Economy and substitutability

139. Although energy-demand projections indicate no particular global problems, ecological requirements might bring about the need: (a) to increase the use of non-conventional fossil fuels; (b) to apply improved

Table 2 World reserves and resources of coal, oil and gas and non-conventional energy (MTOE)

Proven reserves	Conventional			Non-conventional
	Coal	Oil	Gas	(Heavy oil, shale oil, natural bitumen)
Proven reserves	458 000	92 000	77 400	160 000
Reserves (est.)	8 795 000	326 000	238 000	1 117 000
Total	9 253 000	418 000	315 400	1 277 000

MTOE =Million tons of oil equivalent.

Source: Hedley, D, *World Energy: The Facts and the Future* (London, Euromonitor Publications Ltd.,1986),table 5.

energy management; (c) to develop new and renewable energy forms which are environment-friendly; and (d) to spread education on the need for environmentally-sensitive energy systems. In addition, energy will have to be conserved through the adoption or use of energy-efficient settlement forms, transport modes and building designs, and by utilization of human settlements by-products in energy-production systems. For high-energy-consuming countries, it implies a need to reduce per capita energy consumption, and, for low-energy-consuming countries, a need not to generate demand at consumption levels of the former and to adopt technologies for improved production and use of biomass energy sources.

140. World reserves of conventional (coal, oil and gas) and non-conventional (heavy oil, shale oil and natural bitumen) fossil resources are shown in table 2. According to the estimates, the reserves should be sufficient even in the long term, especially if the non-conventional fuels are utilized. However, widespread adoption of non-conventional fossil fuels would require the development of ecologically acceptable and technologically cost-effective methods to improve their price-competitiveness relative to oil and gas.

141. Energy-conservation or -substitution policies are best defined and implemented within an overall resource-management policy, related to specified developmental goals and objectives. A crucial issue is whether these developmental goals and objectives are defined in terms that emphasize consumption and, hence, depletion of natural resources, or in terms that emphasize the quality of consumption. If the former, the likelihood is for increasing resource shortages and a need to increase efficiency of resource use.

142. If, however, the emphasis is on quality of consumption, the implication will be for fundamental change in the lifestyles of developed countries and radical rethinking on future expectations by developing countries.

143. By definition, sustainable development implies use of minimal necessary resources. To overcome system constraints, action is necessary on all fronts to reduce global per capita energy consumption, especially of non-renewable fuels. A sustainable energy future might, therefore, be much dependent on increased availability and use of renewable energy sources - as a means of improving environmental quality and supporting sustainable development. At present, there are only four renewable and practical carbon-free

energy resources - nuclear energy based on the fast-breeder reactor, wind, large-scale use of solar energy and nuclear energy based on fusion. So far, only the first option has achieved commercial exploitation, in some developed and developing countries, contributing about 15.4 per cent to the global electricity generation of 8826 billion kWh in 1986. A key factor in achieving a sustainable energy position will be the price at which renewable energy is made available.

4. New and renewable sources of energy

144. New and renewable sources of energy include hydropower, biomass, solar, wind, oil shales and tar sands, with solar, wind and biomass, including solid wastes, the most promising. These new and renewable sources of energy are individually reducible to heat, and mechanical and electrical energy, respectively, and, with various forms of "transportation" processes, it is possible to transmute from one energy mode to another. Unfortunately, the various end-use applications found so far for these forms of energy are location-specific, of low intensity or non-transferable. There are many new and renewable energy technologies undergoing research and development to make them applicable for worldwide use, including hydrogen and vegetable oils, but these are far from operationally available.

145. The most viable option for meeting the energy needs of the rural and urban poor is the rational use of biomass. To this end, conversion of biomass into gas, through the use of digesters, and the use of improved stoves are the most effective ways of using this resource. The technologies of solar photo-voltaic systems offer prospects for meeting the lighting, telecommunications, refrigeration and other power needs of the rural poor in a cost-effective and efficient manner in areas that are remote from national electricity grids. For households in urban areas, the use of low-power, energy-efficient appliances and the judicious substitution of cost-effective new technologies for fossil fuels, such as solar water heaters and other space heating and cooling devices, offer opportunities to reduce the cost of energy services, whilst, at the same time, conserving resources.

E. Energy policy options

146. Analysis of current energy use shows that energy issues are being tackled only haphazardly. Taking into consideration future energy demand, it is evident that a holistic approach, that relates sustainability in food supply, quality of urban and rural life, and possible environmental impacts to the energy-consuming sector (industry, transport and shelter), must be evolved. The still-evolving industrial structures in most developing countries provide the opportunity to create new patterns of energy utilization, as energy paths are invariably bound to industrial structure.

147. There are only five important sources of energy - fossil hydrocarbons, coal, hydropower, nuclear power and biomass. The other sources are location-specific, purpose-specific or very limited in quantity and quality. As various projections have shown, fossil hydrocarbons will continue to be an important fuel source in the long term, until large-scale production of carbon-free energy becomes technically viable. Estimates place the ultimate potential capacity of carbon-free energy resources at no more than 10 per cent: this limits severely their consideration, and, for now, they could, at best, only complement the main energy forms.

148. Energy availability in the long term depends on the development and large-scale applicability of efficient and environmentally-sound energy technologies: renewable energy technologies, such as solar, wind and biomass, will have a role to play in energy availability. For example, in the United States of America, ethanol derived from biomass is expected to become competitive with oil within seven years; the cost of producing electricity from solar panels and from wind power is constantly being brought down and should become competitive with electricity produced from fossil fuels, especially when life-cycle costing is considered, before the turn of the century. Such technologies should, therefore, be available at affordable cost to developing countries, to enable them to replace imported liquid fuels. The rural populations of developing countries face the fewest options for energy switching, as rural areas have virtually no natural gas, little electricity and hardly any distribution network for LPG. To meet their energy needs, in the short and long terms, policies have to address: (a) regeneration on a sustained basis of biomass, especially forests; (b) increased use of biogas; (c) production of efficient appliances; and (d) the provision of alternative fuels.

