Development and the environment: a false dichotomy

Economic development and sound environmental management are complementary aspects of the same agenda. Without adequate environmental protection, development will be undermined; without development, environmental protection will fail.

More than 1 billion people today live in abject poverty. The next generation will see the world’s population rise by 3.7 billion, even if progress in reducing population growth accelerates. Most of these people will be born into poor families. Alleviating poverty is both morally imperative and essential for environmental sustainability.

Economic growth is essential for sustained poverty reduction. But growth has often caused serious environmental damage. Fortunately, such adverse effects can be sharply reduced, and with effective policies and institutions, income growth will provide the resources for improved environmental management.

The environmental mistakes of the past do not have to be repeated. Today, countries have more choices. They can choose policies and investments that encourage more efficient use of resources, substitution away from scarce resources, and the adoption of technologies and practices that do less environmental harm. Such changes will ensure that the improvements in human welfare which development brings are lasting.

More people today live longer, healthier, and more productive lives than at any time in history. But the gains have been inadequate and uneven. More than 1 billion people still live in abject poverty. To reduce poverty, sustained and equitable economic growth is essential. But past economic growth has often been associated with severe degradation of the natural world. On the surface, there appears to be a tradeoff between meeting people’s needs—the central goal of development—and protecting the environment. This Report will argue that in every realm of economic activity, development can become more sustainable. The key is not to produce less, but to produce differently. This chapter explores the relationship between economic activity and the environment, emphasizing the concerns of developing countries.

The context: population, poverty, and economic growth

Population growth

The second half of the twentieth century has been a demographic watershed. By midcentury the rate of population growth in developing countries had risen to unprecedented levels as mortality declined and life expectancy increased. These gains were the result of progress in living standards, sanitary conditions, and public health practices, particularly the introduction of antibiotics, the increased use of vaccinations, and antimalarial spraying. World population growth peaked at 2.1 percent a year in 1965–70, the most rapid rate of increase in history. Population growth has now slowed to 1.7 percent as more countries have begun a transition toward lower fertility. Even so, world population now stands at 5.3 billion and is increasing by 93 million a year.

To project future trends in fertility—the largest factor in determining population growth—judgments have to be made about two key questions: when will a country begin its demographic transition, and how fast will fertility decline once the transition begins? Figure 1.1 illustrates three alternative paths for world population. Under the World Bank’s base case projections, world population growth would decline slowly, from 1.7 percent a year in 1990 to about 1 percent a year by 2030. World population would more than double from current levels and would stabilize at about
World population will at least double and may quadruple

Figure 1.1 World population projections under different fertility trends, 1985-2160

Billions of people

- Slow decline in fertility
- Base case
- Rapid decline in fertility

1985 2010 2035 2060 2085 2110 2135 2160

a. Countries with high and nondeclining fertility levels begin the transition toward lower fertility by the year 2005 and undergo a substantial decline - by more than half in many cases - over the next forty years. All countries reach replacement fertility levels by 2060.
b. Countries not yet in transition toward lower fertility begin the transition immediately. For countries already in transition, total fertility declines at twice the rate for the base case.
c. Transition toward lower fertility (triggered when life expectancy reaches 53 years) begins after 2020 in most low-income countries. For countries in transition, declines are half the rate for the base case.

Source: World Bank data.

12.5 billion around the middle of the twenty-second century. Two-thirds of the increase would occur by 2050, and 95 percent of population growth would take place in developing countries.

Alternative paths are possible. The scenario of rapid fertility decline illustrated in Figure 1.1 is comparable to the historical experience of, for example, Costa Rica, Hong Kong, Jamaica, Mexico, and Thailand. The scenario of slow fertility decline is consistent with the experience of such countries as Paraguay, Sri Lanka, Suriname, and Turkey. The stable population of 10.1 billion in the rapid fertility decline scenario is about 2.4 billion less than that in the base case, but it is still almost double the present size. In stark contrast, with a slow decline of fertility, population increases more than fourfold, to about 23 billion, and stabilizes only toward the end of the twenty-second century. Few demographers expect world population to reach 23 billion, but the projection shows what might happen if fertility transitions are delayed in many countries.

This tremendous range of possible long-term population trends depends largely on what happens in Africa and in the Middle East. Together, these regions account for 85 to 90 percent of the differences between the alternative scenarios and the base case. Sub-Saharan Africa alone contributes more than two-thirds of the difference under the slow fertility decline scenario. Total fertility rates (measured as births per woman) in Sub-Saharan Africa as a whole have remained unchanged at about 6.5 for the past twenty-five years—a level much higher than in other parts of the world that have similar levels of income, life expectancy, and female education.

Recent statistics provide encouraging indications that a number of African countries are at or near a critical turning point. Total fertility rates have already fallen in Botswana (6.9 in 1965 to 4.7 in 1990), Zimbabwe (8.0 in 1965 to 4.9 in 1990), and Kenya (8.0 in 1965 to 6.5 in 1990) and are beginning to decline in Ghana, Sudan, and Togo. The base case projections, which assume that these positive trends will continue, imply that Sub-Saharan Africa's population will rise from 500 million at present to about 1.5 billion by 2030 and almost 3 billion by 2100. Apart from its terrible effects on health and welfare, the AIDS virus could reduce African population growth rates by as much as 0.5–1.0 percentage points in the early decades of the next century. But because increased mortality from AIDS may delay fertility declines, the overall impact of the disease is ambiguous.

Population growth and the environment. Population growth increases the demand for goods and services, and, if practices remain unchanged, implies increased environmental damage. Population growth also increases the need for employment and livelihoods, which—especially in crowded rural areas—exerts additional direct pressure on natural resources. More people also produce more wastes, threatening local health conditions and implying additional stress on the earth's assimilative capacity.

