

POVERTY ENVIRONMENT AND DEVELOPMENT

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A. Sustainable Development Task of the Future

Sustainable development is a concept that so far has eluded a simple and precise definition. The concept arose as a reaction to negative experiences. Both in the developed and the developing countries past patterns of economic growth have been accompanied by various antinomies. Most importantly, the natural capital stock on which all development ultimately depends has suffered considerable degradation and depletion. And it is feared that perpetuating past patterns of economic growth would result in ecological collapse. Hence, the concern for sustainable development.

In an ecological sense, sustainable development calls for development patterns that maintain the natural resource capital stock and overall ecological integrity. Strictly speaking this would imply that development be based only on renewable resources, used at a rate at which they regenerate.

A more pragmatic view places the emphasis on development to the extent that it is important for sustained development. In this view, key ingredients for sustainable development are seen to be (a) eradication of poverty so as to prevent the poor from causing resource degradation, which calls for changes in the socio-political structures; (b) clean or cleaner technologies to mitigate environmental degradation, which would call for R&D investment and for environmental impact assessment of all new projects; (c) slowing-down of population growth, so as to relieve the pressure of population on natural resources; (d) internalization of environmental costs, so as to reduce discharge of harmful emissions and disposal of hazardous wastes, etc.

Such principles and respective measures, it is believed, would mitigate the negative effects of current patterns of economic growth, prevent further degradation of the natural resource base, and at the same time contribute to the alleviation of poverty.¹ How valuable are such considerations vis-a-vis rural and urban poverty in the developing countries?

B. Environmental Degradation and the Rural Poor

1. Extent and Causes of Land Degradation

In the rural areas of the developing world, poverty defined as severe deprivation of basic needs, and most importantly by inadequacy of nutrition, is first of all, linked to landlessness. According to recent estimates, 73 percent of all rural households in the developing countries are either landless or near-landless. Assuming an average household size of 5 to 6 people that translates to an estimated 935 million rural people who have too little land to meet the minimum subsistence requirements of food and fuel. (This estimate excludes China which could add 200 million absolute poor.) To this must be added another 1,000 million people who are living on the borderline of absolute poverty. Land scarcity on account of population pressure and skewed distribution of land are the prime causes of landlessness.

A second characteristic of the rural poor is that the majority of them have become increasingly clustered on low-potential land. Pushed into marginal areas, the poor have no chance but to overexploit resources available to them in order to survive. Survival thus takes precedence over concern for the future viability of the land. Some 60 percent of the developing world's poorest people live in highly vulnerable areas arid and semi-arid lands, steep slopes and poorly serviced urban lands. The `retreat' of the poor to fragile lands with low agricultural potential is the result of a combination of factors: industrial development and urban sprawl, privatization and commercialization of previously common land, modernization of agriculture with reduced labor inputs, population pressure in previously sparsely populated areas, and inappropriate macro-economic policies which have distorted relative prices against labor-intensive technologies and products.

2. Desertification

Land degradation is reflected in a decline of land productivity due to depletion of the vegetable cover, exposure of the soil to wind and water erosion, reduction of the soil's organic and nutrient content, and deterioration of the soil structure and its capacity to retain water. This process is referred to as desertification. It may be the result of natural phenomena, most importantly, frequent and prolonged droughts. In recent times, however, desertification has been aggravated by the action of man. Large-scale deforestation, slash and burn agriculture, overgrazing and overcultivation of marginal lands are among the main causes.

By the early 1980s, some 1,987 million hectares of productive dryland had been desertified. Of this, 1,536 million hectares were to be found in the developing world. At the regional level, Africa is the most affected, accounting for 37 percent of the area desertified worldwide, followed by Asia, accounting for 29 percent².

What should be of great concern is that the rate of desertification continues to accelerate in parts of the Sahelo-Sudanian Africa, the Near-East, Iran, Pakistan, and North East India. The semi-arid area of North East Brazil and parts of Argentina are subject to similar conditions. Morocco, Tunisia and Libya are losing some 100,000 hectares of rangeland and cropland each year through desertification. Worldwide it is estimated that desertification is claiming 6 million hectares of land each year.

3. Deforestation

Desertification is likely to be exacerbated if the process proceeds unchecked³, particularly if cleared land is put to unsustainable use. Deforested land is subject to soil erosion which is slowly undermining about one-third of the world's cropland. According to FAO, soil erosion could reduce agricultural production in Africa by one-fourth by the year 2000.

Deforestation affects agriculture in other ways. It alters the local hydrological cycles by increasing run-off and affecting rainfall inland. The former effect is starkly evident in the Indian subcontinent where deforestation of the Himalayan watersheds has raised rainfall run-off, causing increasingly severe flooding. The area that is subject to annual flooding in India has more than tripled since 1980, from some 19 million hectares to 59 million hectares.

Another effect of deforestation is increasing scarcity of energy supply for the poor. Fuelwood and charcoal supply over 75 percent of the total energy use in several developing countries, such as Bangladesh and Ethiopia, and even oil producing Nigeria. In Central America it supplies over 50 percent of total household energy consumption, and exceeds 72 percent in the rural areas. In terms of people involved, over 2,000 million use wood for domestic heating and cooking. Projections for the year 2000 suggest that without remedial action, 2,400 million people will be unable to obtain their basic energy requirements. While there may be room for increasing efficiency of use, the problem is obviously daunting. Sources of cheap fuel for the poor, such as dung and biomass, are not in plentiful supply either, and their use may have the effect of depriving agricultural land of vital nutrients. Other alternative sources, such as solar and wind energy, so far are too expensive and will not come within the reach of the rural poor if vigorous initiatives are not taken, both nationally and internationally, to promote and disseminate them.

The causes of deforestation vary from region to region, with the expansion of agricultural production being the most important single factor, followed by ranching (mainly in tropical America), colonization programs (mostly in tropical Asia), and overexploitation of fuelwood (particularly in the dry zones of Africa).

The absolute number of people living in tropical forest areas has been on the rise. Estimates put the current number at 200 million. A high proportion of these people are recent poor immigrants who have been forced into forest areas due to increasing land scarcity in the existing agricultural areas. Tropical forest areas thus have become 'safety valves' for countries facing a rising tide of landlessness because of population pressure on high potential land, for instance in Indonesia; limited urban absorption of people displaced by agricultural modernization, for instance in Brazil; or grossly inequitable distribution of existing agricultural land, for instance in Central America. Some 80 percent of the annual deforestation of tropical forests is attributed to slash and burn agriculture practised by the poor settlers.