149. Another aspect of energy use in human settlements concerns the construction and operation of buildings. The energy required to manufacture building materials constitutes over 80 per cent of the embodied energy in the cost of a building. Most of this energy is used in only a small number of the materials used in buildings, principally iron and steel products, cement and concrete products, bricks and wood products. Moreover, the embodied energy in a building amounts to several times the annual energy consumption of that same building in use. Thus, designers have the opportunity to make a contribution to the reduction of total energy use in the built environment by designing buildings with low-energy materials. They also have to be brought to realize the usefulness of passive solar heating and natural cooling of buildings, and encouraged to design buildings which incorporate these techniques.

F. Recommendations

1. Recommendations addressed to developing countries

1. National action programmes should promote integrated production of agricultural-waste and biomass energy outputs, and support reforestation and natural-forest regeneration, with a view to a sustained provision of biomass energy to meet the needs of poor households.

2. Large-scale dissemination and commercialization of mature renewable energy technologies should be promoted through fiscal measures and internal and external technology-transfer mechanisms, to encourage local manufacture and commercialization of products which make use of these technologies.

3. Builders should be encouraged, through building regulations, standards and codes of practice, to use low-energy, locally-produced building materials.

4. Information and training programmes, directed at manufacturers and users, should be promoted, with the aim of introducing energy-saving techniques and energy-efficient appliances, such as improved stoves, which will reduce pollution.

2. Recommendations addressed to developed countries

1. The central issue of sustainability for most developed countries is the excessive use of non-renewable resources and its contribution to "greenhouse gases" and atmospheric pollution as a result of meeting transport and energy demands. Energy-conservation measures are, therefore, urgently required to reduce the consumption of these resources whilst maintaining the existing quality of life. Recommended energy-conservation measures in the household sector include district heating and cooling, improved insulation especially of existing buildings, and increased use of new and renewable sources of energy. In the transport sector, the measures include increasing charges on automobile use e.g., through higher road and petroleum-products taxes, more stringent pollution control of vehicles, lower speed limits, limiting the use of private automobiles in congested areas, and encouraging public-transport modes.

2. Intergovernmental co-operation should be developed in the related fields of energy conservation, energy pricing and taxation (both domestic and international), as well as promotion of technology-oriented joint ventures between consumer and producer interests.

3. Recommendations addressed to the international community

1. International organizations should assist in preparing resource-management programmes for implementing and monitoring efficient and ecologically benign energy policies.

2. Developing countries should be provided access to research and development results, to increase energy-use efficiency levels, especially in human settlements.

3. International organizations should provide assistance to developing countries, to enable them to apply, on a large scale, renewable-energy technologies, particularly for the use of solar, hydro, wind and biomass sources.

4. International organizations should promote the transfer of state-of-the-art technologies for improving energy conservation and fuel efficiency in the building sector.

Issues and potential responses in the energy and environment equation

Issues	Global involvement (governmental and non-governmental)		National and Local level involvement (governmental and non-governmental)	
	Broad policy responses/objective	Typical instruments	Broad policy responses/objective	Typical instruments
Developing countries:				
Inefficient use of energy	1. Promote public awareness of energy problems and impact on environment	1. Public awareness campaigns/pricing instruments.	1. Promote public awareness of energy problems and impact on environment.	1. Public awareness campaigns/ pricing instruments.
Over-reliance on oil	2. Promote adoption of energy efficient technologies, vehicles, etc., -	2. Import/export regulations, pricing and taxation instruments.	2. Promote adoption of energy-efficient technologies, vehicles, etc.,	2. Import regulations, pricing and taxation instruments.
Increasing per capita consumption	3. Diversify towards better mix of energy.		3. Diversify towards better mix of energy.	3. Subsidize capital cost of adoption of new and renewable energy forms. Encourage developments at the human scale especially in human. Adopt realistic pricing within context of desired energy mix objective.
Increasing energy bill (e.g., for goods production) and reducing ability to pay	4. Reduce demand for energy in socio-economic activities.	4. E.g. by reducing need to travel/use motorized modes, "greening" of human settlements and encouraging where possible "safe" industrial technologies.	4. Reduce demand for energy in socio-economic activities.	4. E.g. by reducing need to travel/ use motorized modes, "greening" of human settlements and encouraging where possible "safe" industrial technologies.

Uncertainty about ability to locate sources for future needs.	5.	Encourage energy exploitation activities and search for and adoption of alternative sources	5.	Relax intellectual property law. Subsidize capital cost of adoption of new and renewable energy forms. Provide incentives and stable climate for energy investments.	5.	Reduce rate of population growth.
Inadequate access to new energy technologies, R & D results and information.	6.	Encourage use of new and renewable energy.			6.	Increase cost recovery and encourage use of passive energy sources where appropriate
Ecological impacts of deforestation and spatial growth of settlements.	7.	Intensify afforestation, soil protection, etc. programmes.			7.	Encourage energy exploitation activities and search for and adoption of alternative sources.
					8.	Encourage use of new and renewable energy.
					9.	Intensify afforestation, soil protection, etc. programmes.
					10.	Evolve land-conservation programmes.
Developed countries:						
Environmental impact of choice of energy and consumption pattern.	1.	Decrease reliance on fossil energy.	1.	Reduce aggregate demand through conservation measures including those related to life-style changes	1.	Stabilize/decrease per capita energy consumption.
					1.	Reduce aggregate demand through conservation measures including those related to life-style changes.
Diffusion of new energy research results	2.	Intensify energy resource management activities.	2.	Promote greater use of non-fossil energy in industry and shelter.	2.	Decrease reliance on fossil energy.
					2.	Promote greater use of non-fossil energy in industry and shelter.
	3.	Make energy sourcing methods more environmentally sensitive.	3.	Apply strong disincentives to environment degrading activities--	3.	Intensify energy resource management activities.
					3.	Apply strong disincentives to environment degrading activities.