Countries with higher population growth rates have experienced faster conversion of land to agricultural uses, putting additional pressures on land and natural habitat. An econometric study of twenty-three Latin American countries found that expansion of agricultural area continues to be positively related to population growth, after controlling for such factors as agricultural trade, yield in-
Box 1.1 The population-agriculture-environment nexus in Sub-Saharan Africa

Rapid population growth, agricultural stagnation, and environmental degradation have been common to most Sub-Saharan countries in recent decades. These three factors have been mutually reinforcing. The World Bank recently completed a study of this "nexus" with the purpose of better understanding causal links and identifying remedies. Its preliminary findings are summarized here.

The equilibrium upset

Shifting cultivation and grazing have been appropriate traditional responses to abundant land, scarce capital, and limited technology. As population densities grew slowly in the first half of this century, these extensive systems evolved into more intensive systems, as in Rwanda, Burundi, the Kenyan highlands, and the Kivu Plateau in Zaire. This slowly evolving system has, however, proved unable to adapt to sharply accelerated population growth over the past four decades. Traditional uses of land and fuel have depleted soil and forests and contributed to agricultural stagnation. Stagnant incomes and the absence of improvements in human welfare have impeded the demographic transition. A combination of high population densities and low investment has caused arable land per person to decline from 0.5 hectare in 1965 to 0.3 hectare in 1987. As a result, in many parts of Burundi, Kenya, Lesotho, Liberia, Mauritania, and Rwanda fallow periods are no longer sufficient to restore fertility.

Population growth drives some people to cultivate land not previously used for farming—in semiarid areas and in tropical forests where soil and climatic conditions are poorly suited for annual cropping or for the practices employed by the new migrants. These problems are most severe in parts of the Sahel, in parts of mountainous East Africa, and in the dry belt stretching from Namibia through Botswana, Lesotho, and southern Mozambique. There is strong evidence that economic stagnation is delaying declines in fertility; family size may be higher (to provide additional labor) where land damage is greatest and fuelwood supplies are depleted. An integrated approach to the problem is needed.

Toward solutions

The traditional development approach, which emphasized supplying services and technologies, must be complemented by a strategy of promoting demand—for appropriate agricultural practices and inputs, for fewer children, and for resource conservation. Demand for these things can be promoted by:

- Removing subsidies that distort prices and incentives—to promote more efficient use of resources
- Improving land use planning—to promote intensification and protect valuable natural ecosystems
- Clarifying resource ownership and land tenure, giving legal recognition to traditional common-property management and private ownership, and reducing state ownership—to encourage investment
- Expanding educational programs for girls and employment opportunities for women and improving information on health and nutrition, in all cases through the use of community groups, NGOs, and the private sector—to promote demand for smaller families
- Expanding investment in and maintenance of rural infrastructure, especially roads, water supply, and sanitation—to improve production incentives, productivity, and health.

The distribution of people between countryside and towns also has important implications for the types of stress placed on the environment. In 1990 most people lived in rural areas. By 2030 the opposite will be true: urban populations will be twice the size of rural populations. Developing country cities as a group will grow by 160 percent over this period, whereas rural populations will grow by only 10 percent. By 2000 there will be twenty-one cities in the world with more than 10 million inhabitants, and seventeen of them will be in developing countries.

The pattern will vary substantially among regions. Over the next thirty years urban population growth will average 1.6 percent a year in Latin America, 4.6 percent in Sub-Saharan Africa, and 3 percent in Asia. Rural populations are expected to
Urban populations will overtake rural populations for the first time in history

Figure 1.2 Rural and urban population in developing regions and high-income countries, 1960-2025

In high-income countries and in Eastern Europe and the former U.S.S.R. the numbers living in rural areas have been declining steadily, and in most South American countries, too, urbanization has brought about some decline in rural populations.

decline in absolute terms within a generation in all regions except Sub-Saharan Africa, the Middle East and North Africa, and Central America (Figure 1.2). Asia’s rural population will continue to increase until the turn of the century but is expected to fall back to current levels by about 2015.
The pace of urbanization poses huge environmental challenges for the cities. That is why much of this Report is devoted to the problems of sanitation, clean water, and pollution from industry, energy, and transport. But urbanization will also affect the nature of rural environmental challenges. Successful urbanization and the associated income growth should ease the pressures caused by encroachment on natural habitats—largely driven by the need for income and employment—but will increase the pressures stemming from market demand for food, water, and timber. In much of Sub-Saharan Africa, the Middle East and North Africa, and Central America rural populations are likely to increase by about 50 percent over the next generation, and direct pressure on natural resources, particularly by poor subsistence farmers, will intensify.

**Policies for reducing population growth.** The declining fertility rates associated with the base case projections should not be taken for granted. They are rapid by historical standards and will require solid progress on four fronts: incomes of poor households must rise, child mortality must decline, educational and employment opportunities (especially for women) must expand, and access to family planning services must be increased.

Investments in female education have some of the highest returns for development and for the environment. Evidence from a cross-section of countries shows that where no women are enrolled in secondary education, the average woman has seven children, but where 40 percent of all women have had a secondary education, the average drops to three children, even after controlling for factors such as income. Better-educated mothers also raise healthier families, have fewer and better-educated children, and are more productive at home and at work. Investments in schools, teachers, and materials are essential. But so too are policies to encourage enrollment, such as scholarship programs. In Bangladesh a scholarship program has succeeded in almost doubling female secondary enrollment, as well as promoting higher labor force participation, later marriage, and lower fertility rates.

Efforts to expand family planning programs have contributed to significant progress; the rate of contraceptive use in developing countries rose from 40 percent in 1980 to 49 percent in 1990. But for the base case projections to be realized, the rate would need to increase by another 7 percentage points by 2000 and by yet another 5 percentage points by 2010. Unmet demand for contraceptives is large—it ranges from about 15 percent of couples in Brazil, Colombia, Indonesia, and Sri Lanka to more than 35 percent in Bolivia, Ghana, Kenya, and Togo. Meeting this demand is essential for reaching even the base case projections and will require that total annual expenditure on family planning increase from about $5 billion to about $8 billion (in 1990 prices) by 2000. An additional $3 billion would be required to achieve the rapid fertility decline scenario. Choices about family planning and education policies today will determine world population levels, and the consequent pressures on the environment, in the next century.