In the face of population growth, massive poverty and landlessness in many developing countries, it is not easy to imagine how deforestation can be stopped and reversed. The problem has, however, received great international attention in recent years, mainly in connection with the loss of biodiversity and reductions of the size of carbon sinks. This attention could be channelled towards new solutions of international support, like compensation schemes for instance.

4. Waterlogging and Salinization

Land degradation is occurring not only in areas of low agricultural potential but also on prime land irrigated fertile areas, and rain-fed areas.

Efforts at raising agricultural yield through large irrigation schemes without adequate provision for drainage have resulted in widespread waterlogging and salinization, which again have reduced productive lands to virtual deserts in many developing countries.

Estimates indicate that some 267 million hectares of land have been salinized to various degrees in the developing world 20 million in S.E. Asia, 40 million in South Asia, 43 million in West Asia, 40 million in North and Central Asia, 71 million in Latin America and 53 million in Africa. According to a recent study by the World Bank, waterlogging and salinity have reduced yields of major crops by 30 percent in the 15 million hectares of irrigated croplands in Pakistan, and 3.5 million hectares in Egypt. FAO estimates that because of salinity and poor drainage, as much as 45 million hectares of irrigated land in developing countries need immediate reclamation or will have to be removed from agriculture.

Salinity problems are to be found not only in irrigated areas but also in rain-fed areas. Again according to FAO, without conservation measures some 544 million hectares of rain-fed cropland in developing countries which are affected by soil erosion and soil fertility problems would cease to be viable for production in the medium term.

Part of the 250 million of the poorest people who still live in agricultural lands of high potential are located in rain-fed areas, and thus could be the prime victims of land degradation in those areas.

5. Water Scarcity

Basically, water scarcity is the result of two phenomena, namely (a) limits imposed by the availability of new freshwater, and (b) limits generated by the development of land and water resources. Water scarcity is increasing rapidly in most of the developing countries.⁴ Asia and Africa are facing the greatest problems. In Asia, water supply per capita is less than half the global average. In Africa, the situation is mainly one of underdevelopment of water resources, and uneven distribution. In South America, water resources are abundant in relation to requirements, but wide disparities exist from place to place.

Over the years, the limits set on freshwater availability by nature have been exacerbated by man. Expansion of irrigation and industrial use of water have led to increased water withdrawal. On account of leaks in the distribution systems, a high proportion of water is lost.

Irrigation is heavily contributing to water scarcity. More groundwater has been withdrawn from aquifers than is recharged naturally. Excessive pumping of groundwater has possibly disastrous long-term consequences for agriculture in the arid and semi-arid areas of the developing world.

Altogether some 53 developing countries could face severe water scarcity by the year 2025, 19 are already in that situation. In most of these countries, industrial and household demand for water strongly compete with the agricultural sector for the limited water supply, making food self-sufficiency a goal increasingly difficult to attain.

Concern about water relates not only to its quantity but even more to its quality. Problems of water pollution must be seen both in the context of rural and of urban health problems.

6. Environmental Degradation and Rural Health

The rural poor suffer from ill-health mainly on account of undernutrition and/or malnutrition. Their health is further affected by various forms of pollution and agricultural hazards, most importantly by water pollution, in-door air pollution and direct exposure to pesticides and herbicides.

High proportions of the rural poor depend on water bodies for drinking water which are heavily polluted. Storm water run-offs carry herbicides, pesticides and chemical fertilizers as well as human and animal wastes into the water bodies. Rivers flowing through urban areas to rural areas are contaminated with industrial pollutants and sewage directly discharged into the rivers. Diseases caused by microbial pollution of water and related to inadequate sanitation are widespread.

According to WHO, up to 2,000 million people are at risk from diarrheal diseases, 800 million from diseases affecting skin and eyes, 500 to 600 million from bilharzia, over 100 million from Guinea-worm, 50 million from sleeping sickness, 900 million from Filaria, 2,100 million from Malaria, 85 to 90 million from river blindness, most of them in rural areas of developing countries.

In spite of some progress made during the International Drinking Water and Sanitation Decade in the 1980s, large numbers of the rural as well as urban poor are still without safe drinking water and adequate sanitation facilities. In Africa, for instance, safe drinking water is inadequate for about 50 percent of the rural population, or about 240 million people. In view of the fact that the poor are generally the last to benefit from services provided by government, high proportions of the rural dwellers still without safe drinking water and adequate sanitation facilities

would be the poorest people.

While air pollution is a growing problem in urban areas, the rural poor also suffer from it because they rely heavily on biomass fuels. Instead of turning biomass into gas, the fuels are usually burnt in primitive cook stoves. The combination of inefficient stoves, absence of chimneys and poor ventilation leads to in-door air pollution which has severe effects on health, particularly on women, infants and children. Data on exposure is limited. According to WHO, an estimated 700 million women worldwide are affected by in-door air pollution arising from biomass fuel. This constitutes the largest single health problem for women in the world.

The problem of direct poisoning of agricultural workers by pesticides is serious in the developing world, but quantitative assessment is meager. Evidence that mortality and illness from pesticides is common has been provided by a recent study in the Philippines.

C. Sustainable Rural Development

1. Slowing Down Population Growth

In the face of persistent degradation and depletion of natural resources upon which development depends, no strategy is likely to succeed unless the day to day pressure of poverty that forces the poor to overuse the resource base is removed.⁵ To achieve poverty alleviation without adverse impacts on the environment, any effective rural development strategy needs to be supplemented by policies to slow-down population growth.

In the 1980s, the population of the developing countries grew by 770 million, and according to the United Nations medium variant projections will increase by an additional 900 million in the 1990s, and by over 3 billion between 1990 and 2025. This implies a further increase of pressure on the natural resource base, especially in the rural areas, where some 63 percent of the population of developing countries reside.

The impact of population growth on the environment will be severe in the rural areas, but urban problems will also be aggravated. As will be discussed later on, the developing countries are in a process of rapid urbanization which is expected to continue for decades to come. By the year 2025 the scale of urbanization in the developing countries is expected to increase by more than 60 percent from the current 1.5 billion people.

