Chapter 17

Consequences of Responses on Human Well-being and Poverty Reduction

Coordinating Lead Authors: Anantha Kumar Duraiappah, Flavio Comim
Lead Authors: Thierry De Oliveira, Joyeeta Gupta, Pushpam Kumar, Marjorie Pyoos, Marja Spierenburg
Contributing Authors: David Barkin, Eduardo Brondizio, Rie Tsutsumi
Review Editors: Julia Carabias, Robert Kates, Kai Lee

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Main Messages

Many of the economic, legal and technological responses used today to manage ecosystems emphasize economic growth—aiming at aggregate welfare as measured by income—through the efficient allocation of the provisioning services of ecosystems. There is little uncertainty that economic, legal, and technological responses have improved the material wealth and livelihoods of many people. However, there is also high certainty that the regulating, supporting, and cultural services have deteriorated in many parts of the world and this has had dire consequences on the health, security, good social relations, and the freedoms and choices of many individuals and local communities, especially in developing countries. Equity has also been deemphasized in the design of many of these responses. There have been losers and winners, with the vulnerable and the poor experiencing losses most of the time.

Responses aimed at development have had a mixed record of improving well-being and have in most instances failed to accommodate the conservation and sustainable use of all ecosystem services. Poverty reduction strategies in many developing countries have failed to integrate ecosystem related issues. However, there is an increasing trend of attempts to mainstream "environmental" in poverty reduction strategies and the accompanying budgetary frameworks. This is a promising trend with the potential for improving well-being and reducing ecosystem deterioration. The scenario in industrial countries is slightly different. One of the main drivers in industrial countries are subsidies that have dire impacts on ecosystem services within their countries as well as in the developing countries. There is increasing pressure on industrial countries to revise their subsidy programs, especially those in the agricultural sector.

Responses relying on market mechanisms require well-functioning institutional frameworks, including legal structures, to work effectively. For example, there is high certainty that market-based approaches have the potential to unlock significant supply- and demand-side efficiencies while providing cost-effective reallocation between old (largely irrigation) and new (largely municipal and in-stream) uses of water resources. But it is also well established that it is important to keep in mind that, while there is a role for the use of markets to develop efficient water markets, there is also a regulatory role for governments in providing stable and appropriate institutions for these markets to operate.

The effectiveness of international and national-local agreements depends upon decentralization of intervention strategies to the lowest level that allows successful participation, implementation, and enforcement. Evidence of international legal agreements shows that their success depends on how they are designed in both substantive and procedural terms, how they compete with other international agreements, and the context in which they are to be implemented. At the national and local level, the success of regulatory instruments depends on how well they target specific incentives and disincentives, and how well the implementation is monitored and enforced.

Technological interventions have had a mix of positive and negative impacts on ecosystems, human well-being, and poverty reduction. Unintended consequences, positive and negative, of technological interventions have been more the norm than an exception. For example, the impacts on ecosystems from attempts to increase food production by technological innovations, have been realized mostly as second round effects, and as such they represent negative externalities. Moreover, the benefits of technological interventions have varied across and within communities with some gaining more than others. On the other hand, technologies have been found to be successful in mitigating ecosystem degradation when they are designed to work within the dynamics of the ecosystems, and not "fight" it. Successful technological interventions revolve around interventions that take into account the temporal and spatial dynamics specific to local ecosystems and that are driven by a participatory, democratic, and cooperative model between local communities who have a rich database of traditional knowledge and outside technical expertise that together are able to produce incremental driven technological interventions.

Responses have been found to be more effective in reducing poverty when they respect the different degrees, and types of use, of ecosystem services by different communities. Response strategies based on capture of benefits by local people from one or more components of biodiversity (for example, products from single species or from ecotourism) have been most successful when they have at the same time created incentives for the local communities to make management decisions consistent with (overall) biodiversity conservation. For example, at a local level, protected areas have more often had a detrimental effect on poverty reduction because rural communities are excluded from a resource that has traditionally provided income-generating activities. Consequently, if conservation is to be useful, then the recommendation is for targeted incentives and involving local stakeholders in the design, implementation, and monitoring of responses.

Poverty reduction can only work if the links between ecosystems and well-being are explicitly mainstreamed into national poverty reduction strategies like Poverty Reduction Strategy Papers. Very few macroeconomic responses to poverty reduction have taken into account the importance of ecosystems to poverty reduction and improving well-being. Assets-based responses, such as the Livelihood Approach to Rural Development, have quite often been limited to narrow perceptions of natural capital as an input for economic production. Yet, there is insufficient information for policy-makers about the broader links between ecosystem services, human well-being, and poverty reduction. If policy-makers are to make informed decisions concerning ecosystem management, then a serious concerted effort to collect and collate data on ecosystem services and human well-being will need to be initiated immediately.

Rather than the "win-win" scenarios promoted (or assumed) by many practitioners, conflict is more often the norm, and tradeoffs between conservation and development need to be acknowledged. Over the last generation, responses motivated by conservation of wetlands and biodiversity have been adopted more widely. Some of these interventions have displaced resident human populations and decreased their well-being, and even in some instances pushed them into poverty. Other interventions have sought to combine conservation and development in the belief of win-win outcomes. These interventions have had a mixed record to date, and more attention may be paid to analyze how fair and equitable these responses are across all stakeholders, and to observe whether tradeoffs need to be negotiated before such responses are implemented.

In light of the urgent desire to improve well-being among the world's poor, and in light of the fragility of many ecosystems needed by people, especially those in subsistence economies, it is vital to learn from the mistakes of the past and the present. A systematic way to do this is adaptive management. Adaptive management necessitates multiple instruments, including a mix of law, economic instruments, voluntary agreements, information provision, technological solutions, research, and education—an integrated response strategy. The key word in adaptive management is flexibility. Equally important is the potential for change within institutions, property rights, and/or communities. Flexibility and change in turn is highly dependent on the availability of a number of key instrumental freedoms—transparency guarantees, par-

ticipative freedom, protective security, economic facilities, social opportunities, ecological security—to all individuals.

17.1 Introduction

Societies have developed and used a wide range of innovative legal, economic, behavioral, and technological responses to manage their interactions with ecosystems. These responses in turn have had impacts on ecosystems, some good and some bad. However, the impacts of these responses have not been confined to just ecosystems but have also had positive and negative impacts on human well-being, defined to include health, security, social relations, material wealth, and freedom of choice and actions (MA 2003).

It is also increasingly becoming clear that development and poverty-reduction focused responses can have positive and negative impacts on ecosystems and human well-being. Experience shows that some responses—either ecosystem focused or development and poverty reduction—have worked well in conserving ecosystem services, improving well-being, and reducing poverty, while others have actually caused deterioration in ecosystem services, a reduction in human well-being, and increased poverty.

But the situation is much more complex in reality and it is difficult to make simplistic linear causality relationships between responses and the consequences on ecosystems and human well-being. To begin, the consequences of responses are usually not shared equally among different stakeholders. For example, some groups may have benefited from a response while others suffered a drop in one or more of their constituents and determinants of well-being. Identifying who loses and who gains is a critical component in evaluating responses. Responses directed at some ecosystem services can cause unintended impacts on other ecosystem services and subsequently on the constituents and determinants of well-being across a range of stakeholders or individuals. It should also be considered that responses implemented in one place could have impacts on ecosystem services and human well-being located further away. It should also be acknowledged that responses implemented today might have significant impacts on ecosystem services and human well-being in the future. The assessment of responses and the learning process to improve the design and implementation of responses will need to consider these complexities if the sustainability of human development, the reduction of poverty, and the integrity of ecosystems to improve human well-being is to be ensured.

Unraveling these complexities can be considered as a scientific quest by the scientific community. Decision-makers, on the other hand, want some answers to some pertinent questions to reduce or reverse the present trends of deteriorating ecosystems, reduce poverty, and improve well-being. In the event that answers are not forthcoming, then decision-makers would like some guidance from the assessment of the risks involved, and what needs to be done in the face of this uncertainty. And they need these answers now. A unique and strong feature of the MA is the guidance, in the form of key questions provided by decision-makers from both the human development and ecosystem fields. (See Box 17.1.)

The chapter is structured in the following manner. The next section provides a synthesis of the chapters in Part II of this report; the responses discussed are primarily responses directed toward the management and conservation of ecosystems and ecosystem services. There is no one systematic format in the way the various responses are presented. The economic and technological responses are structured according to the various ecosystem services, while legal responses are presented according to administrative scales. The social responses are presented along thematic lines. The following section, on the other hand, presents the main findings of a review of existing development and poverty reduction strategies. Both sections examine: (1) how effective responses have been in achieving their objectives; (2) the consequences of these responses on ecosystem services, the constituents, and determinants of human well-being and poverty; (3) the preconditions necessary for the responses to be effective; and (4) the potential for using these responses in the future.

After the two sections examining responses, another section identifies a number of context specificities and enabling conditions that play critical roles in determining the magnitude of the consequences of responses and the relative success of responses in achieving their objectives. A final section revisits the questions posed at the beginning of the chapter and presents some plausible answers.

17.2 Ecosystem Management Responses: Their Effectiveness and Consequences for Human Well-being and Ecosystem Services

Chapter 2 identified four major categories of response interventions. This section looks at the issues and sectors identified in Part II of this volume in the context of the four categories: legal responses; economic and financial responses; social, behavioral, and cognitive responses; and technological responses.

17.2.1 Legal Responses

This section synthesizes material from chapters in Part II of this report in relation to key legal responses ranging from the global through to local levels. Regulatory instruments are important in: (1) addressing the management of ecosystem services, especially the regulating, supporting, and cultural services; (2) helping in the monitoring and regulating of performance; and (3) regulating the use of proper and adapted technology. Such instruments help to provide the framework within which social actors are permitted to act.

There is implicit consensus in the literature that all instruments are embedded within a legal context and that the legal context needs to be compatible with the sociopolitical climate for an instrument to be successful. This means that separating legal from other instruments is a difficult and often artificial endeavor.

17.2.1.1 International Level

The assessment reveals that at the international level responses generally have tended to focus on specific issues rather to than take a comprehensive approach. For example, this has led to a proliferation of agreements and governance frameworks on:

- biodiversity (for example, CITES, Ramsar, CCD, CBD);
- food (for example, food aid regimes, trade regimes, technology and scientific cooperation regimes, food summits, intellectual property regime, commodity agreements, the Common Agricultural Policy of the European Union, bilateral fishery agreements, and ITPGR);
- water (more than 400 agreements in the last 200 years including the Watercourses Convention of 1997);
- wood and wood products (for example, IFAP, ITTO, ITTA, UNFF);
- waste management (for example, Basel Convention); and
- climate change (for example, UNFCC, Kyoto Protocol, bilateral agreements).