The persistence of poverty

The primary task of development is to eliminate poverty. Substantial progress has been achieved over the past twenty-five years. Average consumption per capita in developing countries has increased by 70 percent in real terms; average life expectancy has risen from 51 to 63 years; and primary school enrollment rates have reached 89 percent. If these gains were evenly spread, much of the world's poverty would be eliminated. Instead, more than one-fifth of humanity still lives in acute poverty.

New estimates prepared for this Report reveal a negligible reduction in the incidence of poverty in developing countries during the second half of the 1980s (Table 1.1). The numbers of poor have increased at almost the rate of population growth over the period—from slightly more than 1 billion in 1985 to more than 1.1 billion by 1990.

Asia, with its rapid income growth, continues to be the most successful at alleviating poverty. China was an exception in the second half of the 1980s; although its incidence of poverty remains, for its income, very low, the new estimates reflect some adverse changes for the poorest in that country as a result of a more uneven distribution of income. In most other East Asian countries poverty continued to decline. South Asia, including India, has maintained a steady but undramatic decline in poverty. The experience in other developing regions has been markedly different from that in Asia. All poverty measures worsened in Sub-Saharan Africa, the Middle East and North Africa, and Latin America and the Caribbean.

What are the prospects for poverty alleviation to the end of this century? The estimates presented in Table 1.1 are based on the projections of income
growth presented below (see Table 1.2) and assume that the distribution of income within countries remains constant. Under these assumptions, the number of poor in Asia would continue to decline, and the adverse poverty trends in Latin America and Eastern Europe would be reversed with economic recovery in those regions. Sub-Saharan Africa is the only region in which the situation is expected to deteriorate; with increases in the proportion of the population in poverty, the number of poor would rise by about 9 million a year, on average. By the end of the decade about one-half of the world’s poor will live in Asia and one-quarter will live in Sub-Saharan Africa.

It is sobering to compare these estimates with those in World Development Report 1990. That report identified a path of poverty reduction that would reduce the absolute number of poor in the world by 300 million between 1985 and 2000. The path was presented to illustrate what could be accomplished with sound policies in both developing and industrial countries. Sadly, that target appears no longer feasible, partly as a result of the severity of the current recession and the disappointing progress in the 1985–90 period. Even under fairly hopeful assumptions about economic recovery in the rest of the decade, the absolute number of poor in the world at the turn of the century will probably be higher than in 1985.

Poverty and the Environment

Alleviating poverty is both a moral imperative and a prerequisite for environmental sustainability. The poor are both victims and agents of environmental damage. About half of the world’s poor live in rural areas that are environmentally fragile, and they rely on natural resources over which they have little legal control. Land-hungry farmers resort to cultivating unsuitable areas—steeply sloped, erosion-prone hillsides; semi-arid land where soil degradation is rapid; and tropical forests where crop yields on cleared fields frequently drop sharply after just a few years. Poor people in crowded squatter settlements frequently endure inadequate access to safe water and sanitation, as well as flooding and landslides, industrial accidents and emissions, and transport-related air pollution. The poor are often exposed to the greatest environmental health risks, and they tend to be the most vulnerable to those risks because of their poverty. The impact of environmental degradation on the poor will be described in Chapter 2.

Poor families often lack the resources to avoid degrading their environment. The very poor, struggling at the edge of subsistence, are preoccupied with day-to-day survival. It is not that the poor have inherently short horizons; poor communities often have a strong ethic of stewardship in managing their traditional lands. But their fragile and limited resources, their often poorly defined property rights, and their limited access to credit and insurance markets prevent them from investing as much as they should in environmental protection (Box 1.2). When they do make investments, they need quick results. Studies in India, for example, found implicit discount rates among poor farmers of 30–40 percent, meaning that they were willing to make an investment only if it would treble its value in three years. Similarly, efforts to introduce soil conservation and water-harvesting techniques in Burkina Faso showed that the practices most likely to be adopted were those that could deliver an increase in yields within two or three years. In many countries ef-
forts to encourage rural communities to plant woodlots have failed when people had to wait until the trees reached maturity to realize a return but have succeeded when products such as building poles and fodder could be harvested more quickly.

In many parts of the world women play a central part in resource management and yet enjoy much less access to education, credit, extension services, and technology than do men. In Sub-Saharan Africa women provide an estimated 50-80 percent of all agricultural and agroprocessing labor. Despite such high levels of economic activity, women in many countries have no or only limited rights of tenure to land and cultivated trees. This constrains their access to credit for investments in new technologies. Women are also frequently neglected by agricultural and forestry extension services. When women have been given equal opportunities (as in combating soil erosion in Cameroon), they have shown effective leadership in managing natural resources.

Substantial synergies exist between alleviating poverty and protecting the environment. Since the poor are less able than the rich to "buy out of" environmental problems, they will often benefit the most from environmental improvements. In addition, the economic activities stimulated by environmental policies—such as the use of agroforestry and windbreaks to slow soil erosion and the construction of infrastructure for water supply and sanitation—are often labor-intensive and thus can provide employment. Targeted social safety nets make it less necessary for the poor to "mine" natural resources in times of crisis. Extension and credit programs and the allocation of land rights to squatters increase the ability of the poor to make environmental investments and manage risks. Investments in water and sanitation and in pollution...
abatement will also benefit the poor by improving their health and productivity. But it is equitable economic growth, coupled with education and health services, that is most urgently needed. This will enable the poor to make environmental investments that are in their own long-term interest. It will also be essential for accelerating the demographic transition; better-off and better-educated couples have fewer children.

**Economic growth—long-term trends and prospects**

Average per capita incomes in developing countries rose 2.7 percent a year between 1950 and 1990—the highest sustained rate of increase in history. But the pace of economic growth has differed greatly among regions. Asian countries, which account for 65 percent of the population of the developing world, grew at an average rate of 5.2 percent a year in the 1970s and 7.3 percent in the 1980s, while growth in the non-Asian developing countries decelerated from 5.6 percent in the 1970s to 2.8 percent in the 1980s. Asia was the only developing region to achieve sustained per capita income growth during the 1980s.

**Recent economic developments.** The 1990s started badly for developing countries. In both 1990 and 1991 per capita income in developing countries as a whole fell, after rising every year since 1965. The setback was caused largely by extraordinary events—the war in the Middle East, and economic contraction in Eastern Europe and in the former U.S.S.R. Recession in several high-income countries also contributed to the stagnation of export growth in developing countries. The projections presented in Table 1.2 assume that industrial countries will grow more slowly in the 1990s than in the 1980s. This context provides all the more reason to accelerate policy reform in developing countries. Experience has shown that, on average, the effect of domestic policies on long-run growth is about twice as large as the effects attributable to changes in external conditions.

With continued progress on economic reform in developing countries, GDP growth is projected to increase to about 5 percent a year for the decade as a whole—significantly higher than the 3.4 percent achieved in the 1980s. Growth in Asia is expected to slow from the high levels of the 1980s but will remain well above the average for developing countries. Latin America, Eastern Europe, and the Middle East and North Africa are all expected to grow more rapidly during the remainder of the 1990s. Sub-Saharan Africa's growth performance will improve in comparison with the 1980s, but the gains will be small.

**Longer-term prospects.** Because many environmental issues evolve slowly, this Report takes a longer view than usual, giving special attention to the next four decades. About 3.7 billion people will be added to the world's population during this period—many more than in any previous generation, and probably more than in any succeeding one. Economic projections over this length of time are, of course, subject to great uncertainty. They are presented in Figure 1.3 not as predictions but as indicators of what historical experience suggests is likely to occur.

World GDP could rise from about $20 trillion in 1990 to $69 trillion in 2030 in real terms. For the

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**Memorandum:**

| Developing countries weighted by population | 3.9 | 3.7 | 2.2 | 1.7 | 2.2 | 3.6 |

Note: Totals do not include the former U.S.S.R.

a. Estimates.

developing countries as a whole, average incomes could more than triple in real terms, from an average of $750 today (the level of Côte d’Ivoire) to about $2,500 in 2030, roughly the income per capita of Mexico today. Substantial regional differences would persist, although in the aggregate the gap between income levels in developing and industrial countries would narrow. By the middle of the next century developing countries’ share of world income would have risen from less than one-quarter to almost one-half, and if trends continued, it would rise to more than three-quarters by 2100. The most rapid growth rates are expected in Asia, particularly in East Asia, where per capita incomes would be more than $3,500 in 2030. Although growth rates in South Asia will be robust, the tripling of average incomes during the next generation would still leave them at only about $1,000 per capita. Average per capita incomes in Latin America and in the Middle East and North Africa could exceed $5,000 and $4,000, respectively—well above the average for developing countries. Economic recovery in Eastern Europe would raise average per capita incomes to more than $9,000 by 2030, while those in the former U.S.S.R. could rise to more than $8,000. Projections for Sub-Saharan Africa are the most sobering; under present productivity trends and population projections trends in total output would rise fourfold, but per capita incomes would still reach only $400.

**Sustaining development**

In terms of incomes and output, the world will be a much richer place in the next century. But will the environment be much poorer? Will future generations be worse off as a result of environmental degradation that results from economic decisions made today? Will increases in the scale of eco-
nomic activity be sustainable in the face of increasing pressure on natural resources? Prospective changes of the size described above raise fundamental questions about the kind of world we will bequeath to our children and about the nature and goals of development.

What is development?

Development is about improving the well-being of people. Raising living standards and improving education, health, and equality of opportunity are all essential components of economic development. Ensuring political and civil rights is a broader development goal. Economic growth is an essential means for enabling development, but in itself it is a highly imperfect proxy for progress.

The first step in improving social choices is to measure progress correctly. It has long been recognized that measures of, for example, educational opportunity, infant mortality, and nutritional status are essential complements to GDP or GNP. Some have even tried to merge these indices to capture progress in development. The human development index constructed by the United Nations Development Programme (UNDP) is such an effort.

The fact that environmental damage hurts people—both today and in the future—provides additional grounds for rethinking our measurement of progress. Indeed it raises special concerns, for unlike education, health, nutrition, and life expectancy, which tend to be improved by economic growth, the environment is sometimes damaged by that growth. Furthermore, the people suffering from the damage may be different from those enjoying the benefits of growth. They may, for example, be today's poor, or they may be future generations who inherit a degraded environment. For these reasons it is essential to assess the costs to human welfare of environmental damage—a central theme of this Report—and to take account of the distributional impacts of policies, particularly for the poor.

What is sustainable?

Sustainable development is development that lasts. A specific concern is that those who enjoy the fruits of economic development today may be making future generations worse off by excessively degrading the earth's resources and polluting the earth's environment. The general principle of sustainable development adopted by the World Commission on Environment and Development (Our Common Future, 1987)—that current generations should “meet their needs without compromising the ability of future generations to meet their own needs”—has become widely accepted and is strongly supported in this Report.

Turning the concept of sustainability into policy raises fundamental questions about how to assess the well-being of present and future generations. What should we leave to our children and grandchildren to maximize the chances that they will be no worse off than ourselves? The issue is the more complicated because our children do not just inherit our pollution and resource depletion but also enjoy the fruits of our labor in the form of education, skills, and knowledge (human capital), as well as physical capital. They may also benefit from investments in natural resources—improvement in soil fertility and reforestation, for example. Thus, in considering what we pass on to future generations, we must take account of the full range of physical, human, and natural capital that will determine their welfare and their bequests to their successors.