The dominating policy stance of most developing countries on population growth is shown in a recent survey by the United Nations: more than 74 developing countries or more than 50 percent of developing countries surveyed, consider their rate of fertility to be too high. Out of the total of 131 developing countries, 10 have policies in place to raise fertility, 12 intervene to maintain the rate, 64 have policies to lower the rate, while 45 do not intervene.

In countries that have policies in place to lower the fertility rate, implementation is hampered by cultural, financial and administrative constraints. These constraints are the most severe in the poorest countries, obviously on account of the lack of resources to launch and staff the institutional arrangements required.

Slowing down population growth because of ecological reasons thus is not going to be easy, but efforts are needed so as to relieve the pressure on land. The promotion of rural infrastructure, industries and services would provide alternatives to eking out a living on marginal land. Rural off-farm employment focused on small towns and villages can have the benefits of urbanization people are generally looking for, without putting undue stress on the large cities. Improvement of productivity and equity through land reform in economically viable units would have a direct effect on the alleviation of poverty. High potential land could be allocated to the landless and near-landless through reform of property rights.

To be sustainable, rural development should be based on land use planning and environmental impact assessment. The fragile land, where the bulk of the rural poor is concentrated, needs to be protected, and environmental impact assessments are necessary to prevent individual projects having negative effects on the environment.

It is a matter of some urgency that legislation and regulatory mechanisms in respect to land and natural resources be enacted to ensure sustainable development. There is also an evident need for establishing institutions to deal with land use issues and defining their responsibilities at the national and local levels.

2. Sustainable Development of High Potential Land

Both to improve agricultural productivity and to take the pressure off marginal land, greater attention needs to be paid to the high potential areas. Under optimal conditions these areas alone could produce enough food to meet the demand of growing populations. High potential areas can generally sustain intensive crop production, as long as exploitation does not exceed the regenerative capacity of the soil. Substantial

increase in production is still possible in such areas as the central plains of India, the fertile plains and Savannah belt of Africa, and the high Savannah and Pacific lowland plains of Central and South America, through intensive cultivation. The ecological challenge in those areas is to implement land and water management that will ensure that increased agricultural productivity does not cause land degradation in the long term.

Some 250 million of the very poor people of the world live in areas of high potential land and could benefit from increasing agricultural productivity. To do so it must, however, be ensured that agricultural modernization does not result in the eviction of the poor from these areas, either through land consolidation, privatization of common land, or as a result of mechanization. This may sound politically difficult but it can be done, and would amount to immediate relief of poverty.

3. Sustainable Development of Low Potential Land

While growth of agricultural production will have to rely on the intensification of work on high potential land, investment in low potential land is also necessary, both to alleviate rural poverty and prevent further degradation of land. Low potential lands are generally dry lands, often subject to drought and desertification, mountain ecosystems and saline lands. Hundreds of million of poor people live on those lands, and much could be done in their favour through a change in the mode of farming.

Land degradation in marginal areas has occurred primarily because the poor have not been provided with the infrastructure necessary to move beyond subsistence farming and herding, which deplete soil fertility. It is well known that the type of farming that is economically and ecologically sustainable on marginal land consists of intensive cultivation of non-food crops: perennial bush and tree crops such as coffee, nuts, cocoa, rubber, fruits, vines, etc. and not field crops such as rice, beans, squash, maize, tubers and other traditional crops. Poor farmers should therefore be enabled to switch from subsistence field crop farming to sustainable commercial farming. This type of farming will call for better transportation, for marketing, and for more capital inputs at least initially, but holds out the promise of raising the incomes of the poor and providing plant cover to the land, preventing further degradation.

Some amount of traditional food crops can still be grown on marginal lands through new techniques. For instance, the combination of rows of leguminous trees alternated with rows of annual crops provide organic nutrients that prolong productivity of acid, infertile soils found in much of the humid tropics. Examples of these modes of farming exist in many parts of the developing world, but only on a small scale. The main challenge is in multiplying the successful small scale initiatives. A reorientation of the use of low-potential land will also fit in with the objective of desertification control which is to promote the use of drylands in such a manner that it ensures a sustainable livelihood for those who depend on them.

4. Rehabilitation of Degraded Land

In view of the constraints on increasing cropland in most developing countries, the prevention of further degradation needs to be supplemented by measures to rehabilitate the already degraded land, both in high-potential and low-potential areas. Although not much has been accomplished by way of rehabilitation so far, efforts are underway in a number of developing countries to restore the productivity of degraded land. A few examples of successful measures might serve to illustrate what is possible.

In China, rehabilitation of saline soil by natural and artificial drainage, land levelling, and adding clay to the soil has been tried with good results. Soil structure and fertility have been improved by harvesting flood water and cultivating green manure such as sweet clover and alfalfa. Water tables have been controlled and brackish groundwater has been diluted with fresh surface water. Terracing has made possible cropping with nominal erosion, while cash crops such as apple, and leguminous shrubs good for fodder have been planted to stabilize the remaining sloping land.

Between 1976 and 1985, through projects sponsored by the UN and various foreign aid agencies, Ethiopian farmers built 600,000 kilometers of bunds (walls of rock or earth built across hillsides to stop soil washing down the slope), and about 470,000 kilometers of terraces for reforestation of steep slopes. This impressive effort, however, accounts for only about 6 percent of the threatened highland now protected.

In Pakistan, since 1959 salinity control and land reclamation projects have reduced total soil salinity from about 40 percent to about 28 percent. On average, about 81,000 hectares of affected land were brought back into full production each year, although the achievements fell below the government target.

Land has been restored in the Yatenga Province in Burkina Faso by building stone bunds, digging deep planting holes to collect and concentrate run-off water, and placing manure or compost in each hole. The combination of contour stone bunding and deep planting have proved highly beneficial to farmers. Yields improved by 40 to 60 percent in the first season after the rehabilitation work was done. Even in dry years these techniques ensure moderate yields.

A very successful example of rangeland restoration is the revival of the ancient 'Hema' system of cooperative management in Syria, in which each cooperative has the sole grazing right to a demarcated area of rangeland, and each family member of a cooperative is granted a license to graze a certain number of sheep within that area. By reducing overgrazing, the system has enabled the revegetation of some 7 million hectares of rangeland.

Conservation needs to involve local communities in the planning and maintenance of those projects designed to benefit local people. If local communities see no short-term advantage, conservation projects are likely to be abandoned.