Most of these agreements focus on specific environmental and resource-related problems. Only recently is there a trend to in-

BOX 17.1
Key User Questions

Decision-makers from the human development and ecosystem fields identified key questions that MA users need to have addressed:

1. How effective are international agreements for addressing concerns related to ecosystems and human well-being, and what options exist to strengthen their effectiveness?
2. What is the scope for correcting market failures related to ecosystem services (internalizing environmental externalities)? How much of a difference would this make for ecosystems and human well-being, and what are the necessary conditions for these approaches to be successful?
3. What is the potential impact on ecosystem services and human well-being of removing "perverse subsidies" that promote excessive use of specific services? What trade-offs may exist between ecosystem and human well-being (especially poverty) goals?
4. What more can be done to strengthen national-local legal frameworks for more effective ecosystem management to reduce poverty and increase human well-being? And are there scale effects, which make legal responses at one level more effective in addressing ecosystem services?
5. What are the strengths and weaknesses of an increased focus on technological advances for addressing concerns related to ecosystems, human well-being, and poverty alleviation? What steps can be taken to increase the likely benefits for ecosystems and human well-being of technological change, and decrease the risks and costs?
6. How important is governance/institutional reform to the achievement of effective ecosystem management, and what are the characteristics of that reform that are most relevant to the pursuit of goals related to ecosystems and human well-being?
7. What are the strengths and weaknesses of greater stakeholder involvement in decision-making in the management of ecosystem services? How can decision-makers find the right balance?
8. What tools and mechanisms can promote effective cross-sectoral (water, agriculture, environment, transportation, etc.) coordination of policy and decision-making?
9. What design characteristics of ecosystem-related responses are helpful in ensuring that they provide benefits for poverty reduction?
10. What have been the consequences of macroeconomic responses like poverty reduction strategies for ecosystems and their services?
11. What has been the net impact of trade liberalization, globalization, and privatization on ecosystems, their services, and human well-being?

crease subsidiary goals of poverty alleviation (for example, CBD, MDGs, WSSD, CCD), but the operative mechanisms to achieve the latter are rare. However, in the last few years, there is increasing recognition among these legal frameworks that environmentally sensitive poverty reduction strategies can enhance the resilience of local people to environmental impacts, while also, under many circumstances, reducing the burden on the environment. (See Chapter 5.)

The assessment tends to show that the success of international legal instruments in achieving their specific goal depends on four interrelated conditions: (1) the design of the agreement; (2) the way the agreement has been negotiated; (3) policy coherence at the international level; and (4) the domestic context in which the agreement is to be implemented.

17.2.1.1.1 Instrument design

The assessment of Part II chapters, supplemented by additional literature to complete the picture (Oberthur and Ott 1999; Miles et al. 2002; IPCC 1990; Vingradov et al. 2003; Epiney 2003), shows that effectively designed international agreements:

Are legally binding. If the agreement is legally binding, like the CBD is, it is generally likely to have a much stronger effect than a soft-law agreement such as Agenda 21 and the Declaration and Action Plan of the World Summit on Sustainable Development. This is both the result of the assumption of international law that agreements made will be implemented (*pacta sunt servanda*), as well as verifiable through observation (Henkin 1979).

Have clear objectives. If the agreement has a measurable goal, it is easier to analyze whether it is meeting its goal (Bodansky 1993; Gupta 1997). The UNFCCC did not include measurable targets, though the Kyoto Protocol does. In fact, one of the key factors which contributed to the success of the Montreal Protocol on Ozone Depleting Substances and its amendments was the inclusion of targets. In similar fashion, regional water law regimes with clear objectives have been effective in meeting their goals (Kaya 2003). On the other hand, the CCD and the CBD, which have qualitative goals, allow more scope for interpretation in implementation and their effectiveness has been more difficult to measure. (See Chapter 5.)

Have clear definitions. An agreement with clear definitions and unambiguous language, like the Montreal Protocol, is easier to implement (Franck 1995). On the other hand, the weaknesses of the definitions in the Basel Convention of 1989 undermined its effectiveness. In similar manner, the complexity of the definitions in the climate change regime makes it more open to multiple interpretations. (See Chapter 13.)

Have unambiguous principles. If there are clear principles, this can help guide the parties to reach future agreement. The principles guide the implementation of an agreement. But if there is lack of clarity on the relationship between the principles, then there is no clear incentive for taking action. The interpretation of the precautionary approach in the CBD, Rio Declaration, and UNFCCC lends itself to considerable speculation (Hey and Freestone 1996). There is also conflict between the precautionary principle and the cost-effectiveness principle in the UNFCCC, and conflict between the equity principles and the no-harm principle in the Watercourses Convention. (See Chapter 7.)

Include an elaboration of obligations and appropriate rights. If there is a clear elaboration of obligations and rights, the agreement is more likely to be implemented. (See Chapters 5, 8.) The International Tropical Timber Agreement and the World Heritage Convention have relatively vague obligations, and therefore are difficult to implement. Meanwhile, even though CITES has clear objectives, the large number of species that have to be controlled makes it difficult for customs officials to monitor and implement effectively. (See Chapter 5.) In instances where language is indeterminate ("to explore" or "to encourage"), it has been difficult to control implementation.

Have financial resources. If there are financial resources in the regime, this in general increases the opportunities for implementation especially for developing countries (Brack 1996). The financial mechanism of the Montreal Protocol is a case in point. The GEF and the other funds available for international water, climate change, desertification, and biodiversity have increased the potential for implementation. However, CITES and the

Ramsar Convention, which did not have financial mechanisms, have more limited effectiveness. But sometimes, funding levels are so low that the mere inclusion of a financial mechanism is in itself not enough. A case in point is the resources allocated for desertification. (See Chapter 5.) Funding should be increased where the rich countries value the resource very highly, and where local communities have high opportunity costs of preservation.

Develop mechanisms for implementation. Where financial resources are not forthcoming, the design of market mechanisms in some instances has been found to increase the potential for implementation. For example, joint implementation, emission trading, and the clean development mechanism in the climate change agreements and Type II Agreements at the WSSD have enhanced the potential for implementation by providing the private sector an important role and incentives in the implementation of these agreements. (See Chapter 13.)

Include the establishment of bodies for the facilitation, monitoring, and implementation of the agreement. The establishment of subsidiary bodies with authority and resources to undertake specific activities to enhance the implementation of the agreements is vital to ensure continuity and preparation and follow-up to complex issues. (See Chapter 5.)

Establish good links with scientific bodies. As ecological issues become more and more complex, it becomes increasingly important to ensure that there are good institutional links established to link the legal process with the scientific community. This has been well arranged in the Long Range Transboundary Air Pollutants regime, the Montreal Protocol, and the climate change regime (Haas 1989; Gupta 2001). In the CBD regime, this is being developed. However, even the present limited links with the scientific community are limited to the mainstream natural sciences and economics. There are very few and, in many cases, no links with social science focused on development, gender, and human development studies.

Establish reporting facilities. The existence of requirements to report usually puts pressure on countries to undertake measures and exposes them in the event they have not been able to implement their goals. The inclusion of such features increases the potential for implementation. (See Chapter 5.) However, while such reporting requirements assert continuous pressure on countries, if the ultimate objective and the obligations are not clear, these documents may be less effective. But even so, if there is a reporting format, this makes it easier for implementing officials to implement the documents; and if infractions are reported, this makes it easier to keep the pressure on countries.

Have noncompliance procedures and sanctions. For an instrument to be effective, it should include sanctions for violations and/or noncompliance procedures to help countries come into compliance. (See Chapter 5.) The lack of such sanctions and/or noncompliance procedures in many environmental regimes is a major problem (for example, CBD, Watercourses Convention, CCD). On the other hand, the Montreal Protocol does have successful noncompliance mechanisms and these have played a role in the success of the Protocol. Noncompliance mechanisms are now being developed within the climate change regime.

Have dispute resolution mechanisms. The lack of compulsory jurisdiction for dispute resolution is a major weakness in international law. However, increasingly, many agreements (CBD, Watercourses Convention, SADC Protocol) are explicitly referring to specific options for dispute resolution and these can increase the potential for implementation. The Aarhus Convention, the Watercourses Convention, and the SADC Protocol allow foreigners nondiscriminatory access to the national judicial systems. It is still too early to say anything specific, but it is expected that this will enhance the effectiveness of agreements. (See Chapter 7.)

Establish coordination with other relevant agreements. The literature indicates that it is vital that these agreements are closely linked with other agreements and that solutions designed for one regime do not necessarily lead to problems in other regimes. Many regimes do indeed have articles that link up to other regimes, including CITES, CMS, the ozone regime, the Basel Convention, the UNFCCC, and the CBD.

Establish technology transfer mechanisms. Technology transfer can address environmental and social issues in developing countries. However, such technologies may not necessarily be appropriate or contribute to reducing poverty. (See Chapters 6, 7.) In the context of climate change, a literature survey of IPCC concluded that technology transfer is likely to work best in combination with national systems of innovation; social infrastructure and participatory approaches; human and institutional capacities; macroeconomic policy frameworks; sustainable markets; national legal institutions; codes, standards, and certifications; equity considerations; rights to productive resources; and research and technology development (Hedger et al. 2000; Mansley et al. 2000).

Include distributive elements. The inclusion of distributive elements may increase the effectiveness and sustainability of agreements. Access and benefit sharing with local people, as encouraged by the CBD Article 8(j) through participation of local people in the planning process and in discussion of customary and other regulatory frameworks, is one such idea. A similar provision is found in ITPGR. Benefits shared can be monetary or non-monetary. The ecosystem approach also offers a basis for successful implementation. Transboundary conservation areas may be another way to promote conservation and human well-being. (See Chapter 5.)

17.2.1.1.2 Agreement negotiation

The assessment reveals that, in addition to the design aspects of the various existing agreements, the ways in which agreements are negotiated are also critical for the effectiveness of agreements. While treaty negotiations are in theory based on the assumption of *pacta sunt servanda* (that is, the agreement will be implemented) and call for rules of procedure to be put in place, these rules are sometimes suspended for practical and/or political reasons. The assessment shows that the compliance pull (that is, the likelihood that the agreements will be voluntarily implemented) of agreements can be increased if:

There is leadership shown by specific actors. There is increasing consensus in the literature that leadership shown by the major actors, be it structural, instrumental or directional, will have an influence on the design of a regime. The more leadership in a regime, the more likely it is that the regime will take on good design features (Young 1991; Oberthur and Ott 1999). For example, in the climate change regime, the leadership from the European Union has been critical in steering the way the instrument was designed to effectively implement the goal.

Non-state actors are actively involved in the process. There is increasing consensus in the assessment of the need to include non-state actors into the negotiating process in general. This is seen as a way to increase the legitimacy and compliance pull of an agreement by ensuring that a variety of interests and information are represented at the negotiations, and this can help in the actual implementation process. (See Chapter 5.) On the other hand, the inclusion of non-state actors may actually lead to capture by vested interests (Gupta 2003). Besides, stakeholders themselves may not be willing to accept environmental goals that go against their own short-term and/or long-term local interests. (See Chapter 5.)

The instrument is negotiated in accordance with the established rules of procedure. While all international agreements must be negotiated in accordance with the established rules of procedure, the complex nature of global decision-making processes requires concurrent meetings often only in English. This has placed a big strain on developing countries, which have limited financial resources to attend and participate effectively. The negotiations on the Kyoto Protocol did not provide the developing countries adequate opportunity to negotiate effectively on the instrument as a whole, and specifically on industrial-country targets, emissions trading, and the issue of sinks (Yamin 1998; Werksman 1998). Most developing countries do not have the staying power to negotiate effectively at all these sessions (Gupta 2002).

Negotiators are given the time and expertise to prepare for the negotiations and have consulted domestic stakeholders accordingly. The Law of Treaties assumes that countries send only well informed and prepared negotiators to the negotiating table. Interviews reveal that as the complexity of the negotiations increase, most negotiators from the developing countries may be well informed about one or two aspects, but few if any have a complete grasp of all the issues that are being negotiated (Gupta 1997, 2001; Rutinwa 1997 on the Basel Convention; Nair 1997 on the Montreal Protocol). The assessment of a number of international treaties show that very often the national negotiators have not been able to adequately represent the interests and the actual problems faced by their countries. As a result. international agreements are often cast in first-world language with first-world solutions that may be ill-suited for implementation in developing countries (Agarwal et al. 1999).

The instrument includes poverty reduction and human development measures. While developing countries have tried in almost all environmental negotiations to make links to other global regimes (trade and finance) and the global order (the ''unfair international economic order''), and have tried to focus attention on poverty alleviation, well-being, and development, these items either have been seen as irrelevant, and hence excluded from the agenda for discussion, or have been included to pacify the developing-country negotiators. However, even when they are included, no clear targets and timetables or mechanisms to actually achieve these goals are articulated (for example, CBD, UNFCCC, and the WSSD).

17.2.1.1.3 Policy coherence at the international level

The third element for influencing the effectiveness of legal agreements at the international level is policy coherence. There has been a trend toward synergetic agreements among environmental agreements and governance initiatives, for example, in the CBD, CCD, UNFCCC, WSSD, MDGs. (See Chapter 5.) However, there are contradictions with the trade regime (whose primary focus is trade rather than environmental protection); agricultural policies (where the policies of countries to subsidize their agricultural sector has given perverse incentives to farmers to overproduce in the industrial countries, while reducing markets for many developing countries; see Chapter 6); the intellectual property rights regime (which may lead to reduced access to food for people; see Chapter 7; the investment and private international law regime (where public private cooperation may actually transfer resources to the private sector, and be covered by the more restrictive rules of confidentiality and liability that operate in private international law; see Chapter 2); bilateral fisheries agreements which, combined with heavy subsidies to the fishing sector, are leading to overexploitation of the resource and reduced access for the local people; and the climate change regime (where if the progress made is slow, many ecosystems will be seriously affected and environmental refugees are likely to increase; see Chapter 5).

17.2.1.1.4 The domestic context

Lastly, the assessment shows that the success of an agreement depends on the contextual features of the country in which implementation is to take place. (See Chapters 2, 3.) The agreements are more likely to be successful where:

There is a high level of awareness and resources. The higher the awareness and resources (human and financial) within a country, the greater the likelihood of implementation. For example, studies by Jacobsen and Weiss (1995) and Sand (1996) found that developing countries had more difficulty in implementing international environmental agreements because of the lack of financial capacity and the lack of awareness. However, even in an environment of limited resources, the mere existence of international agreements created internal efforts within many developing countries to try to push and advance the agreements.

There is a strong institutional and legal framework. If the institutional and legal frameworks within a country are well developed, there is a higher likelihood of that an international agreement will be effectively implemented. At the local level, the question is whether non-compliance should be dealt with. Although Chapter 5 argues that, from an economic perspective, it is not optimal to prevent all non-compliance with laws and regulations because the marginal costs may exceed the marginal benefits of full enforcement, from a legal perspective, non-enforcement of rules can lead to an environment of disrespect of national laws and is in the long-term disastrous for creating an effective legal environment.

There is political will. A critical factor remains the availability of political will to actually undertake measures.

17.2.1.2 Instruments at Local and National Level

The assessment shows that one needs to be careful about the way one generalizes about the national level. Countries have legal and cultural experiences that go back more than 2000 years, at least in the case of water and land management. These experiences have shaped the way legal rights and responsibilities have developed. Each country has over the years been subjected to a vast range of influences, conquests, religious influences, colonialism, the spread of epistemic communities, the spread of codification of laws, and now globalization. While in some countries, such as the Netherlands, the influences have been integrated into one comprehensive body of law and policy, and new laws in effect rewrite the older ones, the bulk of developing countries still have multiple legal practices within their context. As such, when new laws are designed and negotiated, these may have no effect at the ground level, if they are not seen as relevant or legitimate by the local people. In other words, most developing countries have multiple levels of law-making. Furthermore, institutions are embedded in each other. Thus administrative rules are embedded in ecosystem rules that are embedded in a host of other relevant rules which are in turn embedded in the constitutional system within a country.

Legal instruments at the national level include the elaboration of rights and responsibilities (for example, who has a right to land use and water), principles (for example, the precautionary principle), obligations, standards, monitoring, the establishment of implementing bodies or the delegation of power to existing bodies, and rules in relation to violation of the agreement.

The assessment of Part II chapters shows that the following are likely to be effective:

Designing new and direct incentives within the regulatory framework. In order to protect ecosystem services, it is vital to recognize the opportunity costs for the local people and to provide with them incentives. (See Chapters 5, 8). Examples of such incentives include:

- In South Africa, direct payments are given to local people who catch and sell wild animals to game ranches instead of being killed because of the danger they pose or because of the value of their skin or hide.
- Land tenure reform. Numerous studies have shown that private land tenure rights have promoted the conservation of ecosystem services while at the same time producing direct benefits to individuals (Tiffen 1993; Kates and Haarmann 1991; Duraiappah 1998). However, it should be noted that private land tenure may not be conducive to ecosystem conservation in all ecosystems. For example, studies have shown that communal land tenure was far more conducive for ecosystem conservation than for the well-being of the local communities (Rutten 1992).

Integrating different levels of conservation of ecosystem services through regional planning. One element of regional planning is the concept of protected areas. The assessment shows that although protected areas are considered an important part of biodiversity conservation programs, notably for ensuring the survival of certain components of biodiversity, it points with a high level of certainty to the fact that protected areas by themselves are not sufficient to protect biodiversity and related ecosystem services (See Chapter 5.)

We note that protected areas were never intended as instruments for poverty reduction but rather as a way of preserving biodiversity. Nonetheless, with regard to poverty reduction, assessment indicates that they may actually exacerbate poverty by reducing access of rural people to the resources that have traditionally supported their livelihoods, thereby affecting their welfare (Bruner et al. 2001). In addition, the fact that protected areas are partly a response to degradation and habitat change due to human activities precludes the use of some ecosystem services that contribute to human well-being.

The use of protected areas as a standalone measure is not sufficient for the approach to be effective. In order to have a more efficient functioning of the area, the design should take into account the ecological, social, historical and political context, and better weigh the multiple economic values accruing to people at the local, national, and global levels, by minimizing conflicts with the needs of society and use of compensation schemes. Measures on protected areas need adequate resources, greater integration with the wider region between protected areas, and greater stakeholder engagement with the objective of giving the local communities greater rights and ownership, and local people direct payments for conservation and management

Last but not least, protected areas should be given special attention due to their prominent position within the CBD as a hybrid instrument of regulatory (legal) and economic incentives to conserve biodiversity. However, they will need to be designed in a manner complementary to the local social, economic, and political settings.

In general, we find regulatory instruments at the national, regional, and local level having the following characteristics:

- Legal instruments focusing on direct management of invasive species are more effective than an integrated approach. This tends to work best when the species in question has low dispersal ability, when sufficient economic resources are devoted to the problem and when social actors are all engaged in addressing the problem.
- Reintroducing species works best when it is based on adequate science. Availability of suitable habitats, a number of healthy and genetically diverse species members, and a long-term program for monitoring are important factors. The reintroduction of the Mexican grey wolf in the Colorado plateau is a successful case in point.
- New regulatory instruments may include regulations on ecosystems for production as a new tool for protecting ecosystem services.
- Where the private sector is engaged constructively in discussions within a strong regulatory framework, there may be potential for protecting the environment and human well-being. The case of Bioamazonia and Novartis shows that the correct modalities of involving the private sector and allowing public participation still have to be worked out.
- Regulatory options that promote community forest management can work to both protect ecosystem services and human well-being. In India, it has worked primarily to improve human well-being.
- Regulatory approaches that promote public participation in policy-making have a higher chance of being effective.
- Fair and strong law enforcement is often a powerful disincentive for exploitative behavior. Law enforcement procedures in Indonesia to stop blast fishing have increased local biodiversity.

17.2.1.3 Distributional Issues

Environmental policy and law inevitably has a distributive effect in terms of responsibilities, impacts, and benefits. Most global environmental problems are essentially ''wicked'' problems in that the distribution of costs and benefits are not aligned, and there is inadequate scientific certainty and a vast difference in the value systems of countries. For example, the desire to protect ecosystems and species is not always based on the same altruistic motives. The pharmaceutical industry has high financial stakes at one end of the spectrum, while the local people may face high opportunity costs that are low in absolute terms. (See Chapter 5.) For example, in the climate change regime, the costs of emission reduction, if taken seriously, are high for the developed countries, while some perceive that it is the developing countries that will benefit.

The way responsibilities are distributed between the parties also can have a distributive effect. On the one hand, the funds established under many of the agreements have a re-distributive effect, because they transfer resources to other countries to enable them to participate more effectively in the negotiations and to fulfill their obligations under the international agreements. On the other hand, the move away from the ''polluter pays'' principle at the international level has led to an inequitable distributive effect internationally. Thus the small island countries and the least developed countries, most of whom have negligible greenhouse gas emissions, will suffer disproportionately in comparison to the other countries, and for no fault of their own. Many may even lose large quantities of land and land-based resources and infrastructure as the impacts of climate change are experienced. In the meanwhile, the world's largest polluter, the United States, does not take on any quantitative commitment, arguing that from a domestic perspective the costs of taking policy measures far outweighs the benefits for Americans.

In the climate change agreements, the distributive effect is highly questionable because of the focus on cost effectiveness. In the other agreements, the distributive effects are similarly not always quite so clear. For instance, if African countries wish to sell

ivory as national resources from a huge elephant population, to what extent may the outside world be allowed to prevent such sales under CITES? If forest-rich countries want to convert forestlands into agricultural lands, to what extent do other countries have the right to prevent such conversion, and who bears the final costs of this? There are no clear-cut answers to these issues, but the distributive impacts surrounding these concerns need to be further explored in a more rigorous and fair manner than presently done in the international arena.

17.2.1.4 Some Inferences

The key international tool for addressing global ecosystem services is treaty negotiation on an issue-by-issue basis. The proliferation of agreements on natural resources over the last two hundred years in the area of water and hundred years in the case of environmental issues has given us a vast amount of empirical evidence on the success of agreements. This evidence shows that the success of agreements depends on how they are designed in both substantive and procedural terms, how they compete with other international agreements, and the context in which they are to be implemented. At the national and local level, the success of the regulatory instruments depends on how well they target specific incentives and disincentives, and how well the implementation is monitored and enforced.

17.2.2 Economic and Financial Responses

It is common practice in economic analysis to compare and contrast regulatory or what economists call ''command and control'' approaches vis-à-vis economic and financial interventions. This section, however, does not apply this commonly used analytical approach. Instead it focuses on the use of economic instruments and financial interventions, as described by the Part II chapters of this volume. It does so based on the following two criteria. The first criteria will be the effect of the instrument on the continued flow of ecosystem services. The second criteria relates to the distributive issues and the impacts on human well-being and poverty reduction. Regulatory instruments are evaluated in the legal section.

Market-based instruments have been implemented to address environmental concerns ranging from solid waste management, biodiversity conservation, sustainable land use, and reducing air pollution. MBIs are said to have great potential for generating win-win situations (Rietbergen-McCracken and Abaza 2002). The win-win situations may arise in the case of the use of charges and environmental taxes, for instance, which have been singled out as providing revenue to the treasury in a cost-efficient manner and at the same time benefit the environment ''by encouraging polluters or users of environmental resources to change their behavior to become less polluting and wasteful'' (Rietbergen-McCracken and Abaza 2002).

Economic instruments are basically structured to achieve a mixture of three main objectives (Rietbergen-McCracken and Abaza 2002, p. 100):

- establish and enforce prices for resources consumed and environmental damages associated with production;
- address issues dealing with property rights which directly contribute to pollution or poor stewardship of resources; and
- subsidize the transition to preferred behaviors.

Against this backdrop, the use and appropriateness of MBIs is assessed, in addressing issues relating to ecosystem services, their effectiveness in different regions, the preconditions necessary for the effective use of the economic/financial instruments, and last, but not the least, how effective these instruments have been in achieving the goals related to human well-being and poverty reduction.

17.2.2.1 Biodiversity

In the case of biodiversity, two broad sets of responses are examined: indirect and direct incentives. Incentives are, broadly speaking, mechanisms to change or affect the behaviors of individuals. Incentives could be negative such as fines or positive such as tax credits.

Indirect incentives such as development interventions, integrated development projects or community-based natural resources management projects have had mixed success in terms of achieving conservation and development goals. (See Chapter 5.) On one hand, indirect incentives have had success in redirecting labor and capital away from activities such as intensive agriculture that degrade the ecosystems, encourage commercial activities such as ecotourism that supply ecosystem services, and can help in raising income to reduce dependence on resource extraction. On the other hand, redirecting labor does not necessarily mean success in reducing the level of degrading activities, as the response itself may create incentive to hire people to take advantage of the opportunities provided by the response (Muller and Albers 2003). Similarly, commercial activities that maintain ecosystem services, such as ecotourism, have limited success due to the fact that demand for such activity is not high enough to support a large fraction of the population.

Furthermore, an assessment of ecotourism in the Khao Yai National Park in Thailand points toward the fact that most income from tourism did not accrue to villagers but to tour companies instead. The information in this case seems to indicate that essential elements of poverty reduction and human well-being, that is, access to resources and income, have not been achieved. Studies find institutional settings and property rights as critical elements for making ecotourism a potential tool for poverty reduction. (See Chapter 5.)

Direct incentives or payment for conservation, which consists of cash or in-kind payment to individuals or groups, were found preferable to indirect payment because they were found to be more efficient, effective, and equitable (Simpson and Sedjo 1996; Ferraro 2001, 2002, 2003).

However, the empirical evidence of direct incentives such as transferable development rights and tax credits in successfully encouraging and achieving conservation of biodiversity in situ is unclear at best and has been the subject of criticism, notably for being relatively complex. In the case of TDRs, a new market that requires learning will need to be established. This implies high transaction costs and the establishment of new supporting institutions. It is also important to stress that TDRs need to be supported by well-defined property rights over the land and resource.

One major drawback of tax credits and TDRs, in terms of achieving goals related to ecosystems and the related services, is that both instruments are unable to target specific habitat types. There is therefore a high degree of uncertainty about whether they can protect specific kinds of biodiversity. However, and in spite of some of the criticisms, there have been successful cases in the use of property rights to conserve biodiversity. The charcoal market in St. Lucia is one example whereby use rights in the form of charcoal rights were successful in preserving biodiversity and reducing poverty. (See Box 17.2.) The main reasons why the charcoal right market was a success was because of its simplicity, using existing institutions instead of depending on new institutions, and last but not the least, it was developed through a participative process involving the local community.

BOX 17.2

Case Study of the Mankote Mangrove in St. Lucia (UNEP 2003)

The Mankote Mangrove constitutes 20% of the total mangrove area in St. Lucia. Uncontrolled charcoal harvesting through excessive tree loggings created a severe environmental decline of the mangroves, which posed a serious threat to many of the ecosystem services that the mangrove provided, including water quality, coastal stability, bird habitat, and fish breeding. Local communities, consisting primarily of poor people, undertook the practice of harvesting charcoal. These communities had no legal right to use the publicly owned mangrove resources. With no possibility for substitution, the loss of access to the mangroves by these poor populations due to resource depletion or degradation would have created permanent loss of their only source of income.

To address this problem, the following solution was implemented:

- The local communities were organized into informal cooperatives and given communal legal and exclusive rights to harvest the charcoal.
- They were involved in monitoring the program, to get accurate information on the overall health of the mangrove.
- Measures to increase the supply of wood outside the mangrove reserve were put in place, as were alternative job options for charcoal harvesters. Tourism played an important role in offering this alternative.

The effort yielded the following results:

- The decline in the Mankote Mangrove was halted and reversed.
- The density and size of trees increased.
- Charcoal harvests were maintained.
- The range of employment options for the poor population somewhat increased.

This is a clear case where a property and legal rights approach made sense, because the subsistence harvesters were the primary source of the problem due to uncontrolled harvesting of charcoal. The use of formal rights to the resource gave the poor an incentive for long-term management of the mangrove as an asset over which they had control. The introduction of a monitoring program further improved the level of and access to information they had about the general condition of the mangrove.

Moreover, the direct payment approach has been criticized because it entails on-going financial commitment by governments, multilateral donors, and firms to maintain the link between investment and conservation objectives, and can create conflicts between communities as property rights are transferred to local participants. Direct payment may also turn biodiversity into a mere commodity (Swart 2003). In other words, paying for biodiversity conservation may give local people the impression that it is something which is important because there is a ''price tag'' on it and this may not help in the long run to capture the real/intrinsic value of biodiversity as it plays a vital role not only in terms of provisioning services, but also in maintaining vital ecosystem equilibrium (through regulating services) and has also an impact on the spiritual lives and culture of certain communities.

In spite of the many criticisms of direct incentives, there is a medium to high certainty that direct interventions have had more success than indirect interventions. However, it will be necessary to iron out the issues of how to achieve a sustained flow of money for payments, the need to more clearly define the issue of rights, and how to make management decisions consistent with the overall biodiversity conservation and not turn biodiversity into a mere commodity.

17.2.2.2 Water

Chapter 7 of this volume finds that, market-based approaches to water have ''the potential to unlock significant supply- and demand-side efficiencies while providing cost-effective reallocation between old (largely irrigation) and new (largely municipal and instream) uses.'' This argument is based on the principal that allocations of water have seldom taken into account its scarce nature and value. Furthermore, the argument puts forth the idea that payment for water conservation can increase water availability and that properly functioning water markets can provide price signals for reallocation not only between different uses, but also as signals to guide conservation activities.

The three main reasons identified by Bjorlund and McKay (2002) to consider the use of markets for the provision of fresh water are: (1) tradable water rights create a value for water that is distinct from land and able therefore to be conserved in its own right, (2) full recovery pricing incorporates externalities associated with the inefficient use and encourages inefficient users to leave the market, and (3) the use of market forces rather than government intervention to facilitate reallocation reduces transaction costs and delays.

Whether through the use of the water banks for direct payment of water, water markets and water exchanges where water rights and permits are traded, or the use of economic instruments for watershed services, the underlying premises behind all these types of interventions remain first and foremost the efficient allocation and use of resources. Experiments conducted in several countries (western United States, southern Australia, Mexico, and Chile), indicate that payments and incentives for water conservation can increase water availability, just as water pricing at its full marginal cost can reduce demand. (See Chapter 7.)

Functioning water markets such as those in the Limari market in Chile, with its largely laissez-faire water code, can not only provide price signals for better reallocation between different uses, but also help guide conservation through flexible management by farmers of some of the risks caused by uncertainties in water supply and agricultural markets. However, experience from Chile suggests that the imposition of an unfettered free market in water into a developing context with significant existing socioeconomic inequality may lead to further inequities. (See Chapter 7.)

At the same time, experience gathered from the California Water Bank, whose purpose was to transfer water from irrigation to municipalities, was found to have both positive and negative environmental impacts, with negative effects including damage to bird and wildlife forage and habitat, as a result of removing grain crops, reduction in groundwater recharge and groundwater quality, and also negative impact on fisheries. The positive impacts are improved surface water temperature, quantity and quality, and reduced fish entrapment (MacDonnell 1994).

Similarly, the use of economic instruments for watershed services—such as transfer payments made to landowners as compen-

sation for the cost of adhering to specific management practices, marketable permit systems, generally in the form of cap-and-trade or credit programs, in order to allocate permitted levels of pollution and resource use—have shown their limitation in terms of achieving by themselves the goals related to ecosystems and their services, including regular flow of water, protection of water quality, and control of sedimentation (Landell-Mills and Porras 2002). The Chapter 7 assessment points out that a mix of market-based and regulatory and policy incentives are the most likely to achieve these goals, notably when the ''threats are beyond the response capacity of individual communities'' (Rose 2002). Among the main conclusions:

- Markets arrangements do not automatically protect ecosystems. A mix of economic and regulatory instruments are needed, especially when the scale of the threats and responses are beyond the capacity of individual communities.
- The issue of poverty reduction and human well-being need to be made explicit. Poverty reduction objectives in the form of equitable rights are not made explicit in the design of economic interventions in the water sector. Furthermore, the achievement of equity in terms of benefits and costs needs as a precondition the presence of enabling institutions (for example, good governance) in order to enable the poor to have access to market.

17.2.2.3 Food

The primary focus of economic responses in the provisioning of food service has been on increasing food production. The impact on ecosystems from attempts to increase food production has been realized largely as secondary effects, and they represent negative spin-offs or externalities of agricultural production. Furthermore, it has been found that these externalities are often ignored by individual farmers, small-scale agents, and by governments in the food and agricultural policies.

The analysis further recommends that the ''need to mitigate impacts on ecosystem and sustain their capacity for future generations makes necessary the introduction of appropriate regulatory frameworks at all levels from local to global, that will control for the externalities affecting the capacity of ecosystems to sustain their food provisioning services.'' (See Chapter 6.) However, it is also noted that the cost associated with regulation, and representing the cost of using ecosystem services for producing food is largely unpaid due to missing markets and lack of well-defined property rights. Instruments identified as important in maintaining and expanding food production capacity include agricultural subsidies, fisheries interventions, and livestock interventions.

17.2.2.3.1 Subsidies in agriculture

Water is a critical input in the various technologies developed to increase food production from ecosystems. One of the criticisms of the present water pricing structure is the low water fees levied on farmers in order to increase food production. The low water prices contribute to inefficient use of water, water shortages, and depletion of water resources in the long run and degradation of the ecosystem (Koundouri et al .2003; Pashardes et al. 2002; Chakravarty and Swanson 2002). Moreover, there is increasing evidence that rich framers benefit more than the poor farmers from these low water fees.

There is not sufficient information from the assessment in Chapter 6 on whether or not economic-based instruments for groundwater such as pumping taxes, transferable property rights, and water markets have created greater incentive for farmers to save water and reduce the ecosystem deterioration witnessed under subsidized water regimes. It is also too early to say if these economic responses create a more equitable distribution of the use of water or if they have marginalized the poor even further.

17.2.2.3.2 Fisheries

Instruments such as total quotas or total allowable catches are used in fishery management to prevent stock depletion. Individual quotas and individual transferable quotas, describing individual annual nontransferable quota and transferable quotas between fishermen, respectively, are also commonly used.

The total allowable catch, which sets a total quota for a time period, is known to create a ''race for fish,'' which raises the cost of fishing activity and is a problematic response to overharvesting. Individual quotas, on the other hand, have an information and compliance problem; they only work when fishing vessels have information about each other's cost structures, and thus require a large amount of information. Individual transferable quotas solve the information problems by letting fishermen trade with quotas, but continue to have compliance problem. ITQs seem to be the preferred option, but need to be combined with a strict control/regulatory and enforcement policy.

There are limited references/assessment on how effective this instrument is in achieving poverty reduction and ensuring equitable distribution across different social groups. Some evidence, notably from developing countries, tends to point toward difficulties in terms of enforcement and monitoring of these instruments. Box 17.3 provides an assessment and illustration of the use of fishery ITQs in Chile.

17.2.2.3.3 Livestock

Livestock grazing and rangeland burning strongly affect the state of vegetation in rangeland systems. Land tenure and economic policy in Mongolia, for example, has changed pastoral burning and practices, reducing forage quality and possibly diversity.

There is strong indication that conversion of rangelands into cropland by farmers leads to vegetation and wildlife losses (Serneels and Lambin 2001). The assessment points toward the fact that in Africa and semiarid India, the poorest groups compete in rangelands for land, with the farmers having the upper hand be-

BOX 17.3

Case Study of the Fisheries Sector in Chile

In the fisheries sector in Chile, fish stocks started depleting greatly after the industry was privatized in 1973. Particularly affected were artisanal fishermen who, under the individual transferable quota system, cannot compete with industrial fisheries in the market and lose their livelihoods. To address this issue, individual transferable quotes were implemented for separate subclasses of fisheries and limited to industrial/commercial fishers.

The success of the program is unclear. As structured, the ITQ policy has protected industrial-country fishing interests, but reduced the potential benefits of the market-based quotas. The issue of artisanal fishermen has not been properly addressed, and regular updating of information about fishery health remains a problem. The small percentage of total catch currently covered suggests that ITQs are not yet addressing the higher goal of protecting Chilean fisheries.

The rationale for using these measures was two-fold: to apply regulatory efforts more consistently and to control access rights.

cause land tenure regimes and property rights often favor crop cultivation over livestock grazing (Blench 2000).

This together with evidence from the tribal grazing land policy in Botswana (UNEP 2000) leads us to with a medium to high degree of certainty to conclude that the use of private land tenure and grazing land policy, as economic instruments have not adequately addressed the goals related to ecosystems conservation in arid and semi-arid ecosystem types. Moreover, these instruments have created greater inequality between the wealthy cattle owners, pastoralists, and subsistence farmers.

17.2.2.4 Wood and Fuelwood

Forest certification was developed initially to mitigate tropical deforestation. However, the assessment in Chapter 8 finds most certified forests in the North, managed by large companies and exporting to Northern retailers. (Chapter 8.) This seems to be a clear indication that this instrument has been more effective in the North than in the South. The assessment further points out that where certification becomes the preserve of large companies, the role and competitiveness of small and medium-sized enterprises, which may bring with them sustainability and livelihoods, may be jeopardized.

Certification standards have provided incentive only to producers who were already practicing good practices, rather than improving bad practice. Some critics suggest that small growers and community groups should not be put under the same certification as large corporations. The heart of the problem is whether small communities, who occasionally harvest for timber, should be subjected to the same level of accountability as large corporations.

Commercialization of non-wood forest products has achieved modest successes for local livelihoods—a component of human well-being—but has not always created incentives for conservation but has contributed sometimes to overexploitation of resources. It has also led to the inequitable distribution of benefits with stronger groups gaining control at the expense of socially and economically weaker groups.

The improved formal access to forests has ''helped in most cases to protect a vital role of forests as safety nets for rural people to meet their basic subsistence needs.'' (See Chapter 8.) At the same time, there has been criticism about the need to have benefits that go beyond subsistence level and that property rights would need to extend to more secure rights over valuable resources, for the poor to really benefit.

Another criticism deals with the inability of certification to interpret social standards in complex social contexts. Norms and methods of traditional societies are not captured by predictions made by document-based certifications that rely on ''scientific means of planning and monitoring.'' (See Chapter 8.) Some environmental and social services are produced at levels other than the forest management unit, which is outside the control of the certified company.

Fuelwood is another large output of the forest sector. Growing demand for fuelwood and charcoal remains one of the main drivers in ecosystem deterioration in regions such as the dryland forest of Africa. However, formal and informal privatization of wood and land resources have led to woodfuel resources being unavailable to fuelwood gatherers. Subsidized fuelwood supplies from government forests; taxes and other charges to generate government revenue; or restriction imposed in the name of conservation have imposed constraints on who can participate in production. (See Chapter 8.)

Low fuelwood prices combined with subsidized alternative fuels have the characteristic of generating very little surplus or incentives/disincentives for the poor engaged in selling fuelwood for their living, and discouraging sustainable management of the resource. At the same time, the low price for woodfuels does not encourage valuing the trees as ''priced assets'' that need to be sustained and invested in with a long-term perspective in mind.

Some of the general lessons learned is that market-based responses are redistributing rights to stakeholders (for example, allocation of used rights to public lands, voluntary certification), making these stakeholders more effective in securing wood supplies and other ecosystem services as well as helping to change the wood industries. (See Chapter 8.) However, it is usually the good practice industries that benefit the most, which does not help create incentive for the bulk of wood producers to improve forest management practice. Economic intervention will not be adequate to answer the issue of illegal traders and asset-strippers; this will require a legal action and enforcement.

There is a need to combine governance and institutional responses with development questions. Better information is needed about the dynamics of wood supply and demand, and the benefits, costs, and distributional impact of the different economic interventions.

17.2.2.5 Nutrient Management

Mandatory taxes and fees were found to have the potential as regulatory instruments for inducing change. These taxes and fees include effluent charges, user or product charges, noncompliance fees, performance bonds, and legal liability for environmental damage. The findings suggest that it is difficult to reach specific targets in pollution reduction using the tax/fee approach since regulators have difficulty predicting how polluters will react. There are no known examples of use of taxes and fees as a nutrient management approach for water quality, but there is a growing interest in the United States for tradable permits in nitrogen control to coastal waters. (See Chapter 9.)

Trading programs were proposed to provide economic incentives for voluntary reductions from non-point pollution sources, and permit requirements for point-source pollution. The lack of statutory authority for regulating non-point sources of nutrients under the Clean Water Act emerged as a major problem for the plan in the majority of watersheds, where non-point sources dominate nitrogen input. The lack of authority over cross-boundary pollution was another challenge.

17.2.2.6 Responses to Climate Change

Use of economic instruments was proposed as an effective response to climate change. (See Chapter 13.) The economic instruments basically involve a series of ''flexibility mechanisms'' to facilitate and reduce the costs of attaining an agreed level of emissions targets. Under the Clean Development Mechanism and Joint Implementation, there is provision of transfers and acquisition of emission reductions (emissions trading) between various parties to the Protocol that are in good standing with respect to the various rules of reporting and accounting.

With regard to the twin goals of the CDM, namely sustainable development and achieving compliance in terms of setting emission targets, there seems to be an imbalance as more focus is put on the latter. Stabilizing greenhouse gases in the atmosphere largely via modifying energy use and energy supply is a central position under this scheme. In this particular case, the assessment found out that any flexibility mechanism would lower the cost of

achieving a compliance target and induce the incentives to invest in new research and new technologies.

The assessment states that in the case of a JI transaction, if the emission reductions would have occurred without the incentive of the carbon trading rights, there would have been no significant impact on the atmosphere; the host country transfers some of its emission reduction credits to the acquiring country allowing the acquiring country to emit more, leaving the host country to carry out extra efforts to meet its target.

Another decision in designing a cap-and-trade program is whether to apply the targets ''upstream,'' where carbon enters the economy (when fossil fuels are imported or produced domestically) or farther ''downstream,'' closer to the point where fossil fuels are combusted and the carbon enters the atmosphere. An analysis by the U.S. Congressional Budget Office concluded that, in general, an upstream program would have several major advantages over a downstream program (also see Chapter 13 for some examples). An alternative is a carbon tax approach in which commodities or activities that lead to carbon emissions are taxed, thus providing an incentive to reduce the use of these commodities or activities. This is often seen as a simpler approach to achieving incentives for emission reductions. However, taxes are usually politically unpopular in most countries. Some have suggested that cap-and-trade and taxes may be combined to overcome the main weaknesses of both schemes, namely the presence of a strong enforcement agency for the cap-and-trade scheme and political unfeasibility for the taxes.

17.2.2.7 Valuation of Ecosystem Services: A Tool for Effective Economic Responses

Many of the economic responses mentioned in the previous sections rely on finding the correct value for specific ecosystem services. For example, in order to preserve a watershed, it is necessary to find the value of not just the provisioning services but also the regulating, supporting, and cultural services it may provide. Economic valuation of ecosystem services is being increasingly used to find these appropriate values. (See Chapters 3, 4.) Market based valuation methodologies have been discussed as appropriate for provisioning services while stated preference method like contingent valuation methods have been suggested to capture regulating, cultural, and supporting services of different ecosystems.

Although both classes of techniques are valuable, it should be acknowledged that these valuation techniques view the individual purely as a self-maximizing agent in a market environment. However, in reality, individuals are known to act as moral agents making judgments and assigning values from a social perspective; this will include therefore not only there own well-being but the well-being of others and in some cases even to a loss of well-being. Moreover, the philosophy of contingent valuation methods treats an environmental good as a normal private commodity that can be purchased and consumed. However, many ecosystem services cannot be treated as private goods and have the characteristics of public goods by which it is not just an individual's value of that service that counts but the collective value society places on it that matters and reflects the true value of the ecological ''good'' (Sen 1995). New techniques based on deliberative community participation are being increasingly used whereby the values are based on social choices vis-à-vis market-driven individual values.

17.2.3 Social, Cultural, and Cognitive Responses

17.2.3.1 Consequences of Responses Related to Changing Perceptions of Ecosystems

Land and waterscapes do not only have physical attributes but are subjected to and influenced by cultural perceptions as well. Culture and memory play an important role in creating contesting meanings for any one place (Schama 1995; Stiebel et al. 2000). Transformations of landscapes have been and will be influenced by cultural perceptions of nature as well as by sociopolitical and economic demands and aspirations. These transformations in turn have a (differential) impact on human well-being.

Over time, ideas about the relationship between humans and nature have changed and continue to change. (See Chapters 5, 14.) The directions these changes take vary from place to place, and may lead to considerable debate within communities, whether these are communities in the sense of groups of people living together, or so-called communities of practice, that is, people who share similar professional interests. It is therefore difficult to assess the consequences of these changes. Nevertheless, some common trends can be observed in the thinking about the relationship between ecosystems and human well-being.

17.2.3.1.1 Nature–culture dichotomy

Certain cultural perceptions of landscapes become dominant or imposed through economic and political forces, often to the detriment of local praxis. For a long time a dichotomous approach to nature–culture relations was dominant in nature conservation initiatives. This dominance manifested itself in many national policies concerning the establishment of nature reserves, but also through the work of international environmental NGOs, and the selection criteria for international recognition of protected sites such as the World Heritage Sites. The establishment of conservation units where human exploitation of natural resources was reduced to a minimum in many cases positively contributed to the protection of certain species. (See Chapter 5.) This strategy has also contributed positively to the human well-being of certain sections of the population through safeguarding provisioning and cultural services. However, for local communities, the consequences have generally been less positive. If concern for environmental conservation does not take into account local dependence on the use of certain natural resources, then the human well-being of local populations is threatened through dispossession, as the case of the Maasai living in the vicinity of the World Heritage Site, the Ngorongoro crater, shows (McCabe 2003).

A dichotomous approach to human–nature relations has also been linked to a tendency in nature conservation to search for ''the pristine.'' This concept may easily lead to conservation policies that ''freeze'' landscapes within enforced boundaries and attribute any disturbance to human intervention that needs to be undone. Many conservation efforts entail restoring landscapes to their ''pristine, natural state,'' even though it may be hard to determine what that state actually was and how far back we need to look. (See Chapter 14.) In some cases, land and waterscape restoration is based on the introduction of physical elements to imitate natural habitats, such as artificial shelters to protect against natural predators, a common strategy in aquatic systems (Gore 1985); in other cases they may involve the restoration of entire wetlands. (See Chapter 7.)

Restoration may also involve the removal of invasive alien species—popular issue in conservation circles worldwide—or the reintroduction of species that have disappeared over time. Again, the impacts are difficult to assess. In some cases, restoration has contributed to human well-being by increasing species populations that can be harvested (Castro and McGrath 2003) or through increased tourism revenues (Lehouerou 1993). The restoration of riverflows has in a number of cases contributed to human well-being by reducing the risks of uncontrolled floods and improving access to (ground) water. In other cases, human well-being has

decreased because access to certain natural resources was denied or because the reintroduced species posed a threat to local economic strategies. (See Chapters 5, 14.)

17.2.3.1.2 People and parks

In the past two decades, there have been notable changes in perceptions of human–nature relationships. As a result, ideas about what land- and waterscapes should be conserved, as well as how they should be conserved (''people and parks'' issues) have changed. There is a growing recognition that a wider variety of landscapes, including agricultural, industrial and aquatic landscapes, need to be conserved, and that certain species may have adapted to or may even depend upon human-made environments (Daily et al. 2003). Many governments and national and international conservation organizations have recognized that the biggest challenge for conservation in the twenty-first century is for it to take place outside parks and enforced boundaries, thus integrating into agricultural and urban systems. (See Chapters 5, 14.)

Conception and policies regarding the creation of conservation units have moved from exclusion of communities and local forms of resource management to inclusion (Brandon et al. 1998). It is, however, difficult to assess the impacts of community participation on ecosystems and human well-being. Studies that have attempted to do so show mixed results. A community-managed forest in India, which contributed to a higher biodiversity as well as to local biomass needs, provides an example. (See Chapter 5, Box 5.6.) In a number of cases the contribution to human well-being has been easier to assess than the contribution to the conservation of biodiversity (Kangwana 2001; Wells et al. 1992). In cases where the contribution to human well-being has been limited, this is often attributed to flaws in the decentralization process (Barrow and Murphree 2001). Furthermore, numerous authors have problematized the concept of ''community'' (for example, Barrow and Murphree 2001).

Communities are notoriously difficult to define, with boundaries between them often blurred and overlapping. Within communities, differentiation exists based on socioeconomic positions, gender, and positions with local government structures. Ecosystem management may have different impacts on the well-being of different groups within communities. Local elites may have better opportunities to capture benefits, while the burden of conservation may be put on other groups in the communities. This entails that the tradeoffs and synergies between different ecosystem services may not be similar for every person with a community. Lastly, community-based ecosystem management systems may take a long time to evolve, longer than the project cycles of environmental and development organizations. In many cases, it is therefore too early to assess the impacts of such management systems on ecosystem and human well-being (Barrow and Murphree 2001). Nevertheless, literature shows that conditions that favor better outcomes of ecosystem management in terms of both biodiversity conservation and human well-being tend to include representative participation and governance; clear definition of boundaries for management; clear goals and an adaptive strategy; flexibility to adjust to new contexts and demands; and clear rules and sanctions defined by participants (Barrow and Murphree 2001; Corbridge and Jewitt 1997)

17.2.3.1.3 Links to the sacred

Recent attempts to link up with local communities' ideas about the protection of certain landscapes involve using sacred areas as a point of departure when creating protected areas (Mountain Institute 1998). While the idea is not new, what is new is a recent growth in translating the sacred into legislation or into legal institutions granting land rights (Bahuguna 1992). However, this approach requires extensive knowledge concerning the specific way in which the link between the sacred, nature, and society operates in a specific locale. Sacred areas may vary from a few trees to a mountain range, and their boundaries may not be fixed. In some cases, access may be restricted to a few religious specialists, while in other cases they are open to the public to perform acts of worship, which may involve harvesting some of the natural resources from within the sacred area.

Relations between landscape and religion have to do with moral and symbolic imaginings, but also with staking one's claim, such as to land contested by immigrants or from invading states and development agencies (Spierenburg 2004). Literature shows that the study of local specific contexts and functions of sacred areas in a participatory and democratic way increases the likelihood that initiatives to use sacred areas as a basis for nature conservation suit the local situation and contribute to human well-being.

17.2.3.1.4 Local identities and linkage to the national and global

If attempts are made to come to an understanding of the complexities of different cultural perceptions of landscapes, and the different local institutional arrangements related to natural resource management, this can (with medium certainty) contribute to alternative strategies to ecosystem management and socioeconomic development.

It is, however, only too common to either put the responsibility for environmental problems and conservation in the hands of local communities or blame the private sector, while disregarding the linkages between local, national, and international policies. Local communities do not operate in a vacuum; they create multilevel alliances, and adopt and adapt global influences to foster their own human well-being. Of course, they do so on the basis of their own cultural repertoires, a process referred by some as ''glocalization.'' At the same time, local identities seem to acquire an increased importance in the face of globalization (Geschiere and Nyamjoh 2001), especially in relation to struggles for control over resources.

These very local identities are increasingly used to mobilize international support for the conservation of local natural resource bases, as the growing recognition of the rights of indigenous peoples shows (Sylvain 2002). International NGOs like Survival International but also the United Nations are assisting indigenous peoples in protecting their rights of access to certain territories. There are, however, risks involved; the use of the term ''indigenous'' (as well as the use of the term ''traditional'') may serve to exclude certain groups who are also dependent on certain natural resource bases, but do not fit whatever characteristics/traits are used to define who is ''indigenous'' or ''traditional'' (Sinha et al. 1997; Gibson and Koontz 1998).

As these developments suggest, there have been changes in perceptions of global-local linkages. There is a growing awareness of global environmental problems by the larger public. This has led to the emergence of different views about rights and entitlements to global ecosystems and environmental resources. Examples range from public engagement in discussing the fate of tropical forests to pressure regarding regulations to curb the greenhouse effect. Chapter 5 provides an example of joint protests from local and international NGOs against the signing of a bioprospecting contract between the government of Brazil and a Swiss-based pharmaceutical company. International organizations now voice their opinions regarding national policies and interna-

tional bank loans for development projects, while national governments complain about their lack of sovereignty and international ''ecological imperialism'' (Geores 2002).

Increased awareness of the globe working as a system has motivated the need to deal with ecosystems in an integrated way. This process has been characteristic of the so-called post-Stockholm way of thinking, that is, an emphasis on the human environment concept (which actually was the title of the Stockholm 1972 conference) and the discussion of environmental problems at a global scale. The very concept of ecosystems reflects changes in thinking about the nature-culture relationship, dismissing the idea of fixed equilibrium, closed systems, and static nature (Moran 1990). Global institutions dealing with the environment have become prominent players not only in environmental management, but also in international politics. Amalgamation of scientific thinking, public awareness, civil society, and business has been present not only at international government forums from Stockholm 1972 to Rio 1992 and Kyoto 1997 to the World Summit on Sustainable Development in 2002, but also in science initiatives such as the Club of Rome, the Man and the Biosphere Program, the International Geosphere-Biosphere Program, and the Millennium Ecosystem Assessment, to cite a few of the most relevant.

The impacts of responses such as multilateral environmental agreements are difficult to assess. The CBD is one of the few agreements that specifically address poverty alleviation. (See Chapter 5.) The Ramsar Convention does not do so, but some of its COP recommendations do so. In a number of cases national governments have elected to let (short-term) economic interests prevail over environmental concerns (see, for instance, problems pertaining to the Kyoto Protocol), which in the short-term may increase human well-being in the countries concerned through economic growth, but whether this strategy in the long run contributes to human well-being is doubtful.

There is a changing focus of attention from local to transnational conservation efforts: the creation of corridors for migrating species and trans-frontier conservation areas. We find examples in South and Central America, central and southern Africa and Asia. The increased focus on trans-frontier conservation is partly based on the realization that ecosystems do not stop abruptly at national boundaries, but also results from wider societal debates about the importance of globalization (Draper et al. 2004). Most transboundary conservation areas have been in existence since a relatively short period only, therefore the assessment of impacts is rather difficult. However, recent studies from southern Africa suggest that transboundary conservation can contribute to local human well-being through increased revenue from tourism, but can also pose a threat to human well-being through the marginalization of local communities in (international) decision-making bodies, and preferential treatment of tourists versus local people. Again, legislation that allows for representative participation by local communities is crucial (Wolmer and Ashley 2003; see also Chapter 14).

17.2.3.2 Knowledge Systems, Ecosystem Management, and Human Well-being

17.2.3.2.1 Knowledge Systems and Management of Natural Resources

Perceptions of land- and waterscapes are influenced by cultural repertoires, which in turn both are influenced by and influence knowledge production (scientific as well as local and indigenous). Most chapters in Part II address the issue of local and indigenous knowledge, arguing that such knowledge is important in conserving ecosystems and contributing to human well-being. Nevertheless, the drive for modernization and technological change is often based on the substitution of small-scale practices. The understanding of crop, forest, and aquatic biodiversity lies in the oral history and cultural memories of indigenous and local communities, but these are often disregarded as backward and unneeded. Given the pace of technological, agricultural, and environmental change, large-scale environmental modification through infrastructure development often happens at the expense of local resources and knowledge. While this impacts local food security and economies, it is also relevant to national and international issues of conservation and economy (Brondizio and Siqueira 1997; Posey 1998; Pinedo-Vasquez et al. 2001).

Formal scientific knowledge has contributed to better ecosystem management and increased human well-being. (See Chapter 6.) However, many natural scientists have contributed to a dichotomous view on the culture–nature relation, and have proposed interventions that threaten the well-being of local communities (see Nazarea 1998; Leach and Mearns 1996). Wynne (1992, p. 120) argues that there is a distinct difference in the way local farmers respond to uncertain environments and the way natural scientists do: ''Ordinary social life, which often takes contingency and uncertainty as normal and adaptation to uncontrolled actors as a routine necessity, is in fundamental tension with the basic culture of science, which is premised on assumptions of manipulability and control. It follows that scientific sources of advice may tend generally to compare unfavorably with informal sources in terms of the flexibility and responsiveness to people's needs.'' Many scientifically based land reform programs designed to combat soil degradation by ''rationalizing'' local land use patterns have had the opposite results and undermined local production (Scott 1998).

Local/indigenous knowledge pertains both to species that are harvested on an extractive basis, as well as to production methods, cultivars, and germplasm (Brondizio and Siqueira 1997; see also Chapter 14). Production and harvesting systems that evolved over long periods of time benefit from cultivars and methods adapted to particular micro-environments, as well as social conditions (Netting 1993; Altieri and Hetch 1990). Diversity of production systems most likely increases the resilience not only to factors such as climatic change, but also facilitates alternative economic options to minimize risks in household food supplies (Wilken 1987; Hladik et al. 1996).

17.2.3.2.2 Compensation for and protection of local and indigenous knowledge

Recently, there is a wider recognition of the validity and importance of farmers' indigenous knowledge (Brush and Stabinsky 1996). This growing recognition has also led to its commercial exploitation. Market imperatives and international monetary policies have pushed countries in the South to gear their economies toward export. In most cases, this has led to the exploitation of their natural resources beyond long-term sustainability, as shown in the case of fishing in the Amazon and timber cutting in Indonesia. The prospecting for local resources has led to exploitation of local knowledge without communities being compensated. The richness and possibilities of resources, for example, medicinal herbs and their possible economic benefits, became an important argument for conserving them. Few mechanisms were available, however, to feed the benefits back to local communities that in many instances contributed to the production of the knowledge concerning certain species, or even the production of the species

themselves. Chapter 5, for instance, shows how the Brazilian government is struggling with legislation in this regard.

The exploitation as well as the growing consciousness concerning the disappearance of local resources and the knowledge about these has led to growing concern about the need to protect local indigenous knowledge. The international community has recognized the dependence of many indigenous peoples on biological resources, notably in the preamble to the Convention on Biological Diversity, which has been ratified by 178 countries. Article 8(j) in the CBD specifically addresses indigenous peoples and their knowledge. The CBD adopted the facilitation of indigenous peoples' participation ''in developing policies for the conservation and sustainable use of resources, access to genetic resources and the sharing of benefits, and the designation and management of protected areas.''

Many governments are now in the process of implementing Article 8(j) of the Convention through their national biodiversity action plans, strategies, and programs. A number of governments have adopted specific laws, policies, and administrative arrangements for protecting indigenous knowledge, emphasizing that prior informed consent of knowledge-holders must be attained before their knowledge can be used by others. In many cases, protection of local/indigenous knowledge is a by-product of protection of biodiversity, while in others the main aim was to guarantee economic benefits to communities.

Apart from national policies, there are also instances of local strategies to protect as well as transmit local and indigenous knowledge. One such strategy is restricting the transmission of certain types of knowledge to specialists; for example, in some societies knowledge of medicinal plants is considered secret and can only be transmitted from one healer to another. Such restrictions can work effectively within communities, but can also complicate the development of international legislation. (See Chapter 14.)

The World Intellectual Property Organization has been the voice behind intellectual property rights. Yet, instead of supporting ''local knowledge,'' IPR has become a Western capitalist response that considers any type of knowledge, whether it is medicinal plants, song, crafts, or any other, as a commodity. Local communities are concerned at the extent of exploitation of local knowledge, how it is being used or removed from its culturally appropriate context, and how it is being usurped as a capitalist commodity. At issue is the Western patenting system, which is used to protect the intellectual property rights of monopolists.

The scale and tendency to focus on corporations is exemplified by industrially advanced Western European countries, which have been strong supporters of IPR and have imposed this system on developing countries. Patents translate into wealth and power for foreign transnational companies, and are likely to bring negative impacts in the biodiversity of particular areas, depending on the level and structure of market demand and exploration practices (Shiva 1997; Settee 2000). Examples are the patenting of local and indigenous knowledge concerning medicinal plants by pharmaceutical companies (see Chapter 5) and the patenting of locally developed crops (see Chapter 6).

Responses such as certification programs are more likely to be effective in addressing local economies and human well-being if they include the impact of particular resource extraction upon people and communities using the same resource basis, but not necessarily sharing resource ownership. Certification programs are better served if they are accessible by communities and small producers' co-ops, which are usually not familiar with bureaucratic and costly procedures of certification. Responses such as ''fair trade'' tools that promote participation of local producers in the commercialization and price negotiations, transformation, and retailing of their products is a necessary component not only of rural development and conservation and management of natural resources, but also for commercial enterprises retailing these products. (See Box 14.14 for an extensive discussion of fair trade initiatives in the Amazon. Box 14.15 describes attempts in a German Biosphere Reserve to establish a certification program.)

17.2.3.2.3 Production of knowledge and integration of knowledge systems

Studies show that local resource users often draw on a variety of knowledge sources, combining formal scientific knowledge with local and indigenous knowledge. (See Chapter 14.) This mix, often combined with a mosaic of different livelihood strategies, is important, especially for the poorer sections of the population, for human well-being. It is important to note, however, that all forms of knowledge are produced and disseminated in a context of power relations. For instance, some knowledge may be considered sacred and secret, some knowledge may be related to specific gender roles. Both community-based natural resource management programs seeking to integrate local and indigenous knowledge as well as programs aiming to protect local and indigenous knowledge are more likely to contribute to human and ecosystem well-being if they take into account the ways in which participants use a variety of knowledge systems, and pay attention to the fact that the production of and access to such knowledge systems is not always equally distributed within communities. Legislation may ''freeze'' knowledge as well as the rituals and practices associated with this knowledge (Laird 1994; Brush and Stabinsky 1996).

Much of the local/indigenous knowledge is not written down, but transmitted through daily practices, stories, songs, dance, theater, and visual arts. Not only knowledge, but also attitudes and perceptions are transmitted that way. Programs on local/indigenous knowledge that take these forms of transmission into account, and try to incorporate these into educational activities, are more likely to contribute to both ecosystem and human well-being (Dove 1999).

Fostering the articulation of international and national conventions, and regulations linking biodiversity with local and indigenous knowledge, are important, taking into account that knowledge is produced in the context of inter- and intra-group interactions, power relations, historical settings, and their dynamics. Responses such as compensating for the utilization of local knowledge and resources are more likely to contribute to human well-being if they take into account relations between companies, national and regional governments, and communities as well as the power dynamics of these relations. Conventional ''best-practices'' methods that focus on content (rather than the process of articulation knowledge from different knowledge systems) and attempt to decontextualize local knowledge are less likely to be successful.

17.2.3.3 Impact of Responses Related to Tourism, Recreation, and Education

Tourism is an economic response, but depends on cultural perceptions of land- and waterscapes. It can provide alternative land use, which decreases pressure for land use conversion (for example, tropical forests to pastoral lands). Tourism can also contribute to the maintenance and revival of lifestyles and cultural practices, including natural resource management practices. Opportunities arise for education and awareness-raising on the need to understand and respect cultural diversity and biodiversity. Conservation areas are especially valued for their educational significance and

providing recreational services. (See Chapter 15.) Valorization of cultural landscapes and monuments are important assets to the larger society.

17.2.3.3.1 Tourism and recreation

Ecotourism can provide economic alternatives to value ecosystem services, but results are mixed. One of the constraining factors is potential conflict in resource use and the aesthetics of certain ecosystems. Different ecosystems are subjected to different types and scales of impact from tourism infrastructures. Furthermore, some ecosystems are easier to market to tourists than others. The market value of ecosystems may vary according to public perceptions of nature. Freezing of landscapes, conversion of landscapes, dispossession and removing of human influences may result, depending on views of what ecotourism should represent. Yet when conservation receives only limited budgetary subsidy, tourism can provide revenues that can meet its needs.

Rural and urban tourism have been receiving increasing support in recent years, including in terms of tax incentives and credit. Changes are occurring in perceptions concerning what types of landscapes and cultural practices are of interest to tourism. Industrial monuments and certain types of resource use are now seen as having historical, social, and environmental potential for tourism. In parallel, it broadens the scope of environmental conservation in areas outside of protected areas. In the North, small-scale farming production, while facing difficult competition in agricultural markets, can find an alternative in providing tourist services. The marketing and branding of agricultural products in a German Biosphere Reserve is just one example of how tourism can contribute to the maintenance of certain lifestyles and production methods and increase human well-being.

The impact of tourism on human well-being though varies as a result of several risks involved. Consumptive tourism activities, such as sport fishing, may represent pressure on the resource. For example, marine recreational angling in the United States alone comprises more than 15 million fishers, with a total harvest of 266 million pounds in 2001. (See Chapter 14.) Conflicts between recreational and professional fishers are commonplace in many parts of the world as recreational fishers detain strong political power in the fishing councils.

Non-consumptive tourism can also involve risks as representations of nature and culture used to entice tourists often refer to pristine ecosystems and exotic cultures, reinforcing stereotypes as marketing tools of communities subjected to tourism. Commoditization of culture does not always benefit those portrayed. Another serious problem is the blurring of boundaries between private and public. Emphasis on pristine ecosystems can furthermore easily lead to evictions of people. Many protected areas result from evicting local populations, but are accessible to tourists. (See Chapter 5.)

The risks and opportunities provided by tourism are related to the economic position of communities and relations of power. Studies show that economic deprivation increases the likelihood of overexploitation of resources and accepting unfavorable positions in the tourism industry (low-skilled labor, sex worker, drugs). Increase in land use value for tourism real estate development purposes are likely to lead to displacement and dispossession. This risk is much higher for communities that enjoy informal or communal land rights. Coastal communities have long been suffering from those impacts as the tourist potential of coastal landscapes continuously pushes local residents away from their livelihood strategies. (See Chapter 14.)

Cultural and ecotourism are not necessarily the same thing as community-based tourism. Concerning access and benefit sharing, tensions often exist between tour operators, local communities, conservation units, and (other) government departments. In some cases, local communities may actually run tourism enterprises themselves, in other cases they may only have access to lowly-paid menial jobs. Issues that are important are matters of local decision-making powers concerning land use, infrastructure, and dealing with externalities, for example, the choice of tour operators and types of tourists, boundaries between the private and the public, goods that are imported by tourists, and waste-management. Capacity building can successfully contribute to human well-being if it not only involves individual professional training to fulfill positions in the tourism industry, but also includes institution building, marketing, and negotiating capacities.

17.2.3.3.2 Environmental education

Recreation and education can go hand in hand. Cultural tourism can serve to educate people about the importance of cultural diversity, as well as the importance of the latter for the conservation of biodiversity, provided the risks mentioned above are taken into account. Tourism and recreation can be linked to environmental education, fostering knowledge about the functioning of ecosystems and provoking tourists to critically examine human–nature relations. Ola-Adams (2001) describes how the Omo Biosphere Reserve in Nigeria is the site of environmental education programs for very diverse audiences ranging from schoolchildren to university students, protected area managers, and policy-makers. West (2001) describes awareness raising activities among local farmers in the Fitzgerald Biosphere Reserve, helping them to address the problem of wind erosion. He stresses, however, that awareness raising requires development, especially among communities that experience periods of economic decline (West 2001, p. 15). ''Top-down'' education is less effective than education that is based on sharing experiences and attempts to reach a joint understanding of the dynamics of human–nature interactions.

17.2.4 Technological Interventions[1]

Technological interventions directed at ecosystems have primarily been focused on increasing the economic productivity and efficiency of ecosystem services, reducing vulnerability of human societies from extreme environmental events, and, more recently, protecting ecosystems by decreasing pollution and the intensity of material use in production activities. For example, in the second half of the twentieth century, the Green Revolution enabled world cereal production to increase threefold on about the same land acreage. Without this success, world farmers would have had to increase cropland use from 600 million hectares to some 1,800 million hectares. The ecological implications of such an expansion could have been catastrophic. We shall cover some of these impacts later in this section.

On the other hand, a weight of evidence has been building up, arguing for decision-makers to design reference frames with a longer-term and more systemic view of the wider impacts of technology interventions rather than seeking short-term solutions. The assessment illustrates that increases in the production capacity of ecosystems through technological interventions often introduce stresses in the form of ''second-round ecological feedbacks.'' In the long run, this could impair the functioning and utility of the ecosystem. In other words, a technological response can become a driver of ecosystem deterioration if not carefully designed and there is growing acceptance that the critical issue involving the introduction of technological interventions is the

management of social, political, and economical tensions that arise as technology drives higher ''service'' yields from ecosystems.

Summarized below are some of the key ecological and social impacts arising from the use of technological interventions in a number of critical ecosystem services. We have only covered the ecosystem services in which we found technological responses being used extensively, and in which they have significant impacts on the ecosystem services themselves as well as on human well-being and poverty.

17.2.4.1 Food

The Green Revolution is the best example of such tensions associated with a technological intervention. An assessment of the Green Revolution as a response establishes beyond doubt that in terms of impact, the combined technologies used in the Green Revolution increased food production significantly. However, from the perspective of human well-being and sustainable development, increased production does not automatically translate to food security. Food security as defined by the United Nations is, ''a situation that exists when all people, at all time, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life'' (FAO 1996). The critical component in food security revolves around the access to food and what Amartya Sen defines as entitlements in his seminal book, *Poverty and Famines* (Sen 1981). But this is not to discredit the importance of food supply. It is critical, and it is a necessary condition for food security but, as illustrated in the definition, not a sufficient condition.

It is well established that the Green Revolution did increase global production of cereals and has improved societal welfare at the aggregate. It is also acknowledged that the Green Revolution did provide some relief from the conversion of more ecosystems into agrosystems. However, there are competing explanations of the distributive impacts of the Revolution, with many experts saying that the technology benefited those with access to financial resources, who were then able to exploit the intensely profit-driven commodities trading environment. There is a temporal element as well in these competing explanations. More recent evaluations suggest that the benefits of the Green Revolution in South Asia were more widely diffused than originally thought (Hazell and Haddad 2001).

In terms of ecosystem impact and projections for the future, many studies have found that the introduction of the new high-yielding seeds together with higher dependence on irrigation and fertilizer regimes have also caused many ecosystems to deteriorate. Increasing soil salinity has been one major side-effect of the Green Revolution. Other effects on ecosystems from the Green Revolution include contamination of soil and water due to use of fertilizers and pesticides, human health alteration because of agrochemicals, and the loss of germplasm diversity and seed banks. The distribution of the effects of these ecological deteriorations has been asymmetrical across stakeholders, with the poor farmers being most acutely affected. (See Chapter 6.)

17.2.4.1.1 Alternative farming-food production systems

On the positive side, in many developing and industrial countries, especially EU countries, urban agriculture—in an ''organic revolution''—is contributing to improving the environment through the recycling of organic matter. Solid wastes converted into compost and gray water emanating from the open drain are used to fertilize soils (Sridhar et al. 1985; Coker 2003). Also, strong agricultural production output has been recorded in a significant number of cases in tribal areas in India where natural resource management practices have been introduced. But we must keep in mind that organic farming by itself will be insufficient to meet the growing demands for food, and the land area needed will also be substantial. The ecological implications of converting more ecosystems into agroecosystems may have a significant impact on the regulation and support of ecosystems as well as the cultural services related to them. The impact on biodiversity will also be disastrous.

17.2.4.1.2 Genetically modified organisms and seed banks

The growing controversy over genetically modified organisms warrants special attention in this section. Experiences to date point to difficulties in assessing the advantages or risks associated with GMOs in food production in general. Rather they must be addressed case by case for specific agroecological and, equally important, socioeconomic conditions. GMOs have also come under increasing criticism for reducing the diversity of the seed bank and for increasing the dependency of many farmers, especially in the developing countries, on large multinational companies who control the patent rights for the GMOs. (See Chapter 6.) Developing countries do stand to gain tremendously in terms of food security and broader human well-being, particularly in the area of health with improved nutrition, if the level of uncertainty associated with these technologies can be reduced significantly. What is recognized as critical from the very limited information, and bad publicity, is that a great deal of work needs to be done in terms of managing the application of these technologies.

A technological intervention to reverse the loss in biodiversity created by GMOs is the development of seed banks. (See Chapter 6.) However, for many developing countries, the maintenance of gene banks is a major problem as electricity supplies are unreliable and fuel costs expensive. A recent technological response to this problem is the ''ultra dry seed storage technology,'' which allows the storage of seed germplasm at room temperature, thereby obviating the need for refrigeration. Other research conducted on drying techniques, such as sun and shade drying (Hay and Probert 2000), offer promising alternatives to improve the capabilities of resource-poor countries to conserve their seeds.

17.2.4.1.3 Increase in drought, salt, and pest tolerance in food production systems

Some traditional farming systems using low inputs have improved yields while safeguarding the resource base by upgrading the subsistent food crops and adopting integrated pest management. For example, Indonesian rice farmers who adopted IPM, which reduces the need for pesticides, achieved higher yields than those who relied solely on pesticides. Biotechnology responses can introduce genes that counter soil toxicity, resist insect pests, and increase nutrient content. Still, the questions of biosafety and the ethics of manipulating genetic material need to be resolved before the potential of biotechnology and genetic engineering can be realized.

17.2.4.2 Flood and Storm Protection

Historically, responses to reduce negative impacts of natural disasters like floods and storms have emphasized the implementation of physical structures/measures (for example, dams/reservoirs, embankments, regulators, drainage channels, and flood bypasses). However, there are competing explanations, where physical responses may cause net harm to an ecosystem in the longer timescale, which may reduce anticipated (or expected) benefits of the responses. A typical case in point is construction of dams to regulate floods, which has been known with high certainty to cause

wider ecosystem degradation and a deepening of poverty among local communities. (See Chapters 7, 11.)

There is increasing recognition that natural environment measures can reduce the negative impacts of natural disasters without causing the longer-term ecological and socioeconomic deteriorations. It is well established that ecosystems such as wetlands act as buffers for floodwaters. (See Chapter 11.). Coastal mangroves have been found very effective in providing protection against storms and surges especially in Bangladesh, India and Southeast Asia. The direct benefits of these natural protective measures accrue to the poor coastal communities in the form of reduced vulnerability. There are also indirect benefits in the form of food, non-wood products, and the water cleansing properties that are equally important. Two issues related to protection and restoration of ecosystems vis-à-vis technological interventions are the degree to which technologies can substitute for ecosystems services, and whether ecosystem restoration can reestablish not only the functions of direct use value to humans, but also the ability of the system to cope with future disturbances.

It should be acknowledged that with increasing frequency and magnitude of extreme events ecosystems themselves would prove to be insufficient to address and mitigate the impacts of these events. In all probability, a system where technical responses work complementarily with natural systems would provide the best protection against extreme events. In terms of the human well-being implications, developing countries need to tap advanced technology that has taken many decades to get established together with indigenous engineering and technology capacity, particularly in water harvesting and management, and develop their own capacity for such technology interventions to work.

In practice, the actual provision of flood and storm protection is often the responsibility of a number of different actors working at different levels—local, regional, national, and transnational. The institutional settings not only affect the delivery of the services, but also the manner in which they are delivered as well as the direct and indirect effects on ecosystems and human well-being.

17.2.4.3 Waste Management

There is a high level of certainty that increasing population and economic activity will result in an increase in the production of solid waste, higher levels of air and water pollution, and that the natural systems will not be able to accommodate these increases, and that technological interventions will therefore increasingly become necessary. (See Chapter 10.) From the responses it is quite evident that developed nations have attained reasonable excellence but at high monetary cost. For example, nitrogen-removal technology for sewage treatment has led to improvement in water quality in Tampa Bay and, to a lesser extent, in Chesapeake Bay. (See Chapter 10.)

For the developing countries, short-term and medium-term solutions lie in the use of ecosystems and relatively cheap technology innovations like oxidation ponds/waste stabilization ponds, and floating vascular aquatic vegetation, which have considerably helped the poorer developing countries. Another example is the utilization of wetland ecosystems as sinks for the absorption of selected nutrients (Hu et al. 1998). Assessments show that this type of response is particularly relevant to deal with solid waste management problems in regions which lack appropriate and networked road infrastructure, sophisticated equipment, operational facilities, and inadequate human resource development.

Governments are often tempted to choose inappropriate technologies due to lack of funds and pressure from private interest groups. A viable response option is for developing countries to mass-produce small-scale equipment that is amenable to community access. Private/community-sector-driven operational schemes coupled with government provisioning of basic facilities in landfill, incinerator, and sewage treatment plants appears to be a promising option. The critical point here is that technologies that have been endogenously developed taking into consideration local ecological, economic, and cultural conditions have a higher certainty of achieving their objectives.

17.2.4.4 Water

A large number of dams have been constructed all over the world. ''In North America, Europe and the former Soviet Union, three-quarters of the 139 largest river systems are strongly or moderately affected by water regulation resulting from dams, inter-basin transfers, or irrigation withdrawals'' In addition, hundreds of thousands of kilometers of dikes and levees have been constructed with the purpose of river training and flood protection. While these structures have clearly provided increased supply of freshwater for many uses, as well as flood control, unfortunately they have all too often had debilitating effects on surrounding ecosystems, affecting their naturally occurring services and their biodiversity.

The direct social impact of large dams is striking; they have led to the displacement of 40–80 million people worldwide and terminated access by local people to the natural resources and cultural heritage in the valley submerged by the dam. (See Chapter 7.) The perennial freshwater systems established by large dams also contribute to health problems. For example, epidemics of Rift Valley fever and Bilharzia coincided with the construction of the Diama and Manantali dams on the Senegal River. Aside from the direct impacts of large dams, the benefits of their construction have rarely been shared equitably, that is, the poor, vulnerable, and future generations are often not the same groups that receive the water and electricity services, and the social and economic benefits from dams (WCD 2000).

Another striking example of where technology may be a more expensive option than the use of ecosystems lies in the provisioning of quality water. The Catskill/Delaware watershed provides up to 90% of New York City's water demands. In 1989, New York City was faced with an order by the U.S. Environmental Protection Agency to build a filtration plant because of declining water quality. The city estimated that a filtration plant would cost approximately $6–8 billion, while maintaining the traditional water cleansing system—the Catskill watershed—was estimated to cost about $1.5 billion. This shows that it may actually be more cost effective for developing countries to choose natural options for providing clean water, especially taking into consideration their lack of financial, technological, and human resources.

17.2.4.5 Wood and Fuelwood

Technology is changing the way wood is produced, processed, and used. Biotechnology is given increasing emphasis in commercial plantations with many now based on cloned trees to standardize production, quality, and growth rates. Much experimentation using genetic modification is also occurring to develop new generations of ''super-trees.'' Though not as controversial as genetically modified food crops, these modified trees are being criticized by pressure groups concerned about possible environmental impacts. Wood engineering is allowing the use of many more species and smaller pieces of wood in processing. Also on the positive side for human well-being, the possibility has been strongly raised that technology allowing for a concentration of fiber for fuel production on small areas of land releases other areas

for the provisioning of regulating services and livelihood activities. (See Chapter 8.)

Though wood is the principal source of energy for cooking and heating for so many of the poor, it is the least efficient—a low-density form of energy used in thermally inefficient devices. Unless the poor have access to technology to convert wood and charcoal into modern forms of energy, real costs of energy from fuelwood can be high for the poor. Lack of access to more efficient energy sources can also be an important constraint to livelihood and broader economic improvement.

The technology to use wood as a fuel is improving and it could become a major contributor to sustainable energy sources globally. Wood fiber gasifying energy generators are being developed and could one day produce large amounts of renewable electricity using trees harvested from fast growing plantations. Dendro power involves the use of wood-based materials for power generation. One useful feature of dendro power is the potential to use sustainably grown fuelwood sources. Dendro power is gathering momentum due to its multiple benefits of renewable power, reforestation, and income generation (especially in rural areas). However, we are uncertain of the impact these ''fast growing'' plantations may have on other ecosystem services and the subsequent impact on human well-being.

If energy policies are to become more efficient and equitable, then emphasis should be on helping the poor to move from woodfuels to more efficient fuels, or at a minimum to more efficient forms of woodfuel. This will release some of the pressures on ecosystems for providing woodfuel and ''free'' up some of the other ecosystem services. Lack of access to more efficient energy sources can also be an important constraint to livelihood and broader social improvement.

Information technology has been instrumental in bringing together the common interest of forest owners and society as a whole in promoting efficient and equitable wood production and at the same time securing a sustainable and diversified forest ecosystem. The relatively rapid modification of Swedish forestry in the 1970s and 1990s to more environmentally adapