



Public policies to ensure environmental sustainability

Ensuring environmental sustainability—the seventh Millennium Development Goal—requires achieving sustainable development patterns and preserving the productive capacity of natural ecosystems for future generations. Both efforts in turn require a variety of policies that reverse environmental damage and improve ecosystem management. The challenge has two dimensions: addressing natural resource scarcity for the world's poor people and reversing environmental damage resulting from high consumption by rich people.

Many environmental problems arise from the production and consumption patterns of non-poor people, particularly in rich countries. Rich countries consume a lot of fossil fuels and deplete many of the world's fisheries, damaging the global environment. They also use a lot of tropical hardwoods and products from endangered species.

To ensure the sustainability of Earth and its resources, including the development prospects of poor countries, these harmful production and consumption patterns must change. Energy systems will have to generate much lower greenhouse gas emissions. Fisheries will have to be managed based on ecological limits rather than heavily subsidized free-for-alls. And international rules of the game will have to mitigate the overconsumption that endangers ecosystems and certain plants and animals. But with smart policies and new technologies, the costs of these changes can be quite low.

At the same time, many environmental problems stem from poverty—often contributing to a downward spiral in which poverty exacerbates environmental degradation and environmental degradation exacerbates poverty. In poor rural areas, for example, there are close links among high infant mortality, high fertility, high population growth and extensive deforestation, as peasants fell tropical forests for firewood and new farmland.

Given this chain of causation, policies that reduce child mortality can help the environment by lowering population growth and reducing demographic pressures on fragile ecosystems. Other examples of poverty contributing to environmental degradation abound.

Thus reducing poverty can play a pivotal role in environmental protection. Worsening environmental conditions—including depletion of natural resources and degradation of ecosystems and their services—hit poor people the hardest. And when poor people degrade the environment, it is often because they have been denied their rights to natural resources by wealthy elites. In many cases, for example, poor people are forced onto marginal lands more prone to degradation.¹

Around the world, 900 million people live in absolute poverty in rural areas, depending on the consumption and sale of natural products for much of their livelihoods. In Tanzania poor people derive as much as half of their cash incomes from the sale of forest products such as charcoal, honey, firewood and wild fruits.² The least developed countries are the most dependent on agriculture and natural resources. Yet relying on primary products—agricultural and forest products, minerals, fish—for export earnings makes developing countries highly vulnerable to resource depletion and worsening terms of trade.

The relationship between poverty and environmental resources also has a strong gender component. Poor women and girls are hurt disproportionately by environmental degradation, often because they are responsible for collecting fuel, fodder and water. In many countries deforestation forces rural women and girls to walk farther and spend more time and energy collecting fuel wood. In Africa they spend up to three hours a day just fetching water, expending more than a third of their daily food intake.³

Goal 7: Ensure environmental sustainability

Target 9: Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources

Target 10: Halve, by 2015, the proportion of people without sustainable access to safe drinking water

Target 11: By 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers

BOX 6.1

How global climate change threatens developing countries

Global climate change is expected to increase the economic disparities between rich and poor countries, especially as temperatures increase. The estimated damage for poor countries partly reflects their weaker adaptive capacity. Hence climate change is a major development issue.

Climate change could lead to large-scale, possibly irreversible changes in Earth systems, with effects at the global and continental levels. Though the likelihood and scope of these effects are not well known, they will be significant and so must be reflected in policy-making. Potential effects include:

- Reduced crop yields in most tropical and subtropical regions and increased variability in agricultural productivity due to extreme weather conditions (droughts and floods).
- Increased variability of precipitation during Asian summer monsoons, which could reduce food production and increase hunger.
- Reduced water availability in many water-scarce regions, particularly subtropical regions. Increased water availability in some water-scarce regions—such as parts of South-East Asia.
- Increased destruction of coral reefs and coastal ecosystems and changes in ocean-supported weather patterns.
- Rising sea levels. With a 1 metre rise in sea level, partly due to global warming, Egypt could see 12% of its territory—home to 7 million people—disappear. Rising seas threaten to make several small island nations—such as the Maldives and Tuvalu—uninhabitable, and to swamp vast areas of other countries.
- Increased exposure to vector-borne diseases (malaria, dengue fever) and water-borne diseases (cholera).