Intergenerational choices of this kind are reflected in the discount rate used to assess investments. The discount rate is the mechanism through which present and future costs and benefits are compared. The lower the discount rate, the more it is worth investing today to make future gains. It is sometimes claimed that a lower discount rate—even a zero discount rate—should be used in order to give appropriate weight to the long-term consequences of environmental change. This argument is erroneous. Provided that the environmental effects of projects are fully taken into account—which they often are not—it is always best to choose the investments which generate the highest net rate of return. Encouraging investments that yield a lower net rate of return is wasteful; it implies a loss of welfare and of income that might have been devoted to environmental objectives.

Weighing costs and benefits

Addressing environmental problems requires not that discount rates be artificially lowered but rather that the value of the environment be factored into decisionmaking. Values that are difficult to measure are often implicit in decisionmaking, but the tradeoffs are not well thought through. There is a clear need to make such costs and benefits as explicit as possible so as to better inform policymakers and citizens. This does not imply that it is possible, or even desirable, to put mone-
Box 1.3 Natural resource and environmental accounting

The limitations of conventional measures of economic activity, such as GNP and national income, as indicators of social welfare have been well known for decades. Recently, the perception has grown that these indicators, which are based on the United Nations System of National Accounts (SNA), do not accurately reflect environmental degradation and the consumption of natural resources. Several alternative approaches have been developed. Early work in this area was conducted by some OECD countries, notably Norway and France. Recent attempts to apply natural resource accounting to developing countries have been made by UNEP, the United Nations Statistical Office (UNSO), the World Bank, and the World Resources Institute. These methods differ in both comprehensiveness and objectives.

Broadly, there are two criticisms of the SNA framework. First, aggregates such as GNP may be inadequate measures of economic activity when environmental damage occurs. The depreciation of some forms of capital, such as machinery, is taken into account, but investments in human capital and depletion of environmental capital, including nonrenewable natural resources, are not measured.

Second, it is argued, by neglecting the services provided by natural resources, the SNA limits the information available to policymakers. Leaving out these services ignores the impact of economic activity on the environment in its role both as a "sink" for wastes and a "source" of inputs. It is argued that ignoring these services and their effects on economic activity makes the national income accounts misleading for formulating economic policies, particularly in economies that are heavily dependent on natural resources.

The various approaches to natural resource and environmental accounting have divergent aims. Each responds to a different problem with the SNA framework. The simplest approaches attempt to measure more accurately the responses to environmental degradation and protection that are already imperfectly measured in the national income accounts. Examples include work in Germany, the Netherlands, and the United States on estimating pollution abatement expenditures. A second approach responds to the inconsistent treatment of natural capital in the SNA and attempts to account explicitly for the depletion of natural resources; estimates of depletion are applied to conventionally measured income to derive a measure of net income. This approach has been applied in Indonesia for forests, petroleum, and soils, in Costa Rica for fisheries and forests, and in China for minerals. Finally, the physical accounting method used by Norway and the effort to integrate environmental and resource use with economic activity being developed by the UNSO both attempt to improve the information available for environmental management. The Norwegian system focuses primarily on the country's main natural resources—petroleum, timber, fisheries, and hydro-power. The more ambitious UNSO approach, currently being applied to Mexico and Papua New Guinea in collaboration with their governments and the World Bank, aims at developing a system of "satellite" national accounts that explicitly incorporate the links between economic activity and the use of natural and environmental resources.
larly air and water pollution and soil erosion, brought the national product down another 7 percent. These estimates are preliminary and are only intended to illustrate a methodology. Of more value than these aggregate numbers are sectoral calculations. In the livestock sector, for example, adjustments for the costs of soil erosion sharply reduced the sector’s net value added. These calculations in themselves give no indication to policymakers as to whether Mexico’s use of natural capital has been in the country’s best interest, but they can be useful in reminding policymakers of potential tradeoffs and can assist in setting sectoral priorities.

Economic activity and the environment: key links

This Report will argue that the adverse impact of economic growth on environmental degradation can be greatly reduced. Poor management of natural resources is already constraining development in some areas, and the growing scale of economic activity will pose serious challenges for environmental management. But rising incomes combined with sound environmental policies and institutions can form the basis for tackling both environmental and development problems. The key to growing sustainably is not to produce less but to produce differently. In some situations, such as protection of forests or control of emissions, good environmental policies may cause short-term growth to fall, even as welfare may rise. In other cases—for example, improved soil conservation practices or investments in water supply—the effect on output and incomes is likely to be positive. In still other areas the impacts are unclear. What is clear, however, is that failure to address environmental challenges will reduce the capacity for long-term development.

Understanding the problem. All economic activity involves transforming the natural world. Why does economic activity sometimes lead to excessive environmental degradation? One reason is that many natural resources are shared and the true value of many environmental goods and services is not paid for by those who use them. Some natural resources are shared because there is no mechanism for enforcing property rights, as with frontier land, and others are shared because, as with the atmosphere, property rights are impossible to enforce. Unless an explicit agreement among users emerges, shared resources will be degraded over time, particularly as the scale of population and economic activity increases. In some cases government policies that subsidize environmental degradation can induce more damage than might otherwise occur. In other cases the poor, with few assets on which to draw, may have no choice but to excessively degrade natural resources.

The most pressing environmental problems are associated with resources that are regenerative but are undervalued and are therefore in danger of exhaustion. Air and water are renewable resources, but they have a finite capacity to assimilate emissions and wastes. If pollution exceeds this capacity, ecosystems can deteriorate rapidly. When fisheries or forests are excessively depleted to meet human needs, critical thresholds may be passed, resulting in the loss of ecosystems and species. Shortages of nonrenewable resources, such as metals, minerals, and energy, the possible exhaustion of which preoccupied early environmental debate, are of less concern. The evidence suggests that when the true value of such nonrenewable resources is reflected in the marketplace, there is no sign of excessive scarcity (Box 1.4).