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| 4. Actively propagate energy R & D results | 4. Promote cross-national cooperative programmes. | 4. Make energy sourcing methods more environmentally sensitive. | 4. Promote cross-national co-operative programmes. |
| 5. Reduce cost of commercial application of R & D results. | 5. Revise intellectual property laws to increase rate of filtering to common use of new technologies. | 5. Actively propagate energy R & D results. | 5. Revise intellectual property laws to increase rate of filtering to common use of new technologies. |
| | 6. Create global energy fund for LDCs to facilitate achievement of sustainable energy future. | 6. Reduce cost of commercial application of R & D results. | |

IX. TRANSPORT POLICIES REFLECTING SUSTAINABLE-DEVELOPMENT PRINCIPLES

A. *Transport, human settlements and sustainable development*

150. Human settlements represent a spatial organization of functions to meet human needs: the value of this spatial organization depends, to a large extent, on the capacity to facilitate interactions, by arranging efficient patterns of physical development and by providing for movement of goods and people. By allowing access to employment opportunities, housing quarters and services, the transport sector meets basic human needs and, by effecting exchanges of raw materials and finished products, it supports diversification and strengthens the economy. However, meeting the demand for transport involves high costs which bear on public spending, business expenditures and family budgets, competing for resources needed for the achievement of other developmental objectives: expenditures on transport affect, in particular, low-income-family budgets, adding to the poverty burden.

151. Transport has substantial impacts on global life-support systems, non-renewable resource consumption, sustainability of production of renewable resources, living conditions and human health, e.g.:

(a) Global life-support systems can be significantly affected by transport-related emissions of carbon dioxide and methane which contribute to the "greenhouse" effect. Vehicle emissions of carbon monoxide, hydrocarbons and nitrogen oxides reduce oxidation, i.e., the cleansing efficiency of the atmosphere.

(b) Transportation consumes about 30 per cent of commercial energy in highly developed countries, mainly responsible for the world's total energy use in transport. In developing countries, with low levels of industrial development, the share of transport in commercial energy consumption is, often even higher, reaching 40 per cent. Only in countries, such as China, those in Eastern European and USSR, where economies are dominated by energy-consuming heavy industries while motorization is relatively low, is the share of transport in commercial energy consumption lower and amounts to about 10 per cent. Transport exerts demand on land for the construction of infrastructure, and the production of vehicles and the construction of transport infrastructure require significant quantities of mineral and other natural resources with limited possibility of reuse.

(c) Transport affects sustainability of renewable-resource production, because emissions of nitrogen and sulphur oxides lead to atmospheric acidity which causes water and soil pollution, degradation of vegetation and a decrease in agricultural and forestry outputs. Furthermore, there is an impact of transport-related emissions through corrosion damage to building materials.

(d) Gaseous and particulate emissions from vehicles, using fossil fuels, create smog and excessive concentrations of carbon monoxide, nitrogen oxides and lead, and they cause pollution of air, water and soil with a set of other toxic chemicals. The movement of vehicles is the main source of noise pollution. These phenomena affect, directly or indirectly, physical and mental health.

(e) Construction of the transport infrastructure often disrupts neighbourhoods, decreases safety, degrades the amenity of public open spaces and creates visual intrusions, damaging social and community values. Yet inadequate or unaffordable transport leads to excessive building and population densities, causing deterioration of the living environment.

In the context of sustainable development, the transport issue is how to make social and economic progress possible with least damage to the natural and built environments, while saving non-renewable resources and ensuring equity in distribution of transport costs and benefits.

B. Transport strategies supportive of sustainable human settlements development

152. Transport in human settlements, to be managed and developed in compliance with the principles of sustainable development, requires the adoption of long-range strategies which should be established on an intersectoral basis, as the issues involved pertain to regional-development, land-use, industrial, energy and fiscal policies, as well as to transport policies themselves. Integrated human settlements planning, carried out at sub-national and local scales and linked to national policies, provides the most appropriate framework for devising such strategies. Only in this framework is it possible to reconcile requirements for transport and the costs involved with developmental objectives and with the need to protect living standards against the adverse effects of transport-infrastructure installation and operation. This is because the demand for transport and the ways in which it can be met depend, to a large extent, on how human settlements are managed.

153. In devising transport strategies compatible with the objective of sustainable development, it is necessary to consider three issues simultaneously:

(a) What is the indispensable level of transport provision to meet socio-economic development objectives, and what kind of transport facilities and services should be provided to bring about this development within the desired limits of resource use and amenity impact?

(b) How should the transport sector be developed and managed to be sustainable itself, thus not undermining the sustainability of other sectors of the economy?

(c) How can organization of the human settlements system, patterns of individual settlement development and action in other sectors add to the sustainability of transport and reduce its costs, its impacts on human health and its demands for non-renewable resources?

Such an integrated approach to devising transport strategies has not been a common practice. National policies on transport in human settlements are usually lacking, and transport planning at local levels tends to adopt, for the sake of simplicity, a strictly sectoral approach. Transport plans attempt to respond to predicted demand for travel, if possible in its entirety, but this future travel demand is derived from models which transpose, into the future, present travel behaviour and accepted tendencies in settlement development. Broad social, economic and environmental objectives are, often, beyond the concern of transport planning which normally takes no account of any external effects likely to be produced.

154. The integrated approach significantly increases the complexity of planning in technical and decision-making aspects. It opens, however, great possibilities for guiding development in a sustainable way. To be effective, integrated planning needs close interagency co-operation and strong urban management in general.

155. Ready-made strategies cannot be proposed, owing to the diversity of conditions and problems in developed and developing countries, but the following lines of action deserve to be considered:

(a) Modifying and managing the demand for transport, including making changes in travel behaviour;

(b) Making modal composition in transport supportive of sustainable development;

(c) Improving vehicles and fuel technologies;

(d) Controlling impacts of investment projects in transport on its environment and quality of life;

(e) Increasing the efficiency of transport operation;

(f) Improving maintenance of existing infrastructure and of vehicles in use.

These lines of action can be fully effective only if they are well co-ordinated and simultaneously undertaken. The optimum combination of options is essential, as they usually have synergistic links: where each individual action on its own might have modest impacts at best, joint actions might achieve considerable benefits. Strategies, to be implemented, must have the support of the general public, which makes public participation in their formulation essential and requires the raising of public awareness of transport's ecological impacts. At the same time, substantial international co-operation is needed in setting environment-protecting standards for production of transport equipment and in transferring environment-friendly transport technologies.

156. Any programme designed to improve transport must identify measures of improvement and establish a means for monitoring progress. This requires the development of means of monitoring impacts on resource use, social conditions and human health more sensitively than is currently achieved by simple economic analyses of transport programmes.

C. Modifying and managing the demand for transport

157. Transport is an imperfect market in which the costs borne by users of transport services and infrastructure neither reflect fully social, economic and, in particular, ecological costs of transport nor distribute these costs among users in an equitable way. This results in individual travel behaviour and locational decisions which increase the demand for transport above real needs and lead to an inefficient use of limited natural resources and to inevitable adverse ecological impacts. Therefore, there is a need to manage the demand for transport, by applying policies which will create such conditions for the users of transport that their behaviour becomes compatible with principles of sustainability.

158. Transport needs can be reduced, and their satisfaction at lowered costs and with lessened impact on the environment can be facilitated, by applying strategies which result in a spatial distribution of activities which shortens travel distances and prevents excessive concentration of the demand for transport. In this context, the importance of sub-national development planning and local land-use planning should be fully recognized. This pertains, in particular, to developing countries, where planning tools can be potentially effective, if they are geared realistically to the current processes of structural transformation which sub-national areas and settlements are undergoing.

159. Sub-national development planning should aim at the distribution of population and economic activities which prevents spatial concentration of the demand for transport to the point where the level of loading of the environment by transport-related pollution will endanger ecological sustainability. It should also aim at reducing sparse population distributions which generate uneconomic transport-service demands. In the use of settlement land, single-purpose zoning patterns should be avoided, and, instead, urban areas should be structured in the form of medium-sized relatively self-contained modules which will meet the needs of different socio-economic groups and allow people's homes and places of work to be within walking distance. However, to achieve this, a substantial improvement in urban management institutions is indispensable.

160. Unlimited mobility and unrestrained choice of mode of travel cannot be ensured in any but the smallest settlements. Therefore, transport networks should be developed, for the benefit of all sections of the community, in such a way that indispensable access to employment opportunities, housing opportunities and services is ensured for all, while freedom of choice in route and mode of travel can be restrained, where it is necessary, for the sake of sustainability. Freedom of car traffic should be restrained, in particular, in the centres of large cities, in recreation zones and in other environmentally sensitive areas.

161. The complexities of transport development and operation and the imperfection of the transport market lead to costs and benefits of transport being unequally distributed; in particular, people with access to cars to benefit at the expense of others. Therefore, fiscal policies and other economic measures should enhance efficiency in transport, discourage excessive use of cars and make car-users pay the economic and environmental costs of their travel. At the same time, environment-friendly travel behaviour should be encouraged, e.g., by raising awareness of transport-related environmental impacts and providing education on energy-efficient driving habits.

D. Modal composition supportive of sustainable development

162. The detrimental effects of the activities of the transport sector on the biosphere, including consumption of energy resources, are mainly related to road transport. It is estimated that, in the member countries of the Organisation for Economic Co-operation and Development (OECD), the non-internalized social costs of road transport amount to about 5 per cent of gross national product.¹ The economic efficiency and environmental quality of large cities are particularly affected by transport based on the massive use of cars and, recently, in some developing countries, also, of motorcycles. Although individual transport has numerous advantages in flexibility, speed, privacy and comfort of travel, these advantages should be weighed against their impact on energy consumption, land use and amenity, including the role of individual transport in encouraging land-absorbing and energy-inefficient physical development patterns. In the conditions of large cities, the need for accessibility and mobility should be largely met by public-transport modes which consume less energy and emit fewer pollutants per passenger-kilometre than private modes, which are economical in use of travel-way space and which support high urban-development densities.

163. Development of public transport should lead to the establishment of transport networks made up of complementary modes that are compatible with travel demand and affordable by the population. Public transport should make use of existing modes and be open to the application of new modes which, with economic and social changes and technological progress, might turn out to be most effective. Progress will require flexible transport-development strategies, particularly in the conditions of uncertainty concerning development prospects prevailing in cities in developing countries. Travel-way space for exclusive use of public transport should be created or reallocated from automobiles to public transport, whenever the latter solution is feasible. The use of this space, i.e., the choice of a public-transport mode or mix of modes, should be appropriate to local conditions, reflecting, *inter alia*, financial affordability of mode installation and operation, its economic viability, its expected impact on the transport network, the sustainability of urban structure and any socially distributive effects.

164. Buses are likely to retain, for a long time, an essential share in public transport; thus, there is the need to improve the operation, maintenance and management practices of bus transport and reduce its contaminant effects and, where feasible, use of electric trolleybuses

and trams. Also, paratransit should retain a substantial role in public transport, in particular in developing countries. Regulation of paratransit by governments should focus on safety and on environmental requirements, while not impeding paratransit operation or limiting entry to the market, with the exception of transport corridors heavily loaded and well served by buses.

165. Rail-bound high-capacity public-transport modes might become

indispensable in very large cities with strong and intensively developed centres. These modes are also preferable for environmental reasons. Capital and operating costs are, however, usually restrictive, and such modes should be developed if high economic and environmental benefits can be achieved.

166. In the pursuit of transport policies reflecting sustainable development, promotion of cycling can be important. The bicycle is by far the most energy-effective means of transport and most affordable for the urban and rural poor. Adequate attention should be given to the provision of safe cycle routes and parking spaces. Likewise, policies must support walking as a prime mode of transport, through the provision and maintenance of walkways.

167. Sustainable rural development in many developing countries requires substantial improvement in rural transport. Making transport by car and truck on modern roads widely available for rural populations is usually an unaffordable option. However, there is a need to fill the gap which, often, exists between this type of

¹ Organisation for Economic Co-operation and Development, *Transport and the Environment* (Paris, 1988), p. 11.

transport and walking and human and animal portage. Policies on rural transport should promote the production of low-cost general-purpose motorized vehicles, enhance local manufacture of improved animal-drawn vehicles and support the construction of all-weather roads and access ways, to link farms and villages with markets and service centres.

E. Improving vehicles and fuel technologies

168. This line of action has, so far, been the one most responsible for conserving energy and combating the detrimental impacts of the transport sector. In the United States of America, the fleet-average fuel economy of passenger cars has been doubled in the past 15 years. Replacement of the fleet in use by new models of cars should bring further increases in fleet-average energy efficiency of up to about 25 per cent by the end of the century.²

169. The introduction of emission standards in the United States reduced carbon monoxide and hydrocarbon emission to 4 per cent of previous levels in the 1990 models of cars, while the emission of nitrous oxides has been reduced by 76 per cent.³ Significant achievements were made in curtailing the use of lead additives to gasoline in industrialized countries; lead emission is down in several such countries by about 50 per cent. Use of unleaded gasoline, besides limiting particularly dangerous lead emission, is essential for the operation of cars with catalytic converters which reduce substantially the emission of other pollutants. In general, road-transport-related air pollution has been stabilized and, often, reduced in industrialized countries in spite of fleet increases: however, the achievement of further technological improvements is now difficult, as theoretical and practical limits are approached. Adoption of national emission standards for new cars by other countries and consolidation of standards on a worldwide basis would be desirable: equally important is the need to establish the regular control of emission of the vehicles in use. Although many new types of road vehicles, with innovative powerplants, are being studied, their wide application cannot be expected soon, even for electric vehicles which need a breakthrough in battery technology.

170. The high dependency of transport on petroleum fuels makes the search for new fuels a very important issue. However, there is, at present, no economically viable alternative. The most promising are alcohol fuels; other options are liquefied petroleum gas and compressed natural gas, while hydrogen fuels might become attractive, if strong control of carbon dioxide emission is introduced.

F. Controlling environmental impacts of transport-infrastructure projects

171. Investments in transport infrastructure have, often, been made worldwide without considering their impact on the environment. Not only was the impact of expected air pollution on regional and global environment not considered but also local impacts, such as smog and noise generation, land consumption, soil contamination, disturbances in water systems, deterioration of the built environment and visual intrusions, were not given appropriate attention. This practice needs to be changed, by requiring each project to contain an integral environment-impact assessment. Such a requirement has been already introduced in several countries which have recognized the insufficiency of financial and economic cost/benefit analysis for justification of projects. However, the methodology of environment-impact assessment is not yet sufficiently developed, and there is usually a lack of appropriate data to carry out such an assessment. In particular, there is a lack of satisfactory indicators of the performance of transport systems, with regard to their impact on health and other quality-of-life factors.

G. Increasing the efficiency of transport operation

² Arango, C.A., "Technical options for energy conservation and controlling environmental impact of highway vehicles", in *Energy and Environment in the 21st Century* (Cambridge, MS, MIT, 1990), p. A-53.

172. The objective of sustainability calls for making the best use of existing transport networks. Traffic-management measures have brought significant although, often, short-lasting effects. Attention should be directed, therefore, to improvements in public-transport operation. Providing for priority in traffic of public-transport vehicles, at the expense of free movement of individual transport, is fully justified by principles of equity and sustainability. Special attention should be given to the segregation of public transport from general traffic, and the provision of busways is one promising option.

173. The objective of a public-transport development strategy is to optimize the effectiveness and efficiency of a multimodal public-transport network. This can be achieved by enhancing modal integration and by ensuring the co-operation of all transport operators. However, this should be done without introducing impediments to competitiveness and the initiative of operators.

H. Improving the maintenance of the transport infrastructure and vehicles

174. Adequate maintenance of the transport infrastructure conditions the efficiency of the transport network and of the overall urban economy. It is also important for environmental reasons, since properly maintained roads and tracks limit emission of pollutants and noise. Particularly important is the maintenance of vehicles: lack of it usually results in very high increases in emissions and decreases in energy efficiency. This issue should be given great attention in all countries.

I. Recommendations

175. Policies aimed at bringing transport in human settlements in harmony with principles of sustainable development should respond to national and local development objectives and reflect specific local conditions. At the same time, they should contribute to sustainability of development in global dimensions. The following set of recommendations may be of help in devising such policies in both developed and developing countries.

1. Sub-national development planning and local land-use planning should be deeply concerned with the implications of transport and of transport-related environmental effects; they should be effectively used for decreasing the demand for transport, preventing its excessive concentration and mitigating its ecological impacts.

2. Fiscal policies and other economic instruments should increase the share within the transport sector of transport modes with high energy-efficiency and low emissions.

3. The role of public transport in making urban transport compatible with the requirements of sustainable development should be fully recognized and be adequately reflected in urban transport plans and development programmes. High-occupancy public-transport vehicles should be given preferential treatment in traffic-management policies.

4. Cycling and walking should be recognized as important components of urban traffic: safe cycleways and footways should be provided, while the attractiveness of these modes of travel should be enhanced by ensuring proximity of work-places and services to residential quarters.

5. Appropriate national emission standards for new vehicles and ceilings for emissions from vehicles in use should be established, and systematic control of emission levels by vehicles in use should be introduced.

6. Monitoring of the environmental impact of transport should be improved, and studies on the quantitative evaluation of this impact, with regard to various transport modes, should be promoted.

7. Research and development on new vehicles and new energy sources, able to replace petroleum fuels, reduce the level of pollutant emissions and increase energy efficiency in transport, should be expanded.

8. Measures to promote public awareness of transport-related environmental impact should be undertaken, so as to enhance the development of environment-friendly travel behaviour; education of drivers in vehicle maintenance and operation should be given attention, since it has proved to result in significant energy savings and lessened pollution.

176. The transport sector in developed countries bears particular responsibility for depletion of non-renewable energy resources and damage to the biosphere. Travel behaviour and urban development patterns prevailing in these countries are evidently incompatible with the objectives of sustainable development. However, it would be unrealistic to aim at their radical change: to reconcile urban transport with objectives of sustainability, it is recommended that:

1. The efficiency of public transport should be increased, and new public-transport systems, able to attract car users, should be developed.
2. Users of motorized individual transport modes should pay the full economic and environmental costs of their travel, and appropriate pollution and congestion pricing should be developed for this purpose.
3. The use of energy-efficient and low-polluting vehicles and fuels should be encouraged by taxation policies and regulatory and other instruments.
4. Introduction of emission standards for carbon dioxide and for other not-yet-controlled toxic emissions should be considered: transport-related emission of noise should be mitigated, and appropriate noise-reducing standards for construction of vehicles and infrastructure should be introduced.
5. In line with improvement in public transport, restrictions on car traffic should be imposed in congested and environmentally-sensitive areas.

177. In developing countries, policies on urban transport should respond to the basic needs of the present generation while preserving sustainable options for the future. Recommendations addressed to developing countries are:

1. Human settlements management should be strengthened, so as to be able to steer physical development in a way which reduces the demand for transport and prevents damage to the environment. Properly located and well-timed investment in transport infrastructure might be a guiding force to induce development in defined directions.
2. Transport modes based on animate energy should be gradually replaced by public-transport modes for long-distance travel.
3. Development of affordable, reliable and efficient public transport should be given top priority in urban transport plans and development programmes. Co-ordinated transport and land-use planning should make provision for gradual improvements to public-transport systems, so as to enable them to respond to a fast-growing demand for transport.
4. Travelway space should be allocated to public transport and segregation of public transport from general traffic should be promoted in heavily loaded traffic corridors.
5. Development of efficient, environment-compatible, high-capacity public-transport modes deserves governmental support which should be granted if it does not undermine the achievement of other important social and economic objectives.
6. Wide public/private partnership in provision of public-transport services should be encouraged.
7. Particular attention should be attached to effective traffic management, to efficient operation of public transport and to proper maintenance of the transport infrastructure.

8. The growth of car and motorcycle ownership should not be directly or indirectly subsidized. Import tariffs, taxation policies and fuel-pricing policies should be used to prevent, in particular, growth in the number of energy- inefficient, highly polluting types of vehicles.

178. International co-operation can be influential in making transport in human settlements compatible with the sustainability goal. It should encompass the following:

- 1. Control of transboundary air pollution resulting from transport.**
- 2. Consolidation of environment-protecting standards for production of transport equipment and fuels.**
- 3. Facilitation of environment-friendly transport technologies.**
- 4. Establishment of financial mechanisms enabling developing countries to build environment-compatible public- transport systems on fair financial terms.**

Table 1. Actions conducive to transport supportive of sustainable development of human settlements

Line of action	Action on individual and household level	Action at neighbourhood or community level	Action on city and metropolitan area levels	Action at national level
1. Modifying and managing transport demand.	Develop environment-friendly travel behaviour.	Develop local services and employment opportunities.	Improve and integrate transport and land-use planning and management encouraging development patterns which reduce the demand for transport and facilitate the provision of public transport.	Promote decentralization and the development of polycentric national and subnational settlement systems
	Encourage participation in community development planning.	Establish neighbourhood or community representation on urban land-use/transport planning.	Introduce car and truck traffic restriction schemes in environmentally sensitive areas, including the control of parking provision.	Develop ways of pollution and congestion pricing. Enhance the development of telecommunication as a potential substitute of transport.
		Introduce or insist on introduction of local environment-protecting traffic management schemes.	Enhance pedestrianization of the city centres. Consider feasibility of road pricing.	
2. Increasing the share of efficient, energy-conserving, land-sharing and non-polluting transport modes.	Encourage the use of public transport.	Form neighbourhood committees to voice needs of public-transport improvement	Adopt long-range strategies for the development of urban transport.	Adopt national strategies and policies for the development of urban transport promoting the development of public transport.
	Make known public-transport service requirements.	Integrate community inputs with government and city inputs to the provision of public-transport service.	Provide affordable, reliable, safe and convenient public transport for all segments of the population.	enhancing the use of energy-efficient transport modes.
	Enhance use of bicycles.	Organize community based informal public transport and encourage ride-sharing.	Allocate more travel ways to public transport including the provision of exclusive right of way, fiscal and import where it is necessary.	Create favourable conditions for the development of public transport by appropriate policies.
	Increase the availability and enhance the use of intermediate technology motorized vehicles and improved animal-drawn carts in rural areas of developing countries.	Organize construction of local roads, cycleways and footways by community effort.	Enhance physical integration of the public-transport network. Provide fair conditions for paratransit operation. Provide cycleways and footways; ensure safety of cycling and walking.	Provide necessary financial support to the development of highly efficient transport systems. Promote tariff and fare policies which reflect real economic, social and environmental costs of transport by various modes.
3. Improving vehicles and fuel technologies.				Establish national emission standards for new vehicles.
				Introduce fiscal and taxation policies

4. Controlling environmental impacts of investment projects in transport infrastructure.

Monitor the impact of transport on the environment and safety.

Monitor the impact of transport on the environment, health and safety.

favouring less polluting and more energy efficient vehicles.

Promote the use of unleaded gasoline.

Enhance research and development on new types of vehicles and fuels.

Establish environmental standards concerning the permitted level of loading of the environment.

Voice fears and proposals for abatement of adverse transport impacts.

Require investment proposals to include environment impact assessment.

Establish procedures for the assessment of environmental impact of transport systems on environment and health.

5. Increasing efficiency of transport operation.

Organize participation in transport planning, in particular, with regard to public-transport routing, to public-transport station location and scheduling.

Introduce traffic management schemes giving the priority operation.

Improve the management of public-transport.

Enhance co-operation between public-transport operators and complementarity of services they provide.

Encourage efficiency through competitiveness and selective regulation.

6. Improving maintenance of existing transport infrastructure and vehicles.

Encourage proper maintenance of private vehicles.

Support maintenance by the community itself of local roads, cycleways and footways.

Exert regular control of technical fitness of vehicles in use, in particular, of their emission.

Establish national regulations concerning the control of technical fitness of the vehicles in use.

Adopt and implement appropriate routines for the maintenance of the transport infrastructure.

PART THREE

THE HUMAN SETTLEMENTS FRAMEWORK FOR SUSTAINABLE DEVELOPMENT

179. Sustainable human settlements management means the co-ordinated planning, financing, development, operation and maintenance of settlements to achieve social, economic and physical goals. In order to experience a decent life, people must have access to housing, water supply, sanitation facilities, transport infrastructure, health and educational services, and recreational opportunities. These needs should all be met through human settlements development. Decision-making concerning settlements must be participatory, and decisions must be implemented through enabling processes.

180. The Global Strategy for Shelter to the Year 2000 is a prime example of the long-terms sustainable approach to settlements management. It is based on an enabling concept which envisages the mobilization of all shelter-production actors - public sector, private sector and community sector - in a participatory approach which assigns each of them the most appropriate role in the shelter-delivery process. It is linked, on the input side, to the economical management of land, the optimum use of natural resources, the economical application of energy and the promotion of indigenous skills; it is linked, on the output side, to the significant improvement of human well-being, the alleviation of poverty, the upgrading of the human environment and the protection of the global commons. It is a model for dealing with all components of the human settlements sector so as to achieve the ultimate goal of sustainable social and economic development.

X. SUSTAINABLE HUMAN SETTLEMENTS MANAGEMENT

181. All of the sectoral elements of human settlements have to be brought together and co-ordinated through the process of management, if sustainability is to be achieved in all aspects of development. Settlements management is the means for reconciling the goals, the priorities, the resource allocations and the implementation methods of all the sectoral components of a comprehensive sustainable-development programme. This is possible because the management of human settlements is an essentially integrating function, taking account of social, economic and ecological goals in a long-term perspective.

A. Distribution of management responsibility and legal framework

182. Settlements management is undertaken at different administrative levels - national, subnational, municipal and, sometimes, submunicipal. Depending on the existing administrative structures and on the development options that a country has adopted, responsibilities will be distributed differently among these administrative levels. In most countries, there will be some strategic development sectors requiring central planning and management, and other sectors requiring only central planning guidance or technical support. Most of the sectors related to the improvement of living conditions and to the management of the environment, even though they might follow national guidelines, are best managed at the local level. In general terms, development management should be decentralized to the level of most efficient service delivery, project implementation and community involvement, both in terms of participation in the decision-making process and in terms of control of the development process. This means devolution of responsibility to local-government level. However, this requires that enabling legislation, principally at the national level, provide local authorities with full management powers, so that they can co-ordinate sectoral agencies and deal appropriately with private-sector organizations.

B. Management tasks

183. The prime concern of settlements management, in establishing a sustainable development programme, must be to evaluate, reconcile and monitor the sectoral components of the programme (described in previous chapters) to ensure overall coherence and to optimize the synergistic effect of the subprogrammes. In order to do this, management authorities must have capabilities in comprehensive planning, revenue generation and monitoring/evaluation. This will enable them to give long-range direction to the subprogrammes, to budget capital and operating costs, and to measure results and make necessary adjustments to the programme.

1. Planning

184. One of the weakest elements of settlements management is forward planning. What passes for planning in most local governments is a rudimentary form of land-use zoning, usually unrelated to any socio-economic framework, divorced from infrastructure-engineering considerations, without which the land-use proposals are meaningless, and lacking any implementation mechanisms for meeting its goals. As a result, planning has been largely dismissed as a futile exercise, irrelevant to the practical needs of settlements management.

185. However, the reality is that no form of capital investment or social programming can be carried out without an identification of goals to be met, constraints to be overcome, methods of execution and design of the system. Where agencies are responsible for multisectoral interactive programmes, which is the essence of sustainable settlements management, some form of integrated planning is essential. It is, in fact, the lack of such planning which is the root cause of most programme failures in the infrastructure and social-facilities fields.

186. Because of the degree of technical expertise involved, it is highly unlikely that all but the biggest cities in developed or developing countries will be able to afford in-house planning expertise broad enough to cover all aspects of settlement development. Most will have to rely on outside advice, monitored by staff with a

generalist knowledge sufficient to judge the quality of the inputs being received. The smallest might even have to rely on advisory support from central government or on pooled staff serving a group of municipalities on a part-time basis. This is an area where international support to developing-country settlements can be of greatest benefit.

2. Revenue generation

187. Budgeting, revenue collection and cost accounting are, characteristically, three extremely weak areas of settlements administration. In developing countries, the weakness is due, to a great extent, to the fact that municipal authorities are given very little responsibility in the area and, accordingly, lack worthwhile experience. It should, however, be a fundamental principle that the responsibility for meeting settlement needs and the power to raise the correspondingly needed resources go together.

188. The generation of revenue requires a knowledge of tax structures and of collection methods which is usually lacking at local-government level. Similarly, cost accounting (as opposed to the standard and almost valueless line accounting used by most authorities) is a requirement for monitoring municipal programmes and providing basic information for budgeting, yet it is rarely installed. Both trained personnel and appropriate equipment are required, and, here, initial support from central government will probably be necessary to make financial administration a functioning part of settlements management.

3. Monitoring/evaluation

189. The evaluation of management effectiveness and the updating of programmes can only be undertaken if there is a monitoring procedure built into all management tasks. Even in developed countries, monitoring tends to be haphazard and, in developing countries, it is virtually non-existent. This is one of the important reasons that ineffective programmes continue in force for so long and that programme emphases fail to reflect real priorities.

190. The first step in establishing a monitoring process is to define indicators. Indicators can be qualitative or quantitative, but they must represent qualities of the human settlements environment in which changes can be measured: indicators can also relate to normative targets or they can be open-ended (e.g., the elimination of illiteracy might be a normative target to be achieved over a fixed time, but extension of life expectancy would be an open-ended target, since there is no upper limit to the age to be reached). The ultimate measures of success in implementing a sustainable-development programme would be increased expectation of life, high levels of education, minimal adverse health impacts, freedom of political and social choice etc. However, these effects cannot be directly measured by human settlements statistics which are focused on intermediate goals. The most appropriate human settlements indicators, which would give indirect measures of sustainable development progress, would be quality and quantity of water supply, availability of sanitation and waste-disposal services, air quality, access to housing, access to educational and health services and similar measures. The means of assessing these indicators would have to be designed for each particular country, depending on existing levels of satisfaction in the indicators and monitoring capabilities.