Source: IPCC 2001a, b; UNDP 1998.

Poor people tend to suffer the most from air and water pollution. They spend more of their household incomes on energy, yet the services they receive are often of low quality—such as biomass fuels burned in inefficient, polluting stoves, or kerosene lamps that cost more per unit of illumination than lamps powered by an electricity grid.

Poor people are also the most vulnerable to environmental shocks and stresses, including floods, prolonged droughts and the emerging effects of global climate change (box 6.1). Moreover, they are the least capable of coping with such shocks and stresses. In dryland India biodiversity-

related products (such as wild fruits or honey) usually account for about 20% of the incomes of poor rural people. But during droughts they account for more than 40% because cultivated crops fail.⁴

Ignoring environmental sustainability, even if doing so leads to short-run economic gains, can hurt poor people and undermine long-run poverty reduction.⁵ The strong links between poverty and the environment call for a focus on the needs of people whose livelihoods depend on natural resources and environmental services. In policy and practice, environmental management should create income-generating opportunities, strengthening people's property and user rights and fostering their participation in political decision-making.

The links between poverty and the environment also run in the other direction. Poor people are often deprived of the means and rights to invest in the sustainable use of environmental resources through improved water treatment and sanitation, cleaner energy technologies and so on. Poor people also lack the money to invest in substitutes for environmental services.

Ever-expanding consumption hurts the environment through polluting emissions and wastes. Growing depletion and degradation of renewable resources also undermine livelihoods. Over the past 50 years carbon dioxide emissions quadrupled, with much of the increase occurring in rich countries. In 1999 per capita carbon dioxide emissions in high-income OECD countries exceeded 12 metric tonnes—compared with 0.2 tonnes in the least developed countries.

Because of their larger contributions to global environmental degradation and their greater financial and technological resources, rich countries bear much of the responsibility for addressing environmental concerns. Rich countries also need to help poor ones pursue environmentally sustainable development. Achieving the Millennium Development Goals requires policies that stress the complementarity between sustainable development and environmental management and that minimize the trade-offs. Indeed, ensuring environmental sustainability is essential for achieving the other Goals (table 6.1).

ENVIRONMENTAL RESOURCES

Ecosystems and natural resources, fundamental to so many productive activities, contribute much to the global economy. In the late 1990s agriculture accounted for nearly a quarter of the GDP of low-income countries.⁶ Industrial wood products contributed \$400 billion to the global economy in the early 1990s, and fisheries accounted for \$55 billion in exports in 2000.⁷

Scarce natural resources and ecosystem stresses often force unwanted trade-offs on poor communities. A community can get more food by converting a forest to farmland, but in doing so it may lose environmental services such as timber, biodiversity, clean water, flood regulation and drought control.

FOOD

Human well-being depends on natural resources and environmental services that help produce food. People rely on soils to grow crops, grasslands to raise livestock and freshwater and oceans to support fisheries. Underlying much of this productivity: genetic resources. Over centuries farmers have generated crucial stocks of knowledge and productivity by breeding livestock and selecting, storing and propagating plant varieties. Diverse genetic resources enable farmers to adapt to environmental change by creating new livestock and plant varieties better suited to new conditions. In periods of scarcity, wild biodiversity is also a source of alternative food products.

WATER

Natural resource mismanagement and degradation threaten vital water services—undermining economic growth, human well-being and environmental resilience. About 1.7 billion people, a third of the developing world’s population, live in countries facing water stress (defined as countries that consume more than 20% of their renewable water supply each year). If current trends persist, this number could increase to 5.0 billion people by 2025.⁸ Limited access to water is weakening the development prospects of many countries, and conflicts over water use and distribution are a common cause of international disputes.

TABLE 6.1

Why reaching the environmental Goal is so important for the other Goals

Goal	Links to the environment
1. Eradicate extreme poverty and hunger	Poor people’s livelihoods and food security often depend on ecosystem goods and services. Poor people tend to have insecure rights to environmental resources and inadequate access to markets, decision-making and environmental information—limiting their capability to protect the environment and improve their livelihoods and well-being. Lack of access to energy services also limits productive opportunities, especially in rural areas.
2. Achieve universal primary education	Time spent collecting water and fuel wood reduces time available for schooling. In addition, the lack of energy, water and sanitation services in rural areas discourages qualified teachers from working in poor villages.
3. Promote gender equality and empower women	Women and girls are especially burdened by water and fuel collection, reducing their time and opportunities for education, literacy and income-generating activities. Women often have unequal rights and insecure access to land and other natural resources, limiting their opportunities and ability to access other productive assets.
4. Reduce child mortality	Diseases (such as diarrhoea) tied to unclean water and inadequate sanitation and respiratory infections related to pollution are among the leading killers of children under five. Lack of fuel for boiling water also contributes to preventable waterborne diseases.
5. Improve maternal health	Inhaling polluted indoor air and carrying heavy loads of water and fuel wood hurt women’s health and can make them less fit to bear children, with greater risks of complications during pregnancy. And lack of energy for illumination and refrigeration, as well as inadequate sanitation, undermine health care, especially in rural areas.
6. Combat major diseases	Up to 20% of the disease burden in developing countries may be due to environmental risk factors (as with malaria and parasitic infections). Preventive measures to reduce such hazards are as important as treatment—and often more cost-effective. New biodiversity-derived medicines hold promise for fighting major diseases.
8. Develop a global partnership for development	Many global environmental problems—climate change, loss of species diversity, depletion of global fisheries—can be solved only through partnerships between rich and poor countries. In addition, predatory investments in natural resources can greatly increase pressure to overexploit environmental assets in poor countries.

Source: Based on UNDP; DFID; World Bank.

ENERGY

More than 2 billion people lack access to electricity and the services it provides, including lighting, refrigeration, telecommunications and mechanical power.⁹ These services are essential to delivering education and health care and to creating productive employment opportunities.

In the poorest countries more than 80% of energy comes from traditional sources such as dung, crop residue and fuel wood.¹⁰ Inefficient stoves and heating technologies often force local people to gather traditional fuels at a rate that exceeds the natural regeneration of these resources, degrading land. Cooking with such fuels can produce extremely high levels of health-damaging air pollutants, both indoors and out. Solutions to such problems involve linking changes in energy consumption patterns in rich countries to the use of low-cost, low-emission technologies in developing countries.

Transportation, the most energy-intensive sector, is a key challenge for achieving sustainable energy use. Governments should provide incentives for consumers and producers to switch to more efficient vehicles and more sustainable resource use. The price of petrol, much of which is determined by taxes, can make a big difference. Among OECD countries Canada and the United States have some of the lowest petrol prices—and, not surprisingly, the highest

per capita consumption. Austria and Japan have among the highest petrol prices—and per capita consumption one-quarter the US level and one-third the Canadian level (figure 6.1). In India petrol costs four times as much (at market exchange rates) as in the United States.