Water provides an example of an undervalued renewable resource that is showing signs of shortage. By the end of the 1990s six East African countries and all the North African countries will have annual renewable water supplies below the level at which societies generally experience water shortage. In China fifty cities face acute water shortages as groundwater levels drop 1 to 2 meters a year. In Mexico City groundwater is being pumped at rates 40 percent faster than natural recharge. These shortages emerge when water is lost or wasted because its true scarcity value is not recognized. In such cities as Cairo, Jakarta, Lima, Manila, and Mexico City more than half of urban water supplies cannot be accounted for. In many countries scarce water is used for low-value agricultural crops, and farmers pay nothing for the water they use. The misuse of water in the Aral Sea in Central Asia is an extreme example of failure to recognize the value of a natural resource (Box 1.5).

Assessment of whether the regenerative capacity of a natural resource has been exceeded is complicated by uncertainty about the effect of economic activity on the environment. In the cases of soil erosion, atmospheric pollution, and loss of biodiversity, there is often substantial scientific uncertainty about the extent of environmental degradation. Controversy also surrounds the consequences of degradation. What are the health
Box 1.4 The dismal science—economics and scarcity of natural resources

The debate about whether the world is running out of nonrenewable resources is as old as economics. The writings of Malthus and Ricardo, which predicted rapidly growing populations and increasing scarcity of resources, earned economics the name "the dismal science." For natural resources that are nonrenewable, increases in consumption necessarily imply a reduction in the available stock. The evidence, however, gives no support to the hypothesis that marketed nonrenewable resources such as metals, minerals, and energy are becoming scarcer in an economic sense. This is because potential or actual shortages are reflected in rising market prices, which in turn have induced new discoveries, improvements in efficiency, possibilities for substitution, and technological innovations.

The rise in the prices of energy and metals in the 1970s encouraged efficiency gains and substitutions that ultimately reduced the growth of demand. Examples of such technological changes include fiber optics, which replaced copper in telecommunications, the use of thinner coatings of tin, nickel, and zinc in a number of industries, the development of synthetic substitutes, and the recycling of aluminum and other materials. Similar efficiency gains were achieved in the energy sector. The use of metals and energy per unit of output has declined steadily in industrial countries, although it is generally rising in developing countries. Current consumption as a proportion of reserves has declined for several mineral and energy resources (Box table 1.4). Declining price trends also indicate that many nonrenewables have become more, rather than less, abundant (Box figure 1.4).

The world is not running out of marketed nonrenewable energy and raw materials, but the unmarketed side effects associated with their extraction and consumption have become serious concerns. In the case of fossil fuels, the real issue is not a potential shortage but the environmental effects associated with their use, particularly local air pollution and carbon dioxide emissions. Similarly, the problems with minerals extraction are pollution and destruction of natural habitat. Because 95 percent of the total material removed from the earth is waste that often contain heavy metals such as copper, iron, tin, and mercury, these commonly find their way into rivers, groundwater, and soils.

Box table 1.4 Energy and mineral reserves and consumption, 1970 and 1988

<table>
<thead>
<tr>
<th>Energy resources</th>
<th>Index of commercial reserves, 1988 (1970 = 100)</th>
<th>Annual consumption as a percentage of reserves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude oil</td>
<td>163</td>
<td>2.7</td>
</tr>
<tr>
<td>Gas</td>
<td>265</td>
<td>2.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mineral resources</th>
<th>Annual consumption as a percentage of reserves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bauxite</td>
<td>0.2</td>
</tr>
<tr>
<td>Copper</td>
<td>2.6</td>
</tr>
<tr>
<td>Iron ore</td>
<td>0.5</td>
</tr>
<tr>
<td>Lead</td>
<td>4.7</td>
</tr>
<tr>
<td>Nickel</td>
<td>0.8</td>
</tr>
<tr>
<td>Tin</td>
<td>5.4</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Source: World Bank data.

Box figure 1.4 Long-run prices for nonferrous metals, 1900-91

Note: The index is based on the real prices of aluminum, copper, lead, tin, and zinc, weighted by the value of developing country exports in 1979-81. Source: World Bank data.

effects of certain pollutants? What will climate change do to the ecosystem? Can tropical forests be regenerated? The solutions are likewise often unclear. How quickly can the atmosphere restore itself? When will certain cleaner technologies become available and cost-effective? Uncertainty is an inherent part of environmental problems. To reduce it, decisionmakers need better information about environmental processes and social preferences.
Efficiency, technology, and substitution. The view that greater economic activity inevitably hurts the environment is based on static assumptions about technology, tastes, and environmental investments. According to this view, as populations and incomes rise, a growing economy will require more inputs (thus depleting the earth’s “sources”) and will produce more emissions and wastes (overburdening the earth’s “sinks”). As the scale of economic activity increases, the earth’s “carrying capacity” will be exceeded. In reality, of course, the relationships between inputs and outputs and the overall effects of economic activity on the environment are continually changing. Figure 1.4 illustrates that the scale of the economy is only one of the factors that will determine environmental quality. The key question is whether the factors that tend to reduce environmental damage per unit of activity can more than compensate for any negative consequences of the overall growth in scale. Factors that can play a particularly important role are:

- **Structure**: the goods and services produced in the economy
- **Efficiency**: inputs used per unit of output in the economy
- **Substitution**: the ability to substitute away from resources that are becoming scarce
- **Clean technologies and management practices**: the ability to reduce environmental damage per unit of input or output.

Economic policies, environmental policies, and environmental investments all have a role in ensuring that individual behavior takes account of the true value of environmental resources. Economic policies affect the scale, composition, and efficiency of production, which can result in posi-
tive or negative effects on the environment. Efficiency gains from economic policies will often reduce the demand for natural resource inputs. Environmental policies can reinforce efficiency in resource use and provide incentives for adopting less-damaging technologies and practices. The investments that are induced by environmental policies will change the way in which goods and services are produced and may result in lower output but will also generate benefits that can increase human welfare.

As incomes rise, the demand for improvements in environmental quality will increase, as will the resources available for investment. Without incentives to use scarce resources sparingly, the pressure to reduce environmental damage will be weaker, and the adverse effects of economic growth are likely to dominate. But where the scarcity of natural resources is accurately reflected in decisions about their use, the positive forces of substitution, efficiency gains, innovation, and structural change will be powerful. In industrial countries these positive forces contributed significantly to improving environmental quality while maintaining economic growth (Box 1.6).

The environmental problems facing poor countries differ from those facing the better-off (see Figure 4 in the Overview). In some cases environment-
Box 1.6 Delinking growth and pollution: lessons from industrial countries

Industrial countries have achieved substantial improvements in environmental quality along with continued economic growth. A recent report by the OECD described some of the achievements since 1970. Access to clean water, adequate sanitation, and municipal waste disposal is now virtually universal. Air quality in OECD countries is vastly improved; particulate emissions have declined by 60 percent and sulfur oxides by 38 percent. Lead emissions have fallen by 85 percent in North America and by 50 percent in most European cities. Japan, which has spent substantial amounts on pollution abatement, has achieved the largest improvement in air quality. Emissions of sulfur oxides, particulates, and nitrogen oxides as a share of GDP in Japan are less than one-quarter of OECD averages. Persistent pollutants such as DDT, polychlorinated biphenyls (PCBs), and mercury compounds have also been reduced in OECD countries, as has the frequency of large shipping accidents and oil spills. Forested areas and protected lands and habitats have increased in almost all countries. These improvements have been achieved as a result of annual expenditures on antipollution policies equivalent to 0.8-1.5 percent of GDP since the 1970s. About half of these expenditures were incurred by the public sector and half by the private sector.

These improvements in environmental quality are even more remarkable when it is recalled that the economies of the OECD grew by about 80 percent over the same period. In many cases economic growth is being "delinked" from pollution as environmentally non-damaging practices are incorporated into the capital stock (Box figure 1.6).

The OECD report, however, also identified a large "unfinished agenda" of environmental problems, as well as emerging issues, that remain to be addressed. Nitrogen oxides, which are emitted largely by transport sources, have increased by 12 percent since 1970 in the OECD countries (except Japan), reflecting the failure of policies and technology to keep up with increases in transport. Municipal wastes grew by 26 percent between 1975 and 1990 and carbon dioxide emissions by 15 percent over the past decade. Human exposure to toxic pollutants, such as cadmium, benzene, radon, and asbestos, remains a concern. Groundwater is increasingly polluted as a result of salinization, fertilizer and pesticide runoff, and contamination from urban and industrial areas. Soil degradation persists in some areas, and encroachment on coastal regions, wetlands, and other natural habitats is still a concern. A number of plant and animal species are endangered; even larger numbers are threatened.

What does the OECD's experience imply for the environmental agendas of developing countries? First, there are many policy lessons—such as the fact that it is often cheaper to prevent environmental degradation than to attempt to "cure" it later. The costly cleanup of hazardous waste sites in several OECD countries gives an indication of what environmental neglect might mean for other countries in the future. Second, many of the environmentally nondamaging technologies and practices developed in OECD countries can be adapted to the needs of developing countries. Cleaner technologies and practices can be acquired through trade and foreign direct investment, as well as through international cooperation. Third, to the extent that environmental degradation in the OECD countries affects developing countries, as in the case of climate change and ozone depletion, polluters should pay and victims should be compensated.

Box figure 1.6 Breaking the link between growth in GDP and pollution

The theory

- Incentives to protect the environment introduced
- Cleaner and more efficient technologies adopted in response

<table>
<thead>
<tr>
<th>GDP</th>
<th>Pollution</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>150</td>
</tr>
<tr>
<td>150</td>
<td>100</td>
</tr>
<tr>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>50</td>
<td>0</td>
</tr>
</tbody>
</table>

Index (1970=100)

Note: GDP, emissions of nitrogen oxides, and emissions of sulfur oxides are OECD averages. Emissions of particulates are estimated from the average for Germany, Italy, Netherlands, United Kingdom, and United States. Lead emissions are for United States. Sources: OECD 1991; U.S. Environmental Protection Agency 1991.
Environmental quality often improves over time.

Environmental quality improves as income rises. This is because increased income allows societies to provide public goods such as sanitation services and because once individuals no longer have to worry about day-to-day survival, they can afford profitable investments in conservation.

Some problems are observed to get worse as incomes rise. Carbon dioxide emissions and municipal wastes are indicators of environmental stress that appear to keep rising with income. But this is because no incentives yet exist to change behavior. The costs of abatement in these cases are relatively high, and the benefits of changing behavior are perceived to be low—partly because (in the case of carbon dioxide) they would accrue mainly to other countries. When societies have decided to enforce a change in behavior—through regulations, charges, or other means—environmental quality has improved. Progress in reducing water pollution and emissions of particulates, lead, and sulfur dioxide are examples of how higher-income countries have been able to break the link between growth and environmental degradation. This is not easy—it requires strong institutions and effective policies—but it can be done. It explains why so many environmental indicators show an initial deterioration followed by an improvement. As incomes grow, the ability and the willingness to invest in a better environment rise.

Past patterns of environmental degradation are not inevitable. Individual countries can choose policies that lead to much better (or worse) environmental conditions than those in other countries at similar income levels. In addition, technological change, coupled with improved understanding of the links between economic activity and environmental damage, is enabling countries to grow more rapidly with less environmental impact than was possible earlier. Figure 1.5 illustrates this for a cross-section of countries. At any given income level, a higher proportion of people in any country is likely to have access to sanitation today than in the past. The same can be true of progress in reducing air pollution. Concentrations of sulfur dioxide are lower today than in the past, so that someone living in a country with a per capita income level of $500 is more likely to breathe cleaner air than in previous decades. The adoption of environmental policies and the investment and technological innovations induced by such policies imply that the environmental mistakes of the past do not have to be repeated.

The nature of the challenge

During the working lifetime of children born today, the population of the world will almost double. By the middle of the next century almost one-third of the world’s population will live in countries with a population density of more than 400 per square kilometer—equivalent to the den-
sity of the Netherlands or the Republic of Korea today. The next generation will also see the size of the world economy triple. Under simple extrapolation of current practices, this growth would lead to severe environmental degradation. Yet in virtually every economic sector, environmentally less damaging practices are available and are in use in a number of countries. For almost every challenge— in water supply and sanitation, or energy and industrial output, or food production—there are possibilities for growing more sustainably.

The challenge for water supply and sanitation will be to respond to the backlog of demand while meeting the needs of growing populations. Making clean water available to everyone in the next generation will require that service be extended to an additional 3.7 billion people living in urban areas and about 1.2 billion rural inhabitants. Since only about 1.5 billion urban residents currently have access to clean water, the magnitude of the task is apparent. For sanitation the problem is even larger; the number of urban dwellers currently served is little more than 1 billion. For a country like Nigeria, providing access to clean water for the entire population by 2030 will imply increasing the number of urban connections by four times and the number of rural connections by almost nine times. To prevent the number of people without access to adequate sanitation from rising, the population covered will have to increase to 6.5 times the current number. Policies to meet these challenges are discussed in Chapter 5.

The challenge for energy and industry will be to meet the projected growth in demand while controlling pollution. Total manufacturing output in developing countries will increase to about six times current levels by 2030. Average emissions of air pollutants per unit of electric power generated would have to be reduced by 90 percent to avoid an increase in total emissions from this activity. Emissions from heavily polluting industries—chemicals, metallurgy, paper, and building materials—will also require large reductions in discharges of air and water pollutants and in wastes produced if a worsening of industrial pollution is to be prevented. In the Philippines, for example, manufacturing output is likely to grow to nine or ten times the current level, and demand for electric power will rise even more rapidly. This means that many industries will have to reduce emissions per unit of output by between 90 and 95 percent to avoid worsening pollution.

The technologies for achieving such reductions in pollution from energy and industry already exist in most instances. Many possibilities also exist for dramatic improvements in pollution prevention—switching to cleaner-burning fuels or recycling industrial wastewater, for example. Cleaner processes often yield productivity gains and cost reductions as well because they use materials more frugally. The scope for pollution abatement and prevention in industry and energy, and the policies for inducing these new technologies, are discussed in Chapter 6.

The challenge for agriculture will be to meet developing countries' expected demand for food. Total world consumption of cereals will have to almost double by 2030. To protect fragile soils and natural habitats, almost all of this increase will have to be achieved by raising yields on existing cropland rather than by extending the area under cultivation. There is little doubt that cultivated soils have the capacity to meet future increases in world agricultural demand so long as they are well managed. But intensification of production will involve the application of much higher levels of fertilizers and pesticides, as well as significant improvements in the allocation of water for agricultural use. Doubling food production in India by 2030 can be achieved by maintaining past rates of crop yields but will require a fourfold increase in fertilizer application. By 2030 average yields in India would have to reach the level of those in China today.

Such gains in food production increase the risk of soil degradation, misuse of pesticides, spillovers from chemical applications, and excessive drawdown of water. Techniques such as integrated pest management, minimum tillage, agroforestry, integrated crop and livestock management, and soil-enriching crop rotations will be needed to reduce land degradation and increase yields. This will often require better-educated farmers, and sometimes social changes as well. When governments are committed to allocating resources to research and extension services and to providing undistorted incentives, many farmers are quick to adopt these less-damaging practices. Policies for improving the management of natural resources, especially of agricultural land, will be discussed in Chapter 7.

Policies and institutions

Without technologies and practices that can be applied at reasonable cost, environmental improvement is difficult. But without the backing of appropriate policies, even the most environmentally
helpful technologies and practices will not necessarily be applied, unless (as is often the case in industry) they are more productive than existing methods. The principles of sound environmental policy (described in Chapter 3) are well understood. But they are difficult for national governments to introduce and are even more difficult to translate into international agreements. National governments may be reluctant to challenge those who cause environmental damage; they are likely to be the rich and influential, while those who suffer most are often the poor and powerless. The institutional obstacles to sustainable development are discussed in Chapter 4.

If institutional obstacles to addressing national environmental problems are large, they are even greater for international problems such as greenhouse warming and the preservation of biodiversity. It may be difficult to reach agreement among many different countries, each of which may perceive its national interest differently. If countries do not think that the benefits of agreement are worth more to them than the costs of refusing to cooperate, they may be willing to join only if other countries are willing to compensate them for doing so. The complications of addressing global environmental problems are analyzed in Chapter 8.

A strategy for sustaining development

The challenges facing this generation are formidable. Many countries have not yet achieved acceptable living standards for their people. Economic growth that improves human welfare is urgently needed. Protecting the environment will be an important part of improving the well-being of people today, as well as the well-being of their children and grandchildren. This Report suggests a threefold strategy for meeting the challenge of sustainable development.

- Build on the positive links. Policies for growth promote efficient use of resources, technology transfer, and better-working markets—all of which can help in finding solutions to environmental challenges. Rising incomes can pay for investments in environmental improvement. Policies that are effective in reducing poverty will help reduce population growth and will provide the resources and knowledge to enable the poor to take a longer-term view.

- Break the negative links. Rising incomes and technological advances make sustainable development possible, but they do not guarantee it. Usually, additional incentives that capture the true value of the environment will be required to induce less-damaging behavior. Effective environmental policies and institutions are essential.

- Clarify and manage the uncertain links. Many relationships between human activity and the environment remain poorly understood, and there will always be surprises. The response should be investment in information and research and the adoption of precautionary measures, such as safe minimum standards, where uncertainties are great and there is a potential for irreversible damage or high costs in the long run.