International environmental concerns

International environmental problems are more complicated to solve than national ones, for two reasons. First, no single authority can lay down and enforce appropriate policies. Second, solutions must accommodate large variations in the balance of benefits and costs to different countries. Some countries may have more pressing local problems and less money for solving them. To secure action, rich countries may sometimes need to pay poor ones.

Given the large uncertainties surrounding the likely effects of greenhouse warming, a wise policy would include measures that both reduce emissions and improve economic performance (for example, the elimination of subsidies for fossil fuel consumption and deforestation); investments in more information to avoid the risks of costly over- or underreaction; precautionary measures to reduce emissions now at modest costs and bring down the costs of future reductions; and financial transfers to help developing countries broaden their technological options. More pragmatic international action is needed to protect biological diversity. Individual countries can do more to manage these resources in their own interests, but additional transfers will be needed to ensure as much conservation as the rest of the world would like.

When the effects of environmental degradation cross national boundaries, an additional layer of complexity is added to the problem of devising and implementing policies. It is not possible to rely, as in an individual country, on a common legal framework, regulatory controls, economic incentives, and, if necessary, the coercive powers of a national government. Solutions to international environmental problems must be based on common principles and rules of collaboration among sovereign states, backed up by persuasion and negotiation. Setting priorities for international environmental policy is also particularly complex. The costs of doing nothing may be borne by other nations; the gains from policies may not accrue to those that take the biggest steps. Above all, the issue of how to give proper weight to the interests of the poor and politically weak lays an especially heavy burden on the world’s more powerful countries.

Earlier chapters of this Report have documented the seriousness of several local environmental issues in the world’s poorer countries. The common good will not be served if international issues that are mainly of concern to rich countries are allowed to divert attention and resources from these pressing problems. In addition, if the poor are to meet the environmental concerns of rich countries, they may reasonably expect to be paid for doing so. The right balance can be achieved, but only if the world’s leaders are prepared to act responsibly and pragmatically.

Three broad classes of issues require international solutions. First, there are regional problems that arise when neighboring countries share a common resource and one country’s actions therefore affect others. Into this category fall most problems of transboundary pollution, including acid rain and the management of international rivers or regional seas.

Second, the world shares certain global environmental resources such as the atmosphere and the deep oceans. Any action by one country that affects such “global commons” has an effect, although perhaps a rather small one, on all other countries. Into this category fall the buildup of greenhouse gases and the thinning of the ozone layer caused by the emission of CFCs. (The term “global commons” as used here reflects its meaning in standard writings on the environment, not necessarily its sense in international law.)

Third, there are resources that clearly belong to
Box 8.1 Enforcing international obligations: how the international legal process works

The international legal system differs from national legal systems in several respects. National systems have a central authority that establishes the law, and institutions that detect breaches and punish violators. In international law there is no central "lawmaker," no central monitoring body, and no courts with compulsory jurisdiction.

Yet international law successfully regulates many economic, technical, and social activities. Most states comply voluntarily, accepting some limitation on their sovereignty in return for similar concessions from other states. That explains, for instance, why states establish international regulations on, say, international telecommunications or gathering data on epidemics—areas in which national law is inadequate.

The rules of international law are either "customary" (based on state practice) or explicitly agreed in treaties. When states perceive cooperation to be in their interest, they negotiate a codification of their areas of agreement. States may then decide to sign legal instruments expressing their approval of the goals. But only through ratification do states take on an obligation to abide by the agreement and incorporate its provisions into national law. Once incorporated, international law benefits from the law enforcement mechanisms used within each state. Treaties may also provide machinery for international enforcement.

The international legal process provides various monitoring and enforcement mechanisms. Among them are the bodies established within the framework of the United Nations Charter, notably the Security Council; fact-finding and diplomatic missions; auditing and reporting systems (for example, those set up by the International Labour Organisation and human rights conventions); and mechanisms created by international treaties (for example, inspection of nuclear sites by the International Atomic Energy Agency). International law relies heavily on the willingness of states to subject their performance to international scrutiny.

What can be done once a breach of an international rule is detected? The International Court of Justice cannot adjudicate unless the parties to a dispute have agreed to submit to its jurisdiction. Other methods for resolving disputes include arbitration, conciliation, mediation, and negotiation. International law can use sanctions, in particular those agreed on in bodies such as the United Nations. As the recent Security Council resolutions against the Iraqi invasion of Kuwait indicate, some sanctions may include the use of force to ensure compliance. Most sanctions, however, apply economic and political pressure.

International law: its role and limitations

Nations adhere to international agreements covering the environment because they judge such agreements to be in their own interest. The gains from cooperation can be large, but as Box 8.1 explains, the enforcement and monitoring of international agreements present several difficulties.

Building an international consensus is often slow and costly. The United Nations Convention on the Law of the Sea (UNCLOS) took more than ten years to negotiate and, a decade after the end of negotiations, still has not come into force. The time was not entirely wasted. The negotiations over the UNCLOS led to a codification of decisions to create exclusive economic zones extending 200 miles out to sea. Most countries have recognized the economic and environmental benefits of "nationalizing" what were once international waters and have therefore adopted these specific measures. There was no such consensus on the notion of creating a supranational authority with powers to ensure the equitable distribution and manage-

one country but have values for the international community which are not reflected in the market. They include tropical rainforests, other special ecological habitats, and individual species.

Some lessons from experience

Growing awareness of environmental issues has prompted institutional innovation at the international, as well as the national, level. Intergovernmental organizations such as the EC, the OECD, the Organization of African Unity, and the Organization of American States have extended their areas of cooperation to include the environment. A whole range of specialized bodies, official and nongovernmental, concern themselves with particular international environmental problems such as pollution at sea, the management of nuclear and toxic wastes, the protection of endangered species, and the conservation of ancient monuments. The UNEP plays a special coordinating role and has been the focal point for establishing legal regimes for international environmental issues.
ment of the mineral and other resources in the deep oceans.

Governments have, however, reached a number of more limited agreements on marine pollution. International conventions prohibit the dumping of radioactive and other wastes in the oceans, and there are internationally agreed procedures for handling many other wastes. Guidelines governing the maritime transport of dangerous goods have been adopted by many countries. Since the guidelines are broadly recognized as best practice, operators have strong incentives to abide by them.

Drawing on and building national capacity

The actual implementation of measures to address international environmental problems must rely on national governments, which ultimately have the capacity to make and enforce policies. The positive lesson from the establishment of 200-mile economic zones has been that when it is possible to delegate responsibility for managing resources to nations, they may do the job more effectively than international bodies. Countries now have the incentive and the legal capacity to manage their fisheries to maximize their value. Although some countries have overexploited their coastal fisheries, others have used the opportunity wisely.

Prospects for fisheries have dramatically improved in such countries as Australia, Iceland, and New Zealand.

Even when countries wish to take environmental action, they often lack the technical and administrative capacity to do so. Experience with "soft law"—nonbinding international guidelines developed by recognized experts—shows a substantial demand for technical advice on environmental issues. Already, some international agreements include provisions for financial and technical assistance with implementation—the Montreal Protocol is an instance—and the Global Environment Facility (GEF) offers help with implementing the Convention for the Prevention of Pollution from Ships (MARPOL). Such initiatives need to be strengthened.

Paying for international environmental action

The potential partners to an international environmental agreement rarely stand to gain or lose equally from it. If an agreement is to work, either it must lead to efficiency gains sufficiently large that all parties can expect to be better off (which rarely happens) or countries must be willing to negotiate transfers to assist those who will lose. Box 8.2 illustrates some of these points for the acid rain prob-

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Box 8.2 Bargaining over acid rain in Europe

Acid rain in Europe is linked to the acidification of lakes in Scandinavia, the death of forests in Central Europe, and damage to property in many countries. One of the primary causes of acid rain is emissions of sulfur dioxide from power stations and other large combustion plants. Approximately half of all deposits of sulfur within Europe have come across national boundaries, so that international agreement is necessary to limit acid rain. In 1985 twenty-one countries signed the Helsinki Protocol to reduce their emissions of sulfur dioxide to not more than 70 percent of their 1980 levels by 1993. Another thirteen countries, including Poland, Spain, and the United Kingdom, did not sign the protocol.

Uniform targets of this kind are very inefficient because both the costs and the benefits of reducing sulfur emissions differ widely across countries. One study computed that the most cost-effective way to share a reduction of 30 percent in total sulfur emissions would be for five countries, including Hungary, the United Kingdom, and Yugoslavia, to make cuts of more than 60 percent and for ten countries, including Spain, Sweden, and the former U.S.S.R., to make reductions of less than 10 percent.

There is disagreement about whether the total benefits of controlling sulfur emissions exceed the costs because benefits are difficult to measure. Another study, which inferred these benefits from government behavior, concluded that a reduction of 39 percent in total European emissions of sulfur would be justified but that there would be large cross-country variations in abatement targets. The aggregate net benefit from reducing sulfur emissions would be large. However, three countries—Italy, Spain, and the United Kingdom—would be significant net losers. Without some form of recompense for their additional costs, they would be unwilling to cooperate to reduce emissions. Nonetheless, the net gainers would have a strong incentive to pay the net losers in order to reach an agreement, since total net losses amount to less than 10 percent of total net gains. The one obvious difficulty is that because of the prevailing wind direction, the primary net gainers are countries in Central and Eastern Europe that are much poorer than the net losers. But even if emissions reductions and payments to net losers were restricted to EC countries, all parties could be net gainers.

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lem in Europe. Arranging for such transfers will not be simple. The many potential parties to an agreement may not share a common view of the urgency of the problem or of the possible solutions. It is extremely difficult to ensure that countries are paid for neither more nor less than the extra costs of meeting their international obligations. Every country has incentives to distort the costs or benefits of taking action.

Although intergovernmental transfers can be an efficient way to make international agreements work, this does not imply that individual polluters in recipient countries should be subsidized. At the national level there are more efficient ways to discourage pollution (see Chapter 3). Individual countries should be allowed to choose the policies that best fit their circumstances. Agreements should set national targets, not national policies for meeting them. To avoid biasing national policy decisions, any transfers should take the form of lump-sum payments rather than finance for specific investments.

An example of a regional problem: international river basins

For centuries countries have disagreed and negotiated over the management of international rivers. More than 200 treaties have been signed between countries on water issues, but mostly by European and North American countries; many rivers that pass through developing countries are still not covered. Over time, the need for international coordination has grown. An expanding population and rising living standards have increased demand for water; technological ability to exploit water resources has advanced; the number of nation states has grown; and people have become more concerned about the environment. A good deal is at stake. More than 200 river basins, which account for over half of the world’s land area, are shared by more than one country. More than 40 percent of the world’s population lives in river basins that straddle national frontiers.

The optimal solution for managing an international river is most likely to be found when all the countries that share the river basin cooperate. That rarely happens. First, river basin management has a distributional dimension—it involves the sharing of a scarce productive resource—which can make negotiations contentious or preclude them altogether. The countries upstream may see little gain in increasing the flow to those downstream. Frequently, countries need a strong incentive, such as the threat of armed conflict or the likelihood of permanent losses for all, before they will compromise. A second obstacle is the lack of clear international law on the subject. No global convention sets out agreed law on international watercourses—indeed, there is not even a generally accepted definition of an international watercourse. But work by various international bodies and jurists has established two generally recognized basic principles: each state has a duty not to cause appreciable harm to others that share the same watercourse; and water rights should be apportioned equitably among the parties involved.

One of the most successful agreements on an international watercourse concerns the sharing of the Indus basin between India and Pakistan. After partition in 1947, Pakistan was dependent on India for much of its irrigation water. After thirteen years of disagreement had brought them to the brink of war, both countries agreed in 1960 to a division of the rivers of the Indus system. Several factors—some of them difficult to replicate—favored success. First, India and Pakistan had strong incentives to compromise: both needed adequate water for irrigation, the technical information was readily available, and neither wanted an armed conflict. Second, the agreement was reached with the help of a third party, the World Bank. Third, external donors and the World Bank provided a total of about $720 million, in addition to India’s contribution of $174 million, to assist Pakistan in undertaking works to replace the flows from the river waters allocated to India. Finally, because the agreement involved allocating to each country the flows of separate rivers in the basin, the need for coordination was minimized.

There are other examples of cooperation: with the Zambezi, for instance, an agreement has been reached covering not only water flows but also other environmental aspects of river management. Another innovative case is the Lesotho Highlands Water Project, where payments between countries facilitated cooperation. Lesotho has undertaken to construct large works on the Senqu River to supply South Africa with water. In return, South Africa is underwriting and servicing the debt incurred for the project. Lesotho benefits from the water royalties that South Africa pays, while South Africa reduced the costs of ensuring its water flow because Lesotho was a better place to put the dam.

In many other cases it has been difficult to reach practicable solutions. One example is the Nile. The river flows for more than 6,800 kilometers through three climate zones and nine nations. Although coordinated management of water storage, irriga-
tion systems, and soil erosion control for the whole river basin has the potential to benefit all countries involved, no single agreement covers the entire Nile basin. Inability to negotiate a compromise has hindered the realization of the benefits of cooperation, although the recent establishment of a coordination group of riparian countries is a promising development.

To encourage cooperation, the World Bank has drawn up guidelines to be used in projects it finances on international rivers. These require that other countries along the river be notified. The aim is to ensure that the project does not appreciably harm the interests of the other countries and is not likely to be harmed by plans they may have.

An example of a global problem: the ozone layer and the Montreal Protocol

The Montreal Protocol on Substances That Deplete the Ozone Layer, signed in 1987, is a pathbreaking international agreement dealing with an environmental "global bad." The protocol aims to control consumption, and hence emissions, of CFCs and related substances that deplete ozone (see Chapter 2). By the mid-1980s world consumption of CFCs was about 1 million tons a year, 80 percent of it in industrial countries.

How agreement was reached. The first evidence that CFCs might not be benign emerged in the early 1970s. In 1977 the U.S. Congress banned CFCs in aerosols. The ban stimulated development of alternative technologies at lower costs than predicted, allaying fears that a phaseout of CFCs would be impossible or prohibitively costly. Evidence of ozone depletion continued to accumulate, and, although uncertainties remained, during the late 1980s progressively more ambitious agreements were reached, culminating in 1990 with a binding agreement to phase out consumption of CFCs and related chemicals in industrial countries by 2000.

Under the Montreal Protocol and subsequent revisions, developing country consumption of CFCs may rise to specified ceilings and will be frozen in 1996, after which it must be phased out by 2010. A ban was agreed on trade between parties and non-parties to the protocol in the substances controlled by the protocol, products made with them, and products containing them. Even so, chlorine concentrations in the atmosphere are unlikely to return to their pre-CFC level until the end of the next century. The agreement also includes two important new provisions: an Interim Multilateral Fund to help developing countries adopt replacements for CFCs if they cost more than what is being replaced, and clauses on technological transfer that urge the parties to ensure the transfer of the best technology "under fair and most favorable conditions." The fund was established on a pilot basis for three years. During that time the extra burden of phasing out CFC use for all countries expected to qualify for assistance was estimated at $240 million.

Issues for the future. The Montreal Protocol, together with the funding and technical assistance arrangements, is a pilot program. When the program comes up for review, some of the key issues will be the following:

- Ensuring that the program is not biased against efficient policies to phase out the use of controlled substances. Countries have a number of policy options. One is for the government to try to identify and invest in alternative technologies. This approach involves governments in a task to which they are generally ill suited: picking good investments. But financing specific investments has the advantage of making the use of funds more transparent to donors and local industries. An alternative is the use of market-oriented mechanisms—for example, the allocation of some import quotas by tender in Singapore. Such policies provide incentives to the private sector to adopt least-cost methods of substitution while encouraging consumers to switch to less CFC-intensive products, but it may be harder to calculate the additional costs entailed.
- Total costs. The Interim Fund provides funding only for the first three years of the program. The ultimate costs may be much larger, and an expansion of the fund may be necessary.
- The grace period. Developing countries have been given longer than industrial countries to phase out CFCs. If this grace period were only used to delay action, however, it would not achieve its purpose, which is to minimize the burden on developing countries. Current arrangements offer no incentives for a more rapid phaseout than that prescribed under the agreement, although the benefits of greater speed are now commonly agreed to exceed the costs. In spite of this, some developing countries are planning to phase out CFC use more rapidly than required, and private industry in many countries is pressing forward in the search for substitutes.

The Montreal Protocol is often viewed as an example of what can be achieved through interna-
tional cooperation. Actually, the Montreal Protocol may prove more a special case than a model for action on more complex and costly global issues, such as greenhouse warming and biological diversity. A number of factors made it easier. For example:

- Action was easier once ozone depletion was observed rather than merely postulated by scientists.
- A small group of products was involved, for which substitutes appear to be technically possible, although more expensive.
- The fact that there are only a few producers worldwide and that the main CFC manufacturers also make the main substitutes makes effective implementation more likely.

Most of the parties to the Montreal Protocol therefore perceived that the gains from cooperating would exceed the costs of not doing so. The negotiations carry a number of other important lessons:

- Even for a problem that is relatively inexpensive to address, negotiations can be quite involved.
- Incorporating payments to defray the costs of phasing out CFCs explicitly in the formal agreement helped to bring on board some of the key parties.
- Making payments to countries eligible for assistance has proved cumbersome. As of late 1991 payments into the fund were behind schedule (less than half of what was due had been paid), and there was not yet a smoothly functioning mechanism for disbursing the funds.

**Responding to the threat of greenhouse warming**

The greenhouse effect is a global issue because all emissions of greenhouse gases, regardless of their origin, affect climate. However, the costs and benefits of measures to mitigate the greenhouse effect may be spread very unevenly across countries. As a result, the negotiations leading up to any international agreement on greenhouse warming will be difficult and lengthy.

Among the factors that must be taken into account are the following:

- Climate change will differ across countries. Regional climate predictions are highly uncertain. The evidence suggests that climate changes will be smaller but more rapid in equatorial areas than in the temperate zones.
- The damage will differ across countries. Some countries may find their climate improving and may gain, while others may find that such effects as modest declines in rainfall cause substantial losses. Even when the pattern of climate change is similar, it may affect countries differently because of differences in ecology, economic activity, or the values placed on natural habitats and other environmental resources.
- Countries are responsible for different amounts of greenhouse gas emissions. The richer countries have been emitting large amounts for many years and have thus contributed a disproportionate share of accumulated gases in the atmosphere (about 60 percent of carbon dioxide from fossil fuels). On the other hand, emissions from low-income countries, starting from a lower base, are growing more rapidly and will become more important in the future.
- Measures to reduce emissions are one response to the threat of climate change—they seek to prevent the problem. Another response is to seek to adapt, by investing in assets that will mitigate the impact of any climate change on economic and social activities. The relative costs and benefits of these two approaches will differ across countries.
- Some countries are heavily dependent on exports of fossil fuels and are likely to suffer from policies that would reduce world demand. They might respond by reducing prices to stimulate demand.

Despite these difficulties, there are various measures that can be adopted at a national or an international level to reduce current emissions of greenhouse gases and to leave the world better placed to address the problem. In important respects, such measures overlap with policies to promote the efficient production and use of energy and the development of clean energy technologies that have been identified in Chapter 6.

**Uncertainty and the range of policy alternatives**

Setting aside the problems of reaching agreement on a global strategy, there are two fundamental reasons why it is extraordinarily difficult to formulate an appropriate response to greenhouse warming.