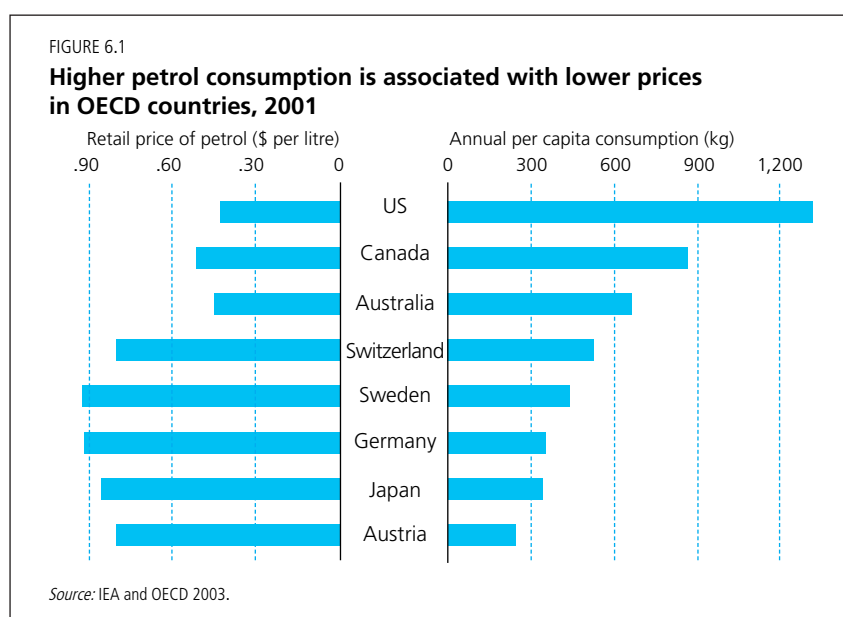
LIVELIHOODS

Natural resources and environmental services are a direct source of livelihood for many people—especially poor people in rural areas, who are the most severely affected when the environment is degraded or access to environmental assets is limited or denied. By maintaining the environment's health and productivity, natural resources and environmental services maintain livelihood options and potential for diversification. Variety is essential because poor people need to be able to diversify their use of natural resources and environmental services as conditions change.¹¹

POLICY RESPONSES

Policy interventions to address natural resource scarcity for the world's poor people—and to reverse environmental damage from overconsumption in rich countries—must take into account the diversity of the natural environment, the many and varying causes of environmental degradation and the complex links between poverty and the environment. Interventions should also draw on past efforts to improve environmental management:

- Environmental management cannot be treated separately from other development concerns. To achieve significant, lasting results, it must be integrated with efforts to reduce poverty and achieve sustainable development. Improving environmental management in ways that benefit poor people requires policy and institutional changes that cut across sectors and lie mostly outside the control of environmental institutions—including changes in governance, domestic economic and social policies and international and rich country policies.¹²
- Successful environmental policies must see poor people not as part of the problem but as part of the solution (boxes 6.2 and 6.3).



- Environmental problems must be actively managed as part of the growth process. Environmental improvements cannot be deferred until rising incomes make more resources available for environmental protection.

Six policy principles should guide environmental policies:

- Strengthening institutions and governance.
- Making environmental sustainability part of all sector policies.
- Improving markets and removing environmentally damaging subsidies.
- Bolstering international mechanisms for environmental management.
- Investing in science and technology for the environment.
- Increasing efforts to conserve critical ecosystems.

STRENGTHENING INSTITUTIONS AND GOVERNANCE

Many environmental problems are grounded in institutional failures and poor governance. Three institutional failures are especially important for environmental management: inadequate property and user rights, insufficient information and opportunities for local stakeholders to participate in decision-making and weak monitoring and enforcement of environmental standards (box 6.4).

At the international level institutional and governance problems are evident in struggles to develop fair, effective systems to manage global resources such as oceans and the climate. At the national level weak property and user rights are a common cause of environmental problems such as deforestation, overgrazing and over-fishing. Managing open access to a common resource is difficult because the decisions of individuals and companies are based on private costs and benefits—and so can reduce environmental and community well-being.

To respond, local people must have the power to manage the environmental systems on which their livelihoods depend. How? Partly by clarifying overall property and user rights to common resources, which may require reforming policies and institutions that control access to land and natural resources. And partly by

BOX 6.2

Improving the lives of slum dwellers

An estimated one-third of the developing world’s urban population lives in slums. They contend with overcrowding, substandard housing and poor access to safe water and sanitation—resulting in high rates of disease and infant mortality.

Rapid urban growth suggests that the problems of slum dwellers will worsen in cities already vulnerable. The United Nations projects that between 2000 and 2010, 85% of the growth in the world’s population will occur in urban areas—almost entirely in Africa, Asia and Latin America. In 2001 more than 70% of the urban populations in the least developed countries and Sub-Saharan Africa lived in slums. Without substantial interventions, this figure will increase.

Millennium Development Goal 7 calls for significant improvements in the lives of at least 100 million slum dwellers by 2020. Traditionally, donors have been less focused on the needs of urban residents. But with growing pressure to manage rapid urban growth, that is beginning to change.

Though cities are often associated with environmental destruction, their high population densities offer opportunities to build crucial infrastructure—such as sanitation, transport and health care services—at lower costs per capita than in rural areas. Urban environments can also offer better prospects for making governments more responsive and accountable to people’s needs. The success of slum dweller associations around the world—such as in Mumbai, India, and Nairobi, Kenya—suggests that higher population densities and closer proximity to decision-makers enable poor urban residents to make their voices heard.