5. Reforestation and Afforestation

Since most of the deforestation is occurring for purposes of agricultural production, the most effective approach to arresting and reversing the process lies in increasing agricultural productivity, as discussed above. Intensification of agricultural production in the high potential areas will make it unnecessary to clear more forests and will free marginal land from agriculture, which then can be reforested. Switching from field crops to tree and bush crops in the marginal areas would at the same time amount to reforestation and afforestation.

In many countries deforestation has been and still is encouraged through direct or indirect subsidies,⁶ such as agricultural and pasture incentives, logging concessions and road construction. The identification and removal of such incentives is indispensable to prevent further deforestation.

Afforestation and reforestation are badly needed in many countries not only to stabilize global climate but, at the same time, to meet local energy demand. Estimates of the rates of reforestation needed are staggering. A World Bank estimate suggests, for instance, that the rate of tree planting in Africa would have to increase 15 fold by the year 2000 if demand for fuelwood were to be met.

Reforestation in many parts of the developing world is also necessary for the restoration of degraded watersheds so as to increase water supply for agriculture and other uses, and has the additional advantage of preventing floods by slowing down run-off. Such reforestation obviously has not only environmentally positive effects but also economic benefits.

In view of growing scarcity of wood resources, for industries afforestation in the form of plantation forestry is a financially viable option. Such afforestation would instantly provide gainful employment to the poor and in the medium term would increase the supply of timber for the domestic and export markets as well as that of fuel wood. Plantation forestry has been established in several countries, notably Southern Brazil and Southern Chile on land degraded by past agricultural activities, with good results. Whenever afforestation and reforestation are undertaken by the private sector on a commercial basis, it would help to have appropriate policy incentives to make the venture profitable. Secure land tenure would help, through the creation of vested interests to maintain forest cover. In other cases, such as reforestation for watershed restoration and climate protection, the government may have to undertake the task itself, hopefully in the future with the help of an International Forest Fund.

D. Environmental Stress and the Urban Poor

1. Nature and Extent of the Problem

In 1975, the rural poor outnumbered the urban poor by three to one; this relationship could be reversed by the turn of the century. Why could this happen?

Urbanization is the most dramatic social and material transformation that has taken place in the developing world since the mid-century.⁷ The urban population rose by 450 million between 1975 and 1985, and demographers expect that by the year 2010, some 52 percent of the population of developing countries will live in urban agglomerations as compared to 37 percent in 1990. By the turn of the century, the developing world might have 37 cities with a population of over five million.

Urbanization was initially propelled by rural-urban migration. Although this is still important, migration has ceased to be the driving force behind urban growth. The urban poor are increasingly born in the urban areas, and urbanization has been accompanied by an increase in the number of the urban poor. Over 130 million of the developing world's poorest live in urban areas.

Manufacturing industries, services and commercial centers are located at the core of many big cities in the developing countries. Large numbers of the urban poor cluster in slums and squatter settlements around such centers or at the urban periphery, be it due to absolute shortage of land or to the high rents on serviced lands. These areas are prone to hazardous natural and man-made environmental conditions, such as flood plains, slopes, or land adjacent to dangerous industries.

Most of the urban poor thus live and work in hazardous exposure situations, shunned by the more affluent. They have to contend with bad

sanitation, contaminated water, floods, or chemical pollution. According to WHO, an estimated 600 million urban dwellers in the developing world live in what might be termed life and health threatening circumstances.

2. Water Pollution, Air Pollution and Hazardous Wastes

The urban poor are affected by water pollution, inadequate sanitation facilities, insufficient collection and disposal of solid and toxic wastes, in-door and out-door air pollution. A WHO estimate for 1988 suggests that 170 million urban inhabitants lack access to safe and adequate water supply, and 330 million lack adequate sanitation. The urban poor depend on water from inland water bodies that are contaminated by human excreta, and industrial toxic wastes. Most urban agglomerations in the developing countries have no sewerage at all.

Large numbers of the urban poor depend for subsistence on urban waste, i.e., gathering materials from dumps and the streets. In so doing, they are exposed to a variety of hazards bacteria, diseases and, most importantly, toxic wastes from industries, hospitals, and utilities.

While by and large the quality of urban cooking fuels is better than that used in rural households, not everybody in the urban areas can afford clean fuels. Poor households still depend on traditional biomass fuels which they burn in unventilated shacks. In the large urban agglomerations increasing numbers of people (both poor and non-poor) are being exposed to out-door air pollution caused by industrial and automotive emissions.

The problem of hazardous wastes in developing countries has been exacerbated by the transfer of products and technologies from developed countries. In many cases it is cheaper to relocate such industries to the developing countries than to meet the increasingly stringent environmental standards and regulations at home. Officially, "codes of conduct" on environmentally sound management have been signed, but in real life such agreements on the national and international level all too often do not reach local decision-making.

E. Sustainable Urban Development

Urbanization in developing countries has put considerable stress on the natural environment and the health of the urban poor. To stop or reverse the process may well be impossible. What is needed, however, and what should be possible, is to find ways of providing cost-effective infrastructure and services, to prevent a further decline in the sanitary conditions, and to contain existing environmental hazards. Given that international mass migration is impossible, these are the only ways to relieve the pressure on the environment, to ensure income growth, and to alleviate poverty.

The spatial concentration of production in urban areas can bring many cost advantages on account of economies of scale. Urbanization in developing countries, however, has proceeded in a haphazard manner in the absence of appropriate institutional and legal structures, turning economies of scale into diseconomies of scale. What is needed, therefore, is a new paradigm for urban development ('urban ecology'), appropriate institutions and a legal framework conducive to environmental city planning.⁸

Assuming an effective city governance, highest priority should be given to the urban poor who are directly affected by the negative side effects of urban dynamics. The urban poor have benefitted little if at all from the industrial and commercial activities that degrade the environment, but bear the full consequences of their adverse effects. They are the primary victims of municipal sewage discharged in water bodies, of solid and toxic wastes dumps.

First and foremost, the urban poor need to be protected from the immediate threats to life posed by unhealthy sanitation facilities, water supplies and cooking facilities. A full-scale attack on urban problems using conventional capital-intensive technology would, however, require large increases in investments.

For example, to meet the WHO targets for water and sanitation in Latin America by the year 2000, a threefold increase in the levels of annual investment (some \$50 billion) would be needed. Moreover, conventional technologies require large amounts of freshwater, often as much as 40 percent of the average daily water consumption. At such costs the crying need of urban sanitation cannot be met. There exist, however, a wide range of alternative technologies that are much cheaper but equally efficient, and use locally manufactured hardware plumbing, concrete caps, etc. Labor for such activities could be provided by the beneficiaries in the form of 'sweat' equity.

Both the social and the technical factors of such basic sanitation facilities have been tested in Africa, in Asia and Latin America. Much headway has also been made in recent years in modifying conventional sewerage designs to reduce costs. Examples are the shallow sewerage system developed in Brazil and the small bore sewerage system. The modified systems cost as little as a quarter of conventional sewerage. What is needed, however, is wider diffusion of these low-cost alternatives.

As far as safe drinking water supply is concerned, cities can encourage water conservation in water intensive industries as well as in the services and residential sectors, by ensuring that water consumers pay realistic prices for water, and by better maintenance of existing

distribution systems to prevent leakage. A survey of 14 large Latin American cities found that unaccounted for water ranged from 39 to 67 percent. These measures alone may suffice to provide safe drinking water to most of the still unserved urban poor. For instance, in the city of Sao Paolo, a program to reduce water leakages in the distribution system succeeded in reducing the unaccounted for water from 35 per cent in 1977 to 27 per cent in 1986. The resulting savings enabled the increase in the number of home connections without the need for additional water development by 46 percent.

Solutions to in-door air pollution are more difficult to find, but several possibilities exist. For instance, charcoal or biomass when fermented to produce wood alcohol provide more energy per unit of fuel than raw biomass, and reduce air pollution at the same time. The impact of biomass fuels burned in-doors can also be reduced by improved cooking stove design that concentrates the heat. Another possibility is the use of solar stoves. Until now, however, such alternatives have largely failed to meet affordability criteria. While technologies to use energy more efficiently and to mitigate adverse health effects are available, their use requires financial resources that the poor often do not have. The ultimate solution thus lies in measures to quickly raise the income of the poor, or to drastically reduce the cost of alternative technologies.

To effectively deal with the growing waste problems, emphasis needs to be placed on waste prevention, minimization and re-use. There is not only need for more stringent environmental laws, there is room also for economic instruments and, of course, many forms of local actions.

Hazardous toxic materials may have to be banned outright. Solid waste minimization can be achieved through modification of industrial processes and through change in the design and use of products. Already many options are available at the processing stage to reduce waste through raw material substitution. Additional recycling, such as the recirculation of cooling water through a closed loop, is also possible to a substantive amount.

Durable packaging instead of single-use packaging can be made mandatory. Establishing strict quantitative and qualitative criteria for discharging industrial waste water into the sewer networks and enforcement of these criteria would drastically cut the cost of sewage treatment by municipal authorities.

The foremost instrument to reduce waste is the application of user charges. To be effective in changing behaviour, however, charges need to be sufficiently high. Various mechanisms such as 'pay-per-bag', or 'charge-per-can' have been successful in reducing solid waste. The "deposit-refund system" for certain kinds of packaging is quite common in many developing countries. Concessional loan and tax incentives can encourage the application of waste minimization technologies, etc.

Generally, environmental costs are fully integrated in the price of a product. As a result, market signals do not provide sufficient incentives for waste minimization. Therefore, efforts need to be made for the full internalization of environmental costs also in order to promote new technology. Charges on the disposal and treatment of wastes can play a useful role in helping to recover the costs associated with waste management.

With regard to municipal sewage treatment plants that ensure the elimination of pathogens, technology is well developed. Cost-effectiveness and affordability, however, remain critical to choice of technology. The most effective waste water technology suited to the climatic conditions of many developing countries is the stabilization pond system. Unfortunately, this system requires large space that is not always available.

Solid waste management which includes storage, collection, transport and disposal poses different problems. The collection technologies imported from industrial countries are often not appropriate, and the large standardized vehicles cannot reach the slum and squatter settlements on account of narrow roads. UNCHS (Habitat) therefore promotes the use of appropriate equipment in solid waste management. In most developing countries, as much as 30 to 40 percent of the refuse can be reprocessed, the rest being primarily organic matter which may be composted and sold to the agricultural sector.

In order to mitigate the effects of out-door air pollution, there is urgent need for regulations on industrial and automotive emissions. New industrial plants and automobiles should be required to be fitted with state-of-the-art pollution control devices and allowed to operate only if they meet strict pollution standards. Leaded gasoline should be banned, at least price differentiation favouring cleaner gasoline could be introduced. Within city limits, better use of public transportation systems would reduce air pollution, cut transportation costs and save energy. In most developing countries, however, the price of gasoline is already rather high. Still, a moderate gasoline tax would be useful for raising revenue which could be spent for financing public transport. In countries where gasoline is subsidized, such subsidies should be removed instantly. Vehicle tax and license fees need to be redesigned to discourage the ownership of energy-intensive and polluting vehicles. Compulsory inspection and regular maintenance of vehicles in most developing countries are still unknown but could, if introduced, cut automotive pollution substantially.

F. National Environmental Policy

Traditionally, regulations have constituted the centerpiece of national environmental policy.⁹ Regulatory instruments aim at directly

influencing the behaviour of polluters by imposing norms or standards on products, technologies and discharge of pollutants into the environment. Their use is likely to persist, particularly as regards hazardous and toxic substances. Increasingly, economic instruments are being introduced, but in most countries they are used only in conjunction with regulations. In theory, economic instruments offer the advantages of flexibility and efficiency in inducing polluters to internalize the costs of pollution and to develop cleaner technologies. A variety of economic instruments could be conceived for the developing countries, namely:

- (a) charges, such as effluent charges, user charges, product charges, tax differentiation;
- (b) enforcement incentives, such as non-compliance fees and performance bonds;
- (c) subsidies;
- (d) deposit-refund systems. Underlying all economic instruments (excluding subsidies) is the "polluter pays principle" (PPP).

The major problem in the application of economic instruments arises from the fact that pollution is a complex and multidimensional problem. Economic efficiency can be achieved only if heavy polluters are charged more than low polluters, which calls for a scale of charges or instruments, based on detailed monitoring. The administrative costs involved in calculating the charges and in enforcing such a system can be high, even in a developing country.

The discussion on economic instruments for pollution control in the literature is based on rather few experiences in developed market economies. A general conclusion from that experience is that if in spite of the sophisticated institutional structures of the developed market economies economic instruments play an essentially financial role, they cannot be expected to do better in the developing countries. Developing countries, most probably, will have to rely mainly on regulatory instruments to achieve environmental policy goals. Still, some differentiated answers can be given with regards to the relation between poverty, environment and development:

1. The application of user charges seems not very viable in situations of extreme poverty. The poor contribute to certain types of pollution, and they are the ones who suffer most of it. The provision of safe drinking water and sanitation facilities to the poor at low cost would be a useful social function since such services give rise to positive externalities in terms of health and productivity. Charges on household water and for discharge of sewage into municipal facilities probably should not be based on the amount of use or discharge but on the ability to pay (income).
2. Regarding solid-waste management, the deposit-refund system, as applied to bottles and other reusable containers, seems to be a viable mechanism. The deposit-refund system makes possible lower prices for energy and raw materials. The system is already in widespread use in developing countries. Tax differentiation or command and control measures could be used to extend the deposit-refund system by inducing the production of reusable containers for as many products as feasible. Metallic waste reuse is not a big problem in most developing countries because it is remunerative and provides an income to the poor. What is needed, however, is sanitary treatment, prior to collection, to prevent adverse health effects.
3. Elimination or reduction of subsidies for products brought directly into the environment, such as fertilizers and pesticides, particularly where they are being overused, would help in reducing their impact on water pollution, soil degradation, biodiversity, and on human health.
4. A major consideration as regards the application of pollution charges is the viability of industries. Even in developed market economies pollution charges are often kept low in order not to undermine the international competitiveness of industries producing for the export market. The main emphasis in developing countries, as far as industrial pollution is concerned, would have to be placed on the use of cleaner technologies, particularly in new plants. While the provision of funds from the budget generally is not compatible with the "polluter pays principle", subsidies would be justifiable in cases where environmental problems are severe, as for instance, water pollution treatment, restoration of hazardous waste sites, and emissions from fossil fuels combustion.

Most industries in developing countries would probably fall in the categories of countries exempted by the 1974 OECD recommendations on the application of the "polluter pays principle." These recommendations made provision for exemptions (a) if they relate to industries, areas, or plants where severe difficulties occur; (b) if they are limited to well-defined transition periods; and (c) if they are not likely to create significant distortions in international trade and investment.

5. Product charges can be effective in controlling pollution if environmentally sounder products are available at prices that will induce polluters to switch to these substitutes, i.e., if the cross price elasticity of demand is high.

G. Global Environmental Policy

1. Global Warming

There are good reasons that global warming features high on the international policy agenda, but the subject is mired in controversy on account of extensive scientific uncertainties.¹⁰ The dilemma is twofold: ecologically, global warming leads to irreversibilities; economically, delayed action will mean higher costs for future generations.

Global warming is due to the emission of so-called greenhouse gases, notably carbon dioxide (CO₂), chlorofluorocarbons (CFCs), methane (CH₄), and nitrous oxide (N₂O). The emission of CFCs leads to the destruction of the stratospheric ozone layer, which is potentially harmful to plants, animals, and to human health. Global warming with the resulting climate change will alter rainfall patterns and increase the incidence of droughts and floods. It will lead to sea-level rise, affecting numerous small island countries but also large countries, like Bangladesh. While the consequences of global warming would be felt worldwide, the poor in the developing countries could suffer the most, as many of them live in fragile areas and along the coasts.

At present, global warming is largely caused by the industrial countries through burning of fossil fuels and the extensive use of CFCs. In the 1980s, the industrial countries were responsible for some 75 percent of the CO₂ and more than 90 percent of the CFC emissions. Unless action is taken, however, the contribution of the developing countries to global warming will increase rapidly. So far a high proportion of the CO₂ emissions in the developing countries is the result of deforestation and burning of biomass fuels; industrialization and motorization will take over in the future. Most of the CO₂ emitted by developed countries is the result of the burning of fossil fuels. Clearly, the industrial countries have a responsibility to lead the way, both through their national policies and through bilateral and multilateral assistance arrangements.¹¹

2. Forests as Habitats of Biological Diversity and as Carbon Sinks

Concern about deforestation has centered on two main issues, namely, loss of biological diversity and reduction of the size of carbon sinks. The tropical rain forests contain a wealth of plant and animal species, including wild relatives of important varieties of crops. Benefits of preserving biodiversity are seen in its potential to respond to specific problems, such as new pests and plant diseases, and to the possible need to develop new plant varieties, resulting from the deterioration in growing conditions from climatic and other environmental changes.¹²

The preservation of biodiversity has assumed increased importance also in the light of recent advances in biotechnology. Eventually, biotechnology might help develop improved varieties of cultivars and raise crop yields. A prerequisite for that is the existence of adequate natural support for all biological diversity—intra-specific and inter-specific.

Forests also contribute to the slowing-down of the rate of climate change by absorbing atmospheric carbon, i.e., by serving as carbon sinks. Current international efforts at reforestation and afforestation center mostly on this role of forests. Economically viable approaches to afforestation need to be accompanied by increased efforts at slowing-down and finally halting the process of deforestation so as to achieve a net gain in forest cover. It must be borne in mind, however, that the major source of carbon dioxide remains the burning of fossil fuels. This means that unless the share of renewables in energy use is multiplied, the expansion of forests alone will not solve the problem of global warming. Natural gas, hydrogen, solar and wind energy are eminently clean sources of energy and deserve greater attention, at the national but particularly also at the international level.

3. International Mechanisms for Preventing and Slowing Global Warming

A number of mechanisms have been proposed to deal with global warming, among them (a) a global carbon tax; (b) tradeable emission permits; and (c) international environmental offset programs.¹³

The chief objective of carbon tax is to stabilize and decrease greenhouse gas emissions, according to the 'polluter pays principle.' The tax is actually intended to alter the behavior of polluters by making fossil fuels more expensive, by inducing them to reduce energy demand, encourage energy conservation, enhance efficiency and use of renewables. One version of the proposal advocates the levying of taxes at varying rates according to such criteria as current emissions, historic emissions, or population size. A global carbon tax could be part and parcel of the envisaged climate convention ("CO₂ protocol"). To be effective in achieving a significant reduction in energy consumption and CO₂ emissions, the tax would have to be rather high, which obviously runs contrary to interests in low-income countries. Moreover, a high tax rate could lead to shifts from fossil fuels to charcoal, firewood and biomass scavenging, with implications for further deforestation and deprivation of nutrients to the soil. It is here that international arrangements must come in.

Perhaps, a feasible use of the mechanism would be to impose a moderate carbon tax in the developed countries (in Europe, for instance) to generate revenue which could be used for transfer of environmentally sound technology to the developing countries on a preferential basis. The intent of the mechanism would be to place the greater financial burden on the wealthier nations which is where life style changes are most necessary if the threat of global warming is to be substantially reduced.

Another mechanism that has received much attention in the literature is emissions trading. This calls for emission permits to be issued (by an international agency) for transboundary pollutants based on current emissions, levels of income or population size. Under this mechanism, permission to release stipulated safe levels, or critical loads of pollutants, would be made available for a fee. Those who do not fully utilize their quotas could sell or lease the balance to third parties anywhere in the world at a price to be determined by the market for emission permits. While experience with tradeable permits is limited, in principle the mechanism offers an efficient solution to reduce the levels of

pollution. Regarding the complexities of setting targets, assessing emissions, etc., tradeable permits may not be introduced at the international level in the very near future. From the point of view of resource transfer from North to South, however, the mechanism has some merits.

A mechanism that could be viable in the short run is an international environmental offset program (compensation principle). In such a case, an industrial country would invest in environmental protection in a developing country whose harmful technologies undermine global emission-reduction targets. Recently, the modernization of two nickel smelting plants in the former Soviet Union near Murmansk were funded by the governments of Finland, Norway and Sweden. This is a clear, though only regional case of concessional transfer of environmentally sound technology that benefits both the donor and the recipient and the natural environment.

4. International Mechanisms for Protecting Biodiversity and Enlarging Carbon Sinks

As pointed out above, deforestation is partly due to massive poverty. Since tropical forests preserve biodiversity and serve as CO₂ pollution sinks to the rest of the world, they could be taken to internationally exemplify the compensation principle. To the extent that tropical forests are important for the state of the global environment, countries with (or people in) tropical forests are currently providing free economic services to the rest of the world and would have to be compensated for preserving these forests by the international community. The modalities of preservation of tropical forests, through appropriate regulations and policies, seem to be of secondary importance and can be devised, once the commitment to preserve and the willingness to pay have been established internationally.

Other mechanisms, such as debt-for-nature swaps and international environmental offset programs, have been used, but are limited in number and extent. Debt-for-nature swaps initiated by NGOs in developed countries have been successful on a small scale but are not viable on a large scale. The major problem is the unavailability of funds for swaps, but there are others. Countries that predominantly have public debt are reluctant to sell them on the secondary market at a discount for fear that this would undermine their credit rating with the international finance system. Moreover, the mechanism is often seen as a device to force developing countries to relinquish sovereignty on natural resources to foreign NGOs.

International environmental offset programs so far have been limited. One example is given above; another is the financing of afforestation in Latin America by the government of the Netherlands to offset CO₂ emissions at home. To the extent that more developed countries want to invest in reforestation and afforestation in the developing countries, this mechanism could become powerful. If, however, forestry measures in developing countries were financed only to offset the effects of additional polluting plants in the developed countries, this would be understood as fake.

5. International Agreements on Transboundary Air Pollution

Because of their transboundary impacts the emission of greenhouse gases can best be controlled through concerted international action. Some efforts have been made in this direction in the last fifteen years or so.¹⁴

The "Convention on Long-Range Transboundary Air Pollution" which has been signed by 31 of the 34 member states of the UN Economic Commission for Europe, was concluded in 1979, and was followed by four protocols. One protocol signed in 1984 dealt with financial contributions to a European cooperative program, one in 1985 established the targets for reducing CO₂ emissions by at least 30 percent (the "30 Percent Club"), one in 1988 established the targets for NO_x emissions to 1987 levels by the end of 1994 at the latest, and another signed in 1991 established targets for the emission of volatile organic compounds.

The "Vienna Convention for the Protection of the Ozone Layer" was concluded in 1985 and supplemented by the "Montreal Protocol" signed by 53 countries in 1987. This protocol at first required a 50 percent reduction of CFCs by the end of the century. In recognition of the special situation of the developing countries, the protocol concedes a grace period to delay their compliance for up to ten years. The Montreal Protocol was strengthened by the "Helsinki Agreement" and the "London Declaration", 1989 and 1990 respectively, signed by 80 countries and aiming at banning all CFC production by the year 2000. Individual countries, like Germany and the Netherlands, meanwhile have announced to phase out production by 1994.

6. International Agreements on Transboundary Movements of Hazardous Wastes

The "Basle Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal" was approved by 116 countries in 1989, but only 36 signed it at that time. Its effectiveness is marred by the fact that it does not actually prohibit the transfer of hazardous wastes, but specifies the conditions under which such transfers may take place. Those conditions can be easily circumvented.

In 1991, African countries adopted the "Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movements of Hazardous Wastes within Africa." This convention imposes an outright ban on the import into Africa of all hazardous wastes. It

also prohibits ships of non-signatory countries from dumping hazardous wastes in the seas, internal waters or waterways of the signatory nations and requires that all waste generation in Africa meets certain requirements.

7. International Support Measures for Sustainable Development in Developing Countries

Putting sustainable development on the agenda without increasing commitment to global environmental policy would lead to serious disturbances of the international system. At the same time, there are no quick fixes to this endeavour. Technically feasible solutions are available or can be found, but the costs involved are high and the returns somewhat uncertain. No doubt, achieving a socially necessary rate of growth and alleviation of poverty in the developing countries while at the same time maintaining the integrity of the environment will call for additional financial resources, but also for new thinking on international burden-sharing.

While parts of the additional financing will represent a cost to ensure sustainability by way of curing environmental degradation, parts of it will represent investments rather than costs. In many cases, such investments will simultaneously produce economic return and environmental relief. Also, the costs of timely (preventive) action will be less than the eventual costs of delayed (adaptive) action. In a broader sense, financing for environmental protection can be viewed as an investment in maintaining the productive capacity of the global natural system.

Estimating the additional financial resources needed to cope with the environmental issues involved is beyond the scope of this report. Some estimates are available, however, which at least give an order of magnitude of the financial requirements. Currently, attempts are being made in the preparatory meetings for the 1992 UNCED conference to provide comprehensive and consistent estimates of sectoral and overall financial needs.