First, the lags between action and effect will inevitably be long. Even adopting stringent measures to reduce output of long-lived greenhouse gases immediately will not stop their atmospheric concentration from rising until late into the next century. This means that some climate change will certainly occur and will probably require investments to mitigate its impact, whatever policies are followed.
For decades scientists have studied the climatic effects of greenhouse gases (GHGs). In 1827 Fourier conceived the theory of the greenhouse effect. Arrhenius published in 1896 an analysis of possible climate change caused by industrial emissions of radiatively active gases. Early in the twentieth century there was a lively scientific debate on whether atmospheric carbon dioxide would increase and lead to warming, or decline and lead to cooling. Major advances in measurement of greenhouse gas concentrations and physical calculations of the greenhouse effect were made in the 1950s and 1960s. Carbon dioxide accumulations were first raised as a national concern in the United States in a 1965 report of the President’s Science Advisory Committee.

In the 1970s attention switched from greenhouse warming to the possibility of global cooling, motivated in part by a cooling trend that began about 1940. By the early 1980s fears of global warming had revived, again partly because temperatures indicated an end to the cooling trend. By the middle of the 1980s a number of national and international scientific panels had issued reports suggesting that mean global temperature would rise between 1.5° and 4.5° Celsius (and possibly higher) by some time in the twenty-first century (Carbon Dioxide Assessment Committee 1983; Bolin and others 1986).

Perhaps the main lesson of recent scientific research on global warming is the importance of transient change (the path of change over time, given the lags in the climate system), as opposed to equilibrium change (the change that would occur once all the lags had worked through the system, which may take decades or centuries). Unfortunately, transient climate change can be only crudely simulated.

More sophisticated analyses of the historical temperature record suggest that the temperature sensitivity to greenhouse gases may be in the lower range of climate model predictions.

In the early 1980s a rise of several meters in the sea level was considered a possibility. By 1990 the estimated range was 0.2 meters to 0.7 meters by the year 2070 (Houghton, Jenkins, and Ephraums 1990).

Improvements in computing capabilities will allow more refined simulations of the path of climate change and better understanding of key climate processes such as cloud and ocean feedback. Improvements in the collection and analysis of temperature data would enable scientists to verify the results from climate models. Finally, more detailed analysis of impacts, coupled with better estimates of the timing and regional distribution of change, could help in assessing the costs and benefits of alternative policies.

Second, there is great uncertainty about the links between atmospheric concentrations of the gases and climate change and about the economic and social consequences of greenhouse warming (see Chapter 2). Much has been learned from research over the past thirty years (Box 8.3) but critical relationships are still poorly understood, and the range of possible outcomes is still very broad. Some scientists worry about the possibility of irreversible change in ecosystems or of thresholds above which climate change accelerates rapidly. Some suggest that such uncertainty highlights the need for immediate, stringent action, while others conclude that such a response is unwarranted without better evidence.

The range of possible policy responses can be divided into three broad categories:

- **Do nothing.** Finance additional research but incur no other costs until the extent and implications of warming become clearer.
- **Take out an insurance policy.** Adopt precautionary measures that entail modest costs now but will reduce the costs of a stronger response in the future should it become necessary. The more weight is put on the worst possible consequences of climate change, even if they have a very low chance of occurring, the more costs should be incurred for such precautionary actions.
- **Take immediate action to stabilize or reduce total output of greenhouse gases.**

The choice among these options depends on an assessment of the relative costs and benefits of mitigating greenhouse warming. In all three cases it is desirable to adopt any policy, such as eliminating energy subsidies, that simultaneously improves economic performance and reduces output of greenhouse gases.

**The benefits of mitigating greenhouse warming.** The climate change that might arise from the increases in greenhouse gas concentrations predicted for the next century could have widespread effects.

Agriculture and livestock would be affected, although it is uncertain whether global agricultural potential would increase or decrease. The effects
may be severe in some regions, especially those that are marginal today. The evidence is not complete enough to suggest a systematic pattern of gains or losses for developing countries.

- Forests and other natural ecosystems could be threatened. Some species or ecosystems may be lost as a result; others may flourish as areas hospitable to them increase.

- Human settlements, especially in areas that are already vulnerable to flooding, droughts, landslides, and severe windstorms, could be severely affected. A rise in the sea level could flood agricultural land in heavily populated coastal lowlands. Vector-borne and viral diseases could shift to higher latitudes, putting new populations at risk. However, climatic conditions for human settlements could also improve in some areas.

Any complex and poorly understood system can spring surprises. This applies to the climate and its impact on human societies and natural ecosystems. A rise in global temperatures might cause some radical changes, although their magnitude and their probability cannot yet be analyzed. It is not yet possible to rule them in—or out—and it is impossible to estimate the associated damage without a clearer idea of how such changes might arise and what they would imply.

Detailed estimates of the damage that climate change may cause have so far been attempted only for the industrial countries, mainly the United States. The very partial evidence so far available suggests that the damage is likely to be relatively modest. One study (IPCC 1990) estimates the costs of protection against inundation from a rise of 1 meter in the sea level at 0.04 percent of world GDP. For some countries, however, such as the small island states, the costs would be much larger. Studies for the United States have estimated the total costs of adapting to climate change induced by the equivalent of doubling carbon dioxide concentrations at about 1 percent of GDP (Cline 1991; Nordhaus 1990, 1991, 1992; and National Academy of Sciences forthcoming). For longer-term warming over the next 250 years, the costs might amount to 6 percent of GDP in the United States (Cline 1991). As emphasized above, there is a high degree of uncertainty associated with these estimates. Some costs may not be quantifiable and are not included in the analyses, particularly damage to natural ecosystems, including species loss. Also, some of the gains from climate change in certain areas may have been missed. Changes in the structure of the world economy over the next century will also affect these cost estimates considerably.

**The costs of preventing climate change.** The costs of preventing climate change rise with the extent and the speed of the reduction in the output of greenhouse gases. For carbon dioxide, modest reductions could be achieved at zero or minimal cost by eliminating subsidies for energy use and deforestation and by disseminating information about efficient energy-saving technologies. A second set of measures would involve low costs because they draw on the synergy between reducing greenhouse gas emissions and achieving other local objectives, environmental and economic. For example, policies to reduce the use of coal might be justified partly because they reduce local air pollution from particulates. Thereafter, the marginal cost of reducing emissions rises rapidly as higher taxes on energy use might be justified partly because they reduce local air pollution from particulates. These costs may be lowered by phasing in emissions reductions and encouraging the development of alternative technologies. The costs of reducing methane emissions have received less attention. The largest sources of methane associated with human activity are agriculture and animal husbandry. On current knowledge, it would be necessary to reduce output of some agricultural products to reduce methane emissions substantially. This would imply extra costs for producing alternative foodstuffs.

Numerous studies have estimated the costs of reducing the output of greenhouse gases. The range is wide, reflecting different assumptions about growth, capital mobility, the costs of substitute technologies, and the underlying rate of decline in energy per unit of output. Several studies suggest that stabilizing emissions of greenhouse gases at present levels appears to mean a reduction of global GDP of between 3 and 7 percent by the end of the next century (Hoeller, Dean, and Nicolaisen 1990). For developing countries the costs may well be higher. Two global studies which include one or more developing countries suggest that they may face costs in relation to GDP which are almost twice as high as the world average (Manne and Richels forthcoming; Whalley and Wigle 1991). The high costs for these countries reflect a number of factors that make adjustment more difficult—limited ability to use less energy in industry, low capital mobility, shortage of funds for investment, and heavy reliance on low-cost but high-carbon energy supplies.

**Choosing among the policy options**

Bringing together the various estimates of economic costs and benefits leads to a simple conclu-
sion: the balance of the evidence does not support a case for doing nothing, but neither does it support stringent measures to reduce emissions now—the costs are too high in relation to the prospective benefits. This conclusion applies particularly to the developing countries, which face high costs of reducing greenhouse gas output. Indeed, the evidence implies that investments with real rates of return as low as 5 percent could do more for future generations than investments in large reductions of greenhouse gas emissions. The effects of climate change, however, could fall heavily on the poor and on particularly vulnerable countries. In that event, these countries should receive financial assistance to cover their losses. The income growth made possible by the additional general investment would be more than sufficient to cover such help.

The wisest course is to make modest immediate reductions in emissions of greenhouse gases and investments designed to lower the cost of achieving larger reductions should this become necessary in the future. Such an insurance policy, which would go further than economic efficiency alone would dictate, is justified by uncertainty about the physical and economic effects of climate change and by the lags between action and response.

A precautionary policy

INFORMATION AND RESEARCH. The case for choosing the insurance option is based on current knowledge of greenhouse warming combined with estimates of the costs and benefits of reducing emissions. As noted above, the returns to reducing the substantial uncertainty about the economic, social, and environmental effects of climate change will be high. So a crucial part of any insurance strategy will be to collect additional information and fund scientific research. Financing will be needed for work related to the developing countries (see Chapter 9). Governments should also prepare to act if evidence emerges that (a) more stringent reductions in greenhouse emissions will be required or (b) their citizens and economies need protection from the effects of climate change.

ENERGY SUBSIDIES AND TAXES. As Chapter 6 noted, many developing countries subsidize consumption of commercial energy. Eliminating such subsidies would reduce carbon dioxide emissions while yielding substantial economic gains. Table 8.1 provides rough estimates of the effect that reducing subsidies would have on carbon dioxide emissions (conventionally expressed as tons of carbon). These estimates represent an upper bound in that world energy prices are assumed to remain constant; the projected reductions in demand could lead to lower world prices, which would tend to increase energy consumption above the predicted levels.

Energy taxes can play an important role in a precautionary strategy. In many European countries, coal, the fuel with the highest carbon content, is the least taxed. Simply on the grounds of raising tax revenue in the least distortionary manner and improving local air quality, this bias in favor of coal should be removed. Well-designed carbon taxes would give market signals for efficient energy use and provide incentives for developing new technologies (Box 8.4). The EC is considering a carbon tax, but it may allow exemptions for heavy industry, which would blunt the incentive for reducing carbon dioxide emissions and make energy taxation more rather than less distortionary.

DEVELOPING RENEWABLE ENERGY. Any long-term strategy to stabilize atmospheric concentrations of greenhouse gases must uncouple economic growth from growth in carbon dioxide emissions. Reducing the amount of energy used per unit of GDP will be one element in such a strategy, but a shift away from fossil fuels will also be essential.

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<th>Table 8.1 Effects of eliminating subsidies on commercial energy in Eastern Europe and the former U.S.S.R. and in developing countries</th>
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<td>Effect</td>
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<td>Reduction in emissions, 1995</td>
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<td>Amount (millions of tons of carbon)</td>
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<td>As share of projected regional emissions (percent)</td>
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<td>Cumulative reduction, 1991-2000</td>
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<td>As share of projected cumulative regional emissions (percent)</td>
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<td>As share of projected cumulative global emissions (percent)</td>
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Note: The base case is derived from World Bank projections of energy demand. In this scenario, worldwide carbon dioxide emissions increase by about 20 percent between 1990 and 2000. Sources: World Bank staff estimates using Bates and Moore, background paper; Imran and Barnes 1990; Marland and others 1989; Hughes 1991.
Box 8.4 Carbon taxes, energy prices, and tax reform

Energy is relatively easy to tax, and many countries rely on energy taxes as a source of revenue. Even so, the structure of energy prices is often not what would be desirable on economic or environmental grounds. Because energy use has a variety of environmental effects, a tax on any one pollutant will not necessarily meet all the objectives of energy taxation equally well.

The key issues are the overall level of energy taxation and the extent of differentiation between fuels. At the very least, no fuel should be subsidized. Taxes on the carbon content of fuels are targeted specifically at emissions of carbon dioxide. By altering the relative prices of different energy sources, they will induce substitution away from carbon-rich fuels. Use of coal emits the most carbon and is also the most serious source of energy-related local pollution. A carbon tax may therefore improve welfare indirectly by reducing emissions of particulates. Petroleum is the second most carbon-intensive of the primary sources of energy. Taxing gasoline and diesel fuel is a substitute for more direct measures for dealing with traffic pollution and urban congestion, so that a carbon tax may have secondary benefits through its effect on vehicle use.

A study commissioned for this Report (Shah and Larsen, background paper [a]) found that in the absence of efficient taxes on local pollution, a higher carbon tax might be justified on local environmental grounds alone. The health benefits associated with the reduction of nitrogen oxides and sulfur dioxide as a result of imposing a $10 a ton carbon tax would be large in countries with low energy taxes, such as Indonesia and the United States.

Revenue generation

Eliminating subsidies for energy consumption would raise more than $230 billion worldwide (Shah and Larsen, background paper [b]). Beyond that, introducing even a modest carbon tax of $10 a ton could raise about $55 billion. In countries whose 1987 GDP per capita was less than $900, such a tax would yield revenues worth an average of more than 1 percent of GDP and 5.7 percent of government revenue.

Welfare costs

A carbon tax may be less distortionary than other significant sources of tax revenue. Shifting the tax burden from inefficient taxes to a carbon tax may improve welfare. But since broadly based taxes such as sales, value added, and income taxes incur lower welfare costs per unit of revenue raised than do fuel taxes (see Hughes forthcoming), fuel taxes should be regarded primarily as instruments for achieving environmental objectives.

Stabilizing carbon emissions requires a switch to renewables

Figure 8.1 How increasing alternative energy sources affects carbon emissions, 1990-2050

<table>
<thead>
<tr>
<th>Percent</th>
<th>(100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fossil fuels</td>
<td>[80]</td>
</tr>
<tr>
<td>Hydroelectric and nuclear</td>
<td>[60]</td>
</tr>
<tr>
<td>Renewables</td>
<td>[40]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Index ((1990=100))</th>
<th>[350]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fossil fuel scenario</td>
<td>[300]</td>
</tr>
<tr>
<td>Alternative energy scenario</td>
<td>[250]</td>
</tr>
</tbody>
</table>

Note: Carbon emissions in 1990 are about 6 billion tons. All data after 1990 are projections.

a. The share of renewables in primary energy sources remains at its 1990 level in this scenario.

Sources: World Bank staff estimates; Anderson and Bird 1992.
Figure 8.1 illustrates two scenarios for the evolution of total carbon dioxide emissions based on the projections for world energy demand presented in Chapter 6. Continued reliance on fossil fuels leads to a tripling of emissions by 2050, whereas with a shift toward renewable energy sources the increase would be only 25 percent. The renewable energy scenario demonstrates the magnitude of the shift from fossil to renewable sources that would be required to stabilize carbon dioxide emissions. Even if the share of renewable sources were to rise from less than 10 percent of total primary energy demand in 2000 to 60 percent in 2050—an unprecedentedly rapid shift—a significant increase in carbon dioxide emissions would still occur.

The shift toward renewable energy can be promoted by appropriate government policies. The key is energy prices, as discussed above, since these provide the incentive for the development and installation of new technologies. In addition, renewable energy should receive larger shares of national expenditures on energy research and development. New technologies should also be supported by financing the dissemination of information and the establishment of pilot projects in developing countries (see Chapter 9).

**Other measures.** Many afforestation projects are justified on economic and local environmental grounds. Growing extra trees can slow the increase in net emissions by fixing carbon. But because afforesting large areas solely to fix carbon would be extremely costly, afforestation cannot be relied on to "solve" the problem of carbon dioxide emissions (Box 8.5).

**Long-term considerations**

As knowledge of climate change improves, the evidence may warrant stronger action to reduce emissions. The costs could be substantial. It will therefore be essential to adopt policies that involve the least loss of welfare and to consider their impact on equity.

**Setting efficient targets.** Considerable gains can be made by reducing emissions in efficient ways. Uniform targets impose greater adjustment costs on some countries than on others. Giving individual countries different targets could lower the aggregate cost of meeting a global target. Adopting targets for annual reductions, rather than setting cumulative targets, will also impose significant extra costs. The scale of warming is a function of the stock of greenhouse gases, not of annual emissions. Countries should therefore be allowed to choose the speed at which they reduce their emissions if the cumulative addition of greenhouse gases does not exceed a safe level. Fixing annual percentage targets would add an unnecessary constraint. So would fixing separate emission targets for each gas rather than allowing tradeoffs among gases on the basis of their climatic effect.

The examples of Egypt and India illustrate this point (Box 8.6). Substantial burdens can be reduced to more manageable levels with few or no differential climatic effects if efficient adjustment targets are set. Making backstop technologies available eventually reduces the costs even more. But allowing flexibility in phasing emissions reductions poses an important problem. The optimal path might be to delay most reductions for a con-

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**Box 8.5 Afforestation: not a panacea for preventing climate change**

As trees decay or are burned, carbon dioxide is released. As trees grow, they capture carbon dioxide. But afforestation reduces net emissions only as long as forests are growing. Once a forest is mature, the emissions from decay just offset the carbon fixation from new growth. If a forest is cut down and the wood used, its carbon will eventually be returned to the atmosphere. Offsetting emissions from fossil fuels would require continual additions to the forest stock.

Temperate forests sequester about 2.7 tons of carbon per hectare a year for the first eighty years of their lives. In temperate areas about 400 million hectares of growing forests would be required to sequester 1 billion of the 3 billion to 4 billion tons of carbon that accumulate in the atmosphere each year—more than the current forested area of the United States, which is about 300 million hectares. In the tropics, where less carbon is sequestered per hectare (Houghton 1990), locking up 1 billion tons of carbon a year would require about 600 million hectares of growing forest, the equivalent of about 75 percent of the area of the Amazon basin. Intensive forest management that reduced the rotation period could increase the sequestration rate per hectare, but only at substantial additional cost.

These calculations show that afforestation is no panacea for greenhouse warming. Nonetheless, afforestation projects that are justified on other environmental and economic grounds can also help to reduce net carbon emissions.
Box 8.6 Greenhouse policy alternatives in developing countries: the cases of Egypt and India

If, eventually, targets for substantial reductions in global greenhouse gas emissions are adopted, developing countries could face the prospect of curbing the growth of their emissions. Background papers by Blitzer and others commissioned for this Report explored how the design of emission targets would affect the welfare costs of these adjustments for two countries. Scenarios for Egypt and India were examined using dynamic optimization models for the period to 2030. The models take account of features that will be important to individual countries, such as industrial structure and consumption of different sources of energy.

Egypt: flexibility in timing

Controlling concentrations of greenhouse gases involves managing cumulative net emissions. A simple approach is to stipulate annual reductions. But there are alternatives that allow for flexibility tailored to the possibilities and preferences of individual countries while reducing cumulative emissions by the same amount. The high cost of the simple approach is shown in Box figure 8.6a. If a cumulative target is phased in at an optimal pace rather than reached through a fixed annual reduction, the welfare costs decline substantially. These gains, however, are achieved only by accepting that emissions reductions eventually have to be made. The shock is cushioned by planning in advance, not just putting off a decision.

India: taking into account more than one greenhouse gas

Carbon dioxide accounts for a large share—more than 50 percent—of the warming effect attributable to human activities. But other gases play a role. Of these, methane is probably the most important for developing countries. Since irrigated rice production and animal husbandry give rise to these emissions, controlling them would affect critical sectors in developing economies. The case of India is illustrative because of the importance of its agricultural sector.

The technological options for reducing methane emissions in agriculture are more limited than for carbon dioxide, and the burden of methane reductions is correspondingly greater. Adding the same annual constraints on methane as on carbon dioxide roughly quadruples total welfare losses. The possibilities for reducing methane emissions while maintaining agricultural output are limited. The economy must therefore contract much more to meet a separate methane constraint than if the country can choose between gases to achieve the same climatic effect (see Box figure 8.6b).

Box figure 8.6a Limiting carbon dioxide emissions in Egypt: cumulative and annual targets

Reduction in welfare (percent)

<table>
<thead>
<tr>
<th>Reduction in emissions</th>
<th>Annual targets become infeasible</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 percent</td>
<td></td>
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<tr>
<td>30 percent</td>
<td></td>
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<tr>
<td>40 percent</td>
<td></td>
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</tbody>
</table>

Box figure 8.6b General and specific targets for greenhouse gas emissions in India

<table>
<thead>
<tr>
<th>Reduction targets</th>
<th>General target for addition to warming effect</th>
<th>Specific targets for annual emissions of carbon dioxide and of methane</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 percent</td>
<td></td>
<td></td>
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<tr>
<td>30 percent</td>
<td></td>
<td></td>
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<tr>
<td>40 percent</td>
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</tbody>
</table>

Index of policy inefficiency a

<table>
<thead>
<tr>
<th>Reduction targets</th>
<th>General target for addition to warming effect</th>
<th>Specific targets for annual emissions of carbon dioxide and of methane</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 percent</td>
<td></td>
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<tr>
<td>30 percent</td>
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<td></td>
</tr>
<tr>
<td>40 percent</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Ratio of percentage decline in welfare to percentage reduction in warming effect, both relative to a base case with no limits on emissions. Welfare is measured as the utility of discounted consumption over the time period of the model.

Source: Blitzer and others, background paper (b).

Note: Welfare is measured as the utility of discounted consumption over the time period of the model. Reductions in welfare and emissions are relative to a base case with no limits on emissions.

Source: Blitzer and others, background paper (a).
siderable period. Eventually, countries would have to live up to commitments made long ago, and it could be difficult to make them stick. Some safeguards will be needed to ensure that countries actually adhere to a long-term strategy.

**DISTRIBUTIONAL ISSUES.** The way that targets for emissions reductions are set has important implications for equity. Steps to limit emissions allocate a global common resource: atmospheric carrying capacity. An agreement to a uniform percentage reduction in emissions would implicitly allocate those rights according to current emissions, favoring the world’s richer populations, whose per capita emissions are high. For example, the per capita carbon dioxide emissions of the United States are almost ten times those of China. If the approach that every human has an equal right to the atmospheric resource were taken, rights to future use could be allocated according to population. Another option is to allocate rights according to some measure of output, such as GDP. That would promote energy efficiency but not equity. Any allocation of future emission rights ought to take some account of cumulative past emissions, since greenhouse gases emitted decades ago continue to contribute to warming.

What might the alternatives for allocating atmospheric carrying capacity look like? Figure 8.2 assumes, for purely illustrative purposes, that the warming effect of greenhouse gases is stabilized at the equivalent of doubling the preindustrial level of carbon dioxide in the atmosphere. It then shows how rights to use this fixed amount of atmospheric carrying capacity might be shared.

- Allocating rights according to population leaves developing countries with substantial capacity to continue emitting gases, while the high-income countries would have a net deficit equivalent to about the amount that they emitted in 1980-88. Thus, on this formula the cumulative past emissions of the richer countries exceed their future share of the atmospheric carrying capacity; they have exhausted their right to emit.
- Allocating rights according to income, which leaves all country groups with the potential to emit more greenhouse gases in the future, looks more feasible. The richest countries, however, take the lion’s share of this potentially valuable resource.

**TRADING EMISSION RIGHTS.** These schemes show how rights to emit might be allocated, but the allocation need not translate directly into emissions targets. Countries could profitably trade their rights to use a share of atmospheric carrying capacity, although the practical difficulties of making such a market work are substantial. For instance, if rights were allocated on the basis of population, the industrial world would purchase rights from the world’s poorer countries. The outcome of such
a hypothetical trade is difficult to predict, but the magnitudes could be large. If rights to emit were sold at $25 per ton of carbon, the industrial world would have to pay developing countries about $70 billion to afford one year's emissions at 1988 levels. Such a sum roughly matches total official development finance in 1989.

**Biological diversity: an approach to common concerns**

Humans have a lot of company on the earth. Millions of species of plants, animals, and other organisms enrich our environment. Awareness of the importance of this biological diversity has grown in recent years along with concern that more effective action is needed to preserve it. There is a particular sense of urgency because destruction of ecosystems and species extinctions entail irreversible losses.

**Priorities for international action**

Biological diversity is a matter of international concern, but it is not global common property. The habitats supporting biological diversity, other than those in international waters, belong to individual countries that have an interest in managing a valuable national resource well. At the same time, protecting biological diversity is of international concern because its benefits accrue not only to the local population but also—sometimes in rather different ways—to people all over the world. Some of those benefits have to do with personal values or preferences and consequently are difficult to define objectively and to quantify.

The tangible economic and health benefits are reflected directly in the use of plants, animals, and services from natural ecosystems (see Chapters 2 and 7). Benefits of this kind can to some extent be captured by the use of appropriate charging mechanisms. In addition, because of their individual preferences or moral views, many people attach value to the existence of species and habitats that they may never see or use. They may wish to save natural ecosystems intact for future generations. Or they may simply feel an ethical responsibility to avoid destruction of the variety of life forms that have evolved on earth. Growing voluntary contributions to conservation organizations bear witness to these values, as does the criticism in industrial countries of developing countries' conservation policies. But the market will not reflect the spiritual and emotional pleasure that people draw from biological diversity, since people do not have to pay to derive these benefits. As a consequence, countries acting on their own will tend to protect their biological diversity less than if they took its global value into account.

Two questions need to be addressed:

- How can developing countries manage their resources in their own best interests?
- How should the world at large contribute to the protection of resources that people value but do not own?

Efficient management of natural resources is essential from both perspectives, and Chapter 7 describes a broad range of measures needed to achieve it. In preserving biological diversity, the starting point—as in other areas of environmental protection—should be policies that both promote development and relieve excessive pressure on natural resources (Box 8.7). In the absence of strong efforts to exploit these "win-win" oppor-
tunities, policies for direct protection are likely to fail.

The more developing countries can profit from the true value of their resources, the smaller will be the divergence between national and international concerns. Beyond that, if the international community wants to ensure a higher level of protection than would be chosen by nations acting on their own, policymakers in the world's richer countries must translate the concerns of their citizens into financial flows to developing countries. They must be prepared to pay the full costs of the additional conservation. That implies a transfer of additional resources, not merely a restructuring of existing aid.

Many developing countries are uncomfortable about accepting funding to manage their resources because of the implied loss of autonomy. Contributing countries may also worry that they are paying for programs that recipient countries should undertake anyway. To address these problems, developing countries should make sure that their resource use is consistent with their own development objectives when accepting international support. Even so, the problem of moral hazard will be hard to avoid altogether.

The full economic costs of preserving biological diversity will typically be much larger than the direct expenditures on protection. If certain uses of natural habitats are prohibited or reduced, the forgone revenue is part of the cost and should be covered by the assistance provided to encourage preservation. These opportunity costs will change over time, since they are closely linked to the value of land in alternative uses. Thus, increasing pressure on land resources will raise the opportunity costs of keeping out of production segments of natural habitat suitable for agricultural use. Financial arrangements to support countries that protect species and habitats will break down if they fail to take account of such changes.