191. There are basically three means of improving performance in the indicators. First, for such items as housing quality, the government must enable and facilitate the people themselves to improve standards without fixing normative targets and allowing the users of housing to determine their own levels of satisfaction; secondly, for such items as water supply and sanitation, the government must fix normative standards and must directly execute programmes designed to achieve the established targets; thirdly, for such items as air and land pollution, noise nuisance and environmental hazards, the government must fix normative standards and must regulate all those whose activities have an impact on the indicators. This last responsibility will require extremely careful consideration of the types of regulations to be introduced (in developing countries, most regulations are inappropriate and unenforceable) and of the means of enforcing them (enforcement is one of the least effective aspects of governmental administration in most developing countries). Community groups could be involved in keeping records and reporting on some of these indicators, since they would have a direct interest in successful results.

192. In order to carry out these tasks, the staff of settlements management authorities will have to be greatly strengthened, with new skills and with new orientations to their responsibilities. Furthermore, management

authorities must forge close links with their constituencies, involving them both in decision-making processes and in operational activities. Management must be based on an enabling concept, whereby all the actors in the sustainable-development process are facilitated in undertaking their most productive roles.

C. Human resources for settlements management

193. In developing countries, the devolution of responsibility for settlements management to local government cannot be effective unless corresponding powers are devolved and unless action is taken to enhance local government's management capabilities. In particular, local government must have authority to raise financial resources for management programmes and to budget expenditure in accordance with locally determined priorities. Also, for some period, central government will have to support training of local-government staff. There is a strong need for improving capabilities and adapting skills of local-government staff to the needs of sustainable settlements development. However, in developing countries, the best trained and most efficient personnel are normally concentrated in central-government positions, and often only minimally qualified officers work in local governments.

194. Governmental recognition of training, as a strategy to increase the supply of efficient personnel, is crucial. As well as a wide spectrum of training programmes, ranging from the development of managerial and technical skills to the strengthening of community organization and participation, there is need for on-the-job training which could be achieved by seconding skilled central-government officers to local authorities to work with and pass on experience to local personnel. What needs to be borne in mind is that the final objective of training should not be just the creation of large numbers of trained individuals but the creation of institutions capable of formulating and executing settlements policies and programmes.

195. In developed countries, the problem is generally much less acute than in developing countries, but, in many cases, there are still opportunities for strengthening local governments with training-support programmes, particularly in emerging areas of technical expertise. Given the range of training opportunities available in developed countries, it is unlikely that central government will need to involve itself directly in training activity, but a central training fund would be a worthwhile facility, in many cases. Technical advice in highly specialized areas could, also, be extremely useful.

D. Community participation in settlements management

196. All developed countries have some form of elected local government which represents the interests of settlement residents. In theory, therefore, at least, there is delegated participation in all decision-making affecting the municipality. Nevertheless, even mandated elected bodies engage in processes of consultation where specific issues are deemed important enough to be put directly to constituents. The process is not without faults, but, by and large, it is seen as being reasonably responsive to community wishes.

197. Developing countries differ in the degree and quality of community participation in their settlements management process. The best way for any administration to prove that it represents the interests of those that it administers is to establish mechanisms to allow and encourage participation, and to adopt a well-designed system of communication and information, so as to make the development process easily understandable. Community participation should be instituted as a permanent feature of the management process, supported by the necessary legal framework and integrated in the management structure.

198. Only participatory management can guarantee the success of plans, in terms of ensuring that the goals and strategies adopted respond to the needs and aims of the population and receive adequate community support. Only through such identification can the mobilization of all the necessary human resources and creative energy to undertake development tasks be ensured. Participatory management not only mobilizes the general public but also contributes to mobilizing the political and administrative actors directly involved.

199. There are several stages in which community participation constitutes a positive contribution to the settlements management process. Different stages of the development process will incorporate different degrees of participation, but the most common stages are the following:

- (a) Participation in planning - in the definition of objectives, strategies and priorities;
- (b) Participation in programming and budgeting - guaranteeing the effective employment of resources to fulfil objectives;
- (c) Participation in implementation - creating responsibility for maintenance and management;
- (d) Participation in operational activities - securing cost-effective and efficient maintenance and management.

Community participation is probably one of the most promising lines of approach for hard-pressed administrations faced with growing management demands, but there is a need for educational and training programmes to give people a good understanding of their roles and responsibilities as participants in the management process.

E. Recommendations

200. Efficient settlements do not only mean improved living conditions within the settlements themselves; they are also crucial to achieving sustainable national development goals. Efficiency can only be reached through the integration of planning, resource mobilization, implementation and monitoring/evaluation in a continuous process. This requires action by national and local governments, with support from the international community.

1. Action required from national governments

- 1. Rationalize relationships between local government and other levels of public administration, ensuring that appropriate responsibilities and powers are devolved to local government.
- 2. Ensure co-ordination between all the governmental actors, through appropriate legal and institutional arrangements.
- 3. Improve the level and performance of managers and create incentives to keep them in public service, through central- government support to training programmes and through creation of a career path which will encourage long- term local-government service.

2. Actions required from local governments

- 1. Relate planning procedures and implementation mechanisms to the factors that contribute to settlements change.
- 2. Strike an appropriate balance between public-sector, private-sector and community-sector roles.
- 3. Find financial resources and improve financial control, by improving tax-collection powers and strengthening capabilities in budgeting and cost-accounting.
- 4. Democratize the management system, by involving communities in decision-making on actions which directly affect them and by providing the opportunity for community involvement in project execution, and operations and maintenance.
- 5. Devise monitoring systems for measuring improvements in human settlements conditions and put in place mechanisms for regulating private-sector actions with impacts on environmental quality.

3. Action required from the international community

- 1. Support the training of settlements management staff and assist in the strengthening of local-government institutions.

2. Provide equipment for monitoring standards of air, water and land quality, and train local-government staff in its use.

3. Encourage the development of community participation, through public-information campaigns and support to co-operatives and other non-governmental organizations.