As is well known, the net capital inflow required for development of the developing countries, in terms of efforts by donors, has been set at 0.7 percent of the GNP of industrial countries. This target, if met, would amount to approximately US\$120 billion in 1990 prices, exchange rates and GNP levels. In terms of the needs of the developing countries to attain a socially necessary rate of growth of 5.5 percent, a WIDER study has estimated that an additional \$40 billion over the actual flows of \$55 billion would have been required in 1990, and would rise to \$60 billion in the year 2000. To achieve both the goals of the socially necessary rate of growth and environmental protection, additional flows over current levels would have to rise from \$60 billion in 1990 to \$140 billion in the year 2000. In other words, the cost of environmental protection would have been \$20 billion in 1990, rising to \$80 billion in the year 2000. An estimate of the Worldwatch Institute puts the financing needs of developing countries for environmental conservation at US\$20 to 50 billion per year during the 1990s. The World Resources Institute (WRI) has also arrived at about the same estimate. Maurice Strong, director of the UNCED conference, in March 1992 came out with a figure on the necessary transfers for environment and development from North to South of US\$ 600 billion or more.¹⁵

Estimates of capital requirements at the sectoral level have also been made. For example, UNEP has estimated that the incremental costs for developing countries for implementing the Montreal Protocol (CFC emissions) would rise from US\$3 billion to US\$6 billion in the period 1990 to 2008. A study prepared for UNEP estimates costs of preserving biological diversity in a wide range of several hundreds of millions of dollars to billions of dollars. The current level of assistance for the protection of biodiversity is about US\$250 billion. According to WRI, estimated finance needed to reduce greenhouse gas emissions in the developing countries vary from \$26 billion to \$65 billion. The installation costs of environmentally sound technologies in new fossil fuel-based power plant adds an estimated 20 percent to the capital cost of the investment. According to the Worldwatch Institute, the costs of afforestation programs in the developing countries are estimated at over US\$2 billion annually.

The WIDER study referred to above shows that the current level of ODA is not adequate to achieve a socially necessary rate of growth to alleviate poverty in the developing countries even when all of it is allocated to traditional development projects. In view of this consideration, it will be important to ensure that ODA flows for environmental purposes be additional to those provided for development, if the goal of poverty alleviation is not to be sacrificed. Environmental and developmental objectives are not mutually exclusive, especially not in the long run. In the short term, however, both corrective and preventive environmental measures will call for vast amounts of additional resources, as is clear from even the fragmentary estimates of environmental costs cited above.

8. Current Efforts at the Bilateral and Multilateral Levels

Most multilateral agencies have started to integrate environmental concerns into the planning, budget allocation, implementation and assessment of their work. For instance, the World Bank now requires an environmental impact assessment for all new projects. UNDP in one year has increased its budget allocation for environmental activities by over 100 percent. Some 55 percent of IFAD's projects reflect concern about the environment.

In addition, several multilateral programs have been established with an explicit environmental thrust. The largest is the Global Environmental Facility (GEF) established in 1990 as a three-year pilot scheme of the World Bank, UNDP and UNEP, to provide grants and low interest loans to developing countries to help them carry out environmental programs. Several sectoral efforts are also underway, for instance, the Tropical Forestry Action Plan (TFAP), the Consultative Group on International Agricultural Research (CGIAR), the Metropolitan Improvement

Programme (MEIP), and the Environment Programme for the Mediterranean (EPM).

The TFAP, initiated in 1985 in collaboration with UNDP, FAO, World Bank and WRI to prepare national action plans for sustainable management of land and forests in 80 countries, is under review. CGIAR's mandate is to carry out research on drought and stress-resistant crop varieties as well as on environmentally sound alternative farming systems. The MEIP, launched in 1990 with the assistance of UNDP, World Bank and the government of Japan, aims at arresting and reversing environmental stress in five major Asian cities— Beijing, Bombay, Colombo, Jakarta, and Manila. The EPM, a long-term technical assistance plan financed by UNDP, World Bank, EC-Commission and the European Investment Bank, aims at improving environmental quality in the Mediterranean Basin.

Thus, the trend at the bi- and multilateral levels regarding environmental protection is positive and must be encouraged. The present efforts, however, do not constitute adequate responses given the magnitude and urgency of the problems. More financial and technology transfer and better coordination of the activities seem to be needed.

9. Potential Sources of Additional Funding

In view of the very substantial amounts of additional financing required for sustainable development, there is need for increasing the resources of the UN agencies. It does not seem realistic to rely primarily on increases in voluntary contributions. Emphasis should be placed on additional long-term commitment. The potential for redeployment of funds within national budgets, through reduction in military spending ("peace dividend"), elimination of subsidies for activities that are environmentally destructive and for changes in taxation systems seems to be great. Also, a number of innovative approaches to funding environmental protection activities have been proposed. Examples are, notably, debt relief, charges for the use of the global commons, earth stamps, non-renewable energy or carbon tax, tradeable emission permits.¹⁶

Debt relief through debt-for-nature swaps has been tried on a small-scale basis. What is needed, however, is comprehensive debt relief. The World Resources Institute has proposed a "Multilateral Authority" which would purchase debt at a discount and then negotiate for phased forgiveness in return for the implementation of sustainable development programs.

Charges for the use of the global commons—seabed resources, ocean fishing, use of the high seas by shipping, use of the atmosphere for air transport and other economic activities—could yield substantial financial resources. These charges could be levied and collected nationally or through an international taxing authority established under the United Nations (ITF - International Taxation Fund), and the revenues could be used for environmental protection measures.

Funds could also be raised by asking UN member states to permit their postal systems to sell "earth stamps" which would be added to regular postage. The funds could be used to finance the transfer of clean technologies to developing countries.

A non-renewable energy or carbon tax has been proposed and meanwhile is widely debated. The primary objective of such a tax is to alter the behavior of polluters by raising the cost of highly polluting products and technologies. Behavior modification, however, would require the tax rate to be rather high, which again could make many current economic activities unprofitable. But the willingness of implementing at least a moderate tax in many industrial countries is also high.

Tradeable emission permits offer the potential of effectuating substantial transfer of resources from one country to another. In recent plans by WMO, UNEP, and the Enquete-Kommission of the German Parliament it has been argued that in the case of greenhouse gases, industrial countries have the room to reduce emissions considerably (up to 80 percent), while many developing countries would need to maintain or even increase emissions to achieve legitimate development objectives. If the allocation of permits to developing countries were larger than needed in the short to medium term, they could sell or lease their permits to industrial countries, giving them time to adjust to stipulated lower emission levels, and use the proceeds for developing clean technologies or for other sustainable economic activities.

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