Total, urban and slum populations worldwide, mid-2001

Region	Total population (billions of people)	Urban population (percent)	Urban slum population (percent)	Urban slum population (thousands of people)
World	6.1	47.7	31.6	923,986
Rich regions	1.2	75.5	6.0	54,068
Developing regions	4.9	40.9	43.0	869,918
North Africa	0.2	52.0	28.2	21,355
Sub-Saharan Africa	0.7	34.6	71.9	166,208
Latin America and the Caribbean	0.5	75.8	31.9	127,567
East Asia and Oceania	1.4	39.0	36.3	194,323
South-Central Asia	1.5	30.0	58.0	262,354
South-East Asia	0.5	38.3	28.0	56,781
West Asia	0.2	64.9	33.1	41,331
Central and Eastern Europe and CIS	0.4	62.9	9.6	24,831

Estimates from African Population and Health Research Center, in collaboration with UN HABITAT. Source: UN-HABITAT 2002; UN 2002i.

strengthening women’s property rights, because women tend to be more dependent on environmental resources for their livelihoods.

Decentralization can improve environmental governance (see chapter 7). But it should be accompanied by efforts that build community capacity to manage environmental resources and influence planning and policy-making. Respecting the rights of marginal and indigenous groups, who often rely on natural resources for

BOX 6.3

Involving local residents in conservation in Guanacaste, Costa Rica

Since its inception in 1985, Costa Rica's Area de Conservación Guanacaste (ACG) has exemplified a new model of conservation—one featuring decentralized decision-making, a commitment to making wild land a productive asset and a focus on making conservation economically sustainable. Designated as a World Heritage site by the United Nations Educational, Scientific and Cultural Organization, the ACG encompasses 2% of Costa Rica's national territory and is home to more than 235,000 species—65% of the country's biodiversity.

Through a local council, civil society is involved in decision-making on the area, which is one of the region's largest employers and hires only native Costa Ricans. More than \$45 million has been invested in

the area's development, and its annual budget of \$1.5 million is spent directly in the area and neighbouring towns. Local businesses benefit from the influx of visitors. In addition, the ACG serves as a springboard for applied research being conducted by the National Institute for Biodiversity: forest restoration will increase the habitat available to search for profitable natural chemicals. Other environmental services provided by the ACG include eco-tourism, water generation and carbon storage.

The main lesson of Guanacaste is that protected areas must be managed entirely at the local level, with resources suitable for their sustainability. The ACG manages and develops 2% of the country at almost no cost to Costa Rican taxpayers.

Source: Janzen 2000, pp. 122–32; UNDP 2001a.

BOX 6.4

Promoting equity and the environment—a creative fiscal example from Brazil

In 1992 most Brazilian states adopted an ecological value added tax (Imposto sobre Circulação de Mercadorias e Serviços, or ICMS-E). A levy on goods, services, energy and communications, the tax is the largest source of revenue in Brazil. One-quarter of the revenue goes to municipalities, with allocations to individual municipalities based on various indicators of environmental performance. The states of Paraná and Minas Gerais, for example, distribute revenue based on the proportion of protected areas in each municipality, weighted by a conservation factor related to protection of each area.

The ICMS-E was intended to compensate municipalities with large conservation areas for the resulting loss of revenue. Revenue from the tax is often used to maintain parks and reserves, including tool purchases and employee salaries.

In some states the tax appears to have significantly increased the number and size of protected areas. In Paraná conservation areas grew by more than 1 million hectares between 1991 and 2000—a 165% increase. During 1995–2000 Minas Gerais also added more than 1 million hectares—a 62% increase.

Source: May and others 2002.

much of their incomes, is particularly important.

In many developing countries natural resources are plundered by corruption, benefiting powerful elites at the expense of poor people who depend on such resources. Countering corruption requires strengthening governance, with better enforcement, stiffer penalties and increased community involvement. In several countries citizens are assessing how well governments provide access to environmental decision-making and regularly monitoring environmental governance. Both efforts will likely spur further progress.¹³

*MAKING ENVIRONMENTAL SUSTAINABILITY
PART OF ALL SECTOR POLICIES*

Most sector policies affect the environment, but too often environmental considerations do not inform policy-making. More scientific advice can ensure that understanding of the natural world feeds into the political process at all levels. Economic analysis, incorporating valuations of environmental assets, should also inform policy-making in all sectors.

Sector policies with significant effects on the environment should be subject to rigorous environmental impact assessments. In addition, Poverty Reduction Strategy Papers—as well as national development and sector strategies—should explicitly address environmental protection and management. National governments, multilateral organizations and bilateral aid agencies need to systematically incorporate environmental impact assessments into their policies and programmes.

Social policies related to the Millennium Development Goals also affect environmental quality (see chapter 4). Investments in human development, particularly in education for women and girls, offer numerous environmental benefits, including reduced population pressure. So, environmental policies need to address the gender dimensions of the links between poverty and the environment, integrating them into the formulation, implementation and monitoring of Poverty Reduction Strategies and related policy reforms.

National frameworks, such as strategies for sustainable development, should guide policies for natural resource management in light of a country's specific resources and concerns. Many national environmental action plans fail to address their effects on other sectors and on the needs of poor people. To improve environmental policy-making, such plans should explicitly address these concerns—as well as their contributions towards reaching the Goals.

*IMPROVING MARKETS AND REMOVING
ENVIRONMENTALLY DAMAGING SUBSIDIES*

The normal operations of markets drive apart private gains and social costs because productive

activities often generate private benefits for economic agents but impose costs on society. Thus regulation or corrective taxation may be required to align private and public incentives with the need for environmental protection.

Especially harmful are government policies, such as direct or hidden subsidies, that send the wrong signals by pricing environmental resources inappropriately. Reducing environmentally damaging subsidies is often far more cost-effective than directly regulating economic activity. Reflecting environmental costs in market prices—through pollution charges and other market-based policies—also promotes environmentally sound practices and sustainable use of natural resources.

Prices for irrigation water are an important example. Even though water is becoming more scarce in many countries, it tends to be provided to users almost free of charge. That approach promotes waste, increases soil waterlogging and salinization and discourages farmers from investing in water conservation. Other environmentally damaging policies include subsidies that promote large-scale commercial fishing and forestry and excessive use of agricultural chemicals such as fertilizers and pesticides (boxes 6.5 and 6.6).

Topping the list of damaging subsidies, however, are those for fossil fuel consumption. Worldwide, their value exceeds all foreign aid from all sources.¹⁴ There is growing consensus that energy subsidies should focus on expanding access to technology, developing and disseminating cleaner fuels and increasing end use efficiency—not promoting consumption. As some European countries show, pricing fossil fuels appropriately can provide a powerful incentive for increasing the use of renewable energy. The lower unit costs of renewable energy technologies benefit both rich countries and developing countries considering their adoption.

Policy interventions should also account for the impact of economic activities on environmental assets. National income accounts (such as GDP) should differentiate between income from sustainable use of natural resources (sustainable agriculture and forestry) and from activities that reduce stocks of natural capital (extracting minerals or oil). These accounts should

BOX 6.5

Global fisheries—getting sunk by subsidies

Around the world, fish stocks are being depleted because of unrestricted, highly advanced fish harvesting. Overfishing occurs in Asia, parts of Africa and Latin America and many small island countries—with overfishing by local residents often aggravated by fishing fleets from rich countries. According to the United Nations Food and Agriculture Organization, more than a quarter of the world's fisheries are overexploited or depleted.

Global subsidies for fishing are conservatively estimated at \$10–15 billion a year—about a quarter of the annual \$56 billion trade in fish. These loans, tax incentives and direct payments often support distant fleets that are too large given available

fish stocks. The United States provides about \$400,000 a boat to help its fishers catch tuna in the South Pacific. In 1996 the European Union spent \$252 million—a third of its budget for fisheries—on access agreements for its fleets to fish in distant waters. The European Union also continues to spend more on harmful subsidies—such as to build new boats or modernize old ones (1.2 billion euros in 2000–06 from EU and national budgets)—than on efforts to reduce fishing (1.1 billion euros). According to the World Bank, only 5% of fishing subsidies have a positive environmental aim. Most reduce fish stocks and hurt marine ecosystems.

Source: Institute for European Environmental Policy 2002; WWF 1998; IFPRI 2001; Milazzo 1998.

BOX 6.6

Felling forests—with subsidies

In 1998 the Group of Eight (Canada, France, Germany, Italy, Japan, the Russian Federation, the United Kingdom, the United States) committed to protecting the world's forests. But some G-8 members continue to subsidize forest industries—undermining forest protection and accelerating forest loss.

Among the most pervasive subsidies are low charges for logging companies cutting old-growth wood on public lands, tax write-offs for logging companies, government construction of logging roads at no cost to the companies that will use them and direct grants to logging companies for, say, planning costs. Canada, Japan and the United States are the leading G-8 subsidizers. Among European members, France stands out as the only government with direct investments in logging companies.

Canada's subsidies total \$2.0–2.7 billion a year. Japan subsidizes sawmills that process logs imported from old-growth forests in Canada, Siberia and elsewhere, and its export promotion agencies support programmes that destroy old-growth forests and hurt traditional communities in Australia, Indonesia and elsewhere. In the United States timber sale programmes in national forests cost taxpayers more than \$2 billion in 1992–97. France is building roads and making related logging investments in environmentally sensitive areas of Central Africa. Numerous studies have shown that such road building does serious harm to the region's primary tropical forests. The Russian Federation's forests are beset by massive illegal logging. Not collecting taxes and fees from such operations is a type of subsidy, offset somewhat by the high risks of doing business in the country.

Source: Sizer 2000; Myers and Kent 1998.

also include the effects of economic activities on environmental quality and productivity, such as soil and water degradation.

Such “green” accounts place environmental problems in a framework that economic ministries understand. They also encourage decision-makers in finance, planning and sector ministries to pay more attention to environmental degradation. When the costs of environmental degradation and natural resource

depletion are accounted for, Sub-Saharan Africa's net savings rate goes from positive to negative in most years between 1976 and 2000.

*BOLSTERING INTERNATIONAL MECHANISMS
FOR ENVIRONMENTAL MANAGEMENT*

Environmental degradation rarely stops at national borders, yet many environmental policies and institutions do. International watersheds, fisheries, pollution and climate change pose environmental policy challenges that must be addressed by countries working together—because the actions of one country affect the welfare of others. Compounding the problem are the unequally distributed benefits of environmental services and the costs of managing them within and between countries.

BOX 6.7

Policy responses to climate change

Scientific evidence strongly supports immediate action to curb the greenhouse gas emissions that cause global warming. The 1997 Kyoto Protocol places most of this burden on rich countries—because while they contain only 16% of the world's population, they generate 51% of such emissions.

The protocol calls on rich countries to reduce carbon dioxide emissions by at least 5% of 1990 levels by 2008–12. Supporters of the protocol see this as an important step towards mitigating climate change. Opponents castigate it for unnecessarily high implementation costs—due to restrictions on emissions trading—and for a lack of emission limits for poor countries. Another criticism is that, even if fully implemented, the protocol would reduce the average global temperature by less than 0.15 degrees Celsius by 2100.

The United States, which produces 25% of global greenhouse gas emissions, has refused to ratify the protocol. Without US participation, no international agreement on climate change is likely to significantly reduce the threat of global warming. But international cooperation is required to provide incentives for the private sector, consumers and governments to reduce greenhouse gas emissions.

To increase acceptance of the protocol, more attention should be paid to minimizing the costs of combating climate change. It will also be important to build on the Clean Development Mechanism, which permits reductions in carbon emissions through innovative international trading systems.

In addition, there is scope for long-term reductions in greenhouse gas emissions in rich and poor countries beyond the terms of the Kyoto Protocol:

- Developing clean energy technologies—solar or wind energy, fuel cells, hydropower, geothermal energy—that release little or no carbon dioxide. Making these technologies cost-competitive with fossil fuels will require increasing public investment in research and development and removing fossil fuel subsidies.
- Developing safe, economical carbon sequestration technologies that prevent the release of carbon dioxide into the atmosphere. Promising examples include natural carbon sinks such as forests, sequestration in deep seas and mines and chemical fixation of carbon dioxide as thermodynamically stable metal carbonates.
- Increasing energy efficiency through more efficient vehicles, appliances, lighting and industrial motors, and through reduced electricity transmission losses.