Some domestic policies, in addition to being economically inefficient, may encourage the destruction of natural habitats and species. In such cases, the international community may reasonably choose not to support conservation programs, on the grounds that effectiveness would be undermined by the overall policy framework.

In the longer term there needs to be some agreement on priorities so as to ensure the best use of limited funds. Work is under way to analyze this question more systematically; it will be important for the future. In the meantime, scientists have attempted to establish criteria to guide action now.

A number of options are under consideration; there is no consensus on which is best. All agree that developing countries should have a high priority, largely because tropical ecosystems are so rich but also because industrial countries now retain so little of their own habitats in pristine state. The geographic distribution of various priority areas is shown in Figure 8.3.

These priority areas rarely lie in the countries that can afford to spend the most on conservation. Satisfactory figures are difficult to obtain, since spending on conservation appears under a wide range of categories. Many countries raise some revenues from their national parks, so net outlays may be less. One can, however, estimate a rough order of magnitude of spending on biological diversity using information on budgetary allocations for national parks management. Table 8.2 shows these estimates for a few countries. The figures suggest that spending on conservation-related activities may amount to between 0.01 and 0.05 percent of GDP in developing countries and about 0.04 percent in industrial countries, implying a total of about $6 billion–$8 billion a year. Estimates of international transfers for conservation activities, equally hard to come by, are roughly $200 million a year, or about 3 percent of world spending on conservation activities (excluding lending from multilateral development banks, which is growing rapidly). Most of the spending is in the richer countries. Modest increases in the amount of funds transferred by the international community could allow a significant increase in spending on conservation in developing countries. Chapter 9 discusses further the costs and financing of a program to protect biological diversity.

<table>
<thead>
<tr>
<th>Country and year</th>
<th>As share of government spending (percent)</th>
<th>As share of GDP (percent)</th>
<th>Total spending (millions of dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botswana, 1984</td>
<td>0.32</td>
<td>0.11</td>
<td>1.3</td>
</tr>
<tr>
<td>Denmark, 1989</td>
<td>0.11</td>
<td>0.04</td>
<td>45.0</td>
</tr>
<tr>
<td>Indonesia, 1988</td>
<td>0.04</td>
<td>0.01</td>
<td>6.0</td>
</tr>
<tr>
<td>Malaysia, 1988</td>
<td>0.05</td>
<td>0.01</td>
<td>5.0</td>
</tr>
<tr>
<td>Sri Lanka, 1988</td>
<td>0.03</td>
<td>0.01</td>
<td>0.6</td>
</tr>
<tr>
<td>Tanzania, 1983</td>
<td>0.17</td>
<td>0.05</td>
<td>2.9</td>
</tr>
<tr>
<td>United States, 1988</td>
<td>0.15</td>
<td>0.04</td>
<td>1,702.3</td>
</tr>
</tbody>
</table>

Priority areas for conservation are mostly in the developing world

Mobilizing resources

The international community should transfer additional funds to developing countries to achieve a level of spending that reflects its desire to protect species and habitats there. Innovative financing mechanisms such as debt-for-nature swaps may play a useful role. But debt-for-nature swaps cannot substitute for a concerted effort by the international community to make the necessary transfers (Box 8.8). There are three key elements in any strategy for making international transfers more effective.

- First, if increased spending is to be used efficiently to improve protection, it is important to develop programs rather than fund discrete projects. The receiving countries themselves should take the initiative in designing programs for international financing to ensure that these take into account their own priorities and what is feasible for them.
- Second, better coordination is needed to capitalize on the growing interest of private and public donors in supporting developing countries’ efforts. International donors recognize that there is growing competition for good projects. Receiving countries spend much time and effort working separately with a number of donors. Recipient countries and donors would benefit from a process akin to the aid group mechanism that matches country program requirements with a variety of donor capacities and interests. The Brazilian Tropical Rainforest Fund is a promising example of this approach (see Box 9.4).
- Third, finance for conservation efforts needs to be sustained. Unlike traditional investment projects, most conservation activities will never become self-financing. Even new mechanisms...
Debt-for-nature swaps were developed to transform commercial debt of developing countries into finance for the environment. The transactions have appeal in principle because they can meet two objectives: financing worthwhile environmental activities with substantial leverage for donor funds, while helping to manage developing country debt. In practice, the transactions are complex, and the instances in which both objectives can best be served with a single instrument are few.

Since the first debt-for-nature swap was completed (for Bolivia, in 1987), a further sixteen swaps in eight countries have retired nearly $100 million in external debt, using original donations of $16 million. Although this represents only a small fraction of the commercial debt of these countries, it paid for significant conservation efforts, in some cases vastly expanding existing expenditures.

For NGOs, swaps demanded a new financial expertise. NGOs have also had to build up relationships with local NGOs and government agencies. For the recipient government, the conversion of external to local-currency obligations has several implications for economic and debt management. First, debt-for-nature swaps imply greater domestic spending by the debtor government. To avoid stimulating inflation, most such swaps have been not for cash but for government bonds, with payments spread out over a number of years. Second, many severely indebted countries have serious budgetary problems that may preclude converting a foreign debt into a domestic obligation.

A recurring issue is the amount of local-currency bonds the government issues in exchange for the external debt. If the new bonds are close to the face value of old debt, the financial leverage of the donor is maximized, but so too is the financial obligation of the local government. In three-quarters of the swaps the new “conservation bonds” have a value of about 90 percent or more of the original debts.

Debt-for-nature swaps financed by NGOs are likely to be small in relation to both the overall needs of environmental funding and to foreign debts. National aid agencies in a number of countries, notably the Netherlands, Sweden, and the United States, have made grants available to buy some outstanding debt. These debt-for-nature swaps have been valuable for some countries, but their effect has been more to reallocate aid than to generate additional resources. Some official debts are now eligible for swaps. Part of eligible Paris Club debts can now be exchanged for local-currency funding of agreed environmental activities. The U.S. Enterprise for the Americas Initiative provides for local-currency payments on reduced official debt, to be used to fund eligible environmental projects in Latin America and the Caribbean.

such as the GEF do not provide long-term financing. If recurrent costs are to be financed over the long term, it is essential to find the right balance between the need to provide incentives for program development and the donors’ requirements for accountability. If developing countries devote scarce managerial and institutional capacity to conservation programs for the benefit of the world at large, adjusting to wavering levels of commitment from the international community could come at high cost. Recipient countries should have assurance that funding will be provided to maintain the programs or at least to wind them down in an orderly fashion should that become necessary. Most donors, however, find it difficult to make binding financial commitments for long periods because of their budget cycles and because they need assurances that programs will be managed well as long as finance is provided.