Source: UN 1997; Nordhaus and Boyer 1999, pp. 93–130; World Bank 2003; Baumert and others 2002.

Several international environmental agreements have drawn attention to the need to manage the global environment. But implementation of these agreements could be improved. Greater emphasis should be placed on the needs of poor people, particularly in reaching the Goals. And more needs to be done to build developing countries' capacity to implement these agreements and integrate them with national policy-making.

New institutional arrangements may be needed to coordinate national policies in response to regional and global environmental challenges. Stronger cooperation is needed for regional environmental management. The countries along the Rhine river show how costs and benefits can be shared in managing an international watershed.

Intergovernmental processes tend to be difficult to organize and slow to execute, but they are the only realistic way to address cross-border pollution and ecosystem degradation. International agreements should share burdens equitably and ensure that the benefits of better environmental management accrue to the local people who bear the direct costs and lost opportunities of environmental resource protection. The Montreal Protocol—the international agreement to protect the ozone layer—has been a resounding success of global environmental policy. But its implementation was facilitated by cost-effective alternatives to ozone-depleting substances, limiting the need for extensive benefit- and cost-sharing between rich and poor countries.

Although rich countries produce most of the emissions that lead to global warming, the effects are felt all over the world. Meanwhile, progress on curbing these emissions has been mixed (box 6.7).

*INVESTING IN SCIENCE AND TECHNOLOGY
FOR THE ENVIRONMENT*

Available technologies can go a long way towards addressing complex environmental challenges cost-effectively. Needed are ways to provide these technologies to people who need them most. In poor countries this will often require significantly strengthening institutional capacities for technological cooperation.

Improving technologies for environmental problems will require dramatically reorienting research and development policies. In rich countries public investment in energy research and development—including for renewable energy—has dropped precipitously over the past two decades.¹⁵ Given the need to address climate change, increased investment is essential to expand markets for renewable energy technologies and lower unit costs, benefiting rich countries and enabling poor countries to adopt the same solutions.

Scientific understanding of the natural world is substantial, but a remarkable amount remains unknown. No mechanism exists to track major ecosystems and their continued ability to produce needed goods and services. A Life Observatory should be established to systematically monitor major ecosystems such as coastal habitats, major watersheds and wetlands. Such an observatory would complement current efforts, including the Global Terrestrial Observing System, the Global Climate Observing System and the Global Ocean Observing System.

The Life Observatory should build on the Millennium Ecosystem Assessment, a four-year effort involving 1,500 scientists compiling the best available knowledge on the world's ecosystems and the services they provide. The Life Observatory would ensure that these analyses are continuously updated to map the long-term effects of human activities on specific ecosystems.

To devise responses, policy-makers require reliable scientific forecasts of human-induced environmental change. Environmental indicators

that accurately track the environment should be developed and integrated with national policy-making. Long-term planning should factor in projected changes in climate and changes to specific ecosystems to assess how these trends will affect development progress and needs.

INCREASING EFFORTS TO CONSERVE CRITICAL ECOSYSTEMS

Creating protected areas is often the best way to conserve species diversity and critical ecosystems. More than 60% of terrestrial species are found in 25 ecoregions on just over 1% of Earth's land surface. These biodiversity hotspots face extreme threats that have already caused a 70% loss of their original vegetation.¹⁶

The best hope for conserving biodiversity and critical ecosystems is for the world's governments, scientists and other key stakeholders to set priorities and cooperate on common goals. Conservation efforts are most effective when constructed by experts from a wide array of disciplines, in consultation with local residents.

Well-managed protected areas can generate significant revenues through tourism and innovative financial mechanisms, such as payments for ecosystem services. Local people, particularly poor people, should be seen as part of the solution—not part of the problem. People whose livelihoods depend on protected areas must benefit from them and have a stake in their continued success. Otherwise such efforts will not be sustainable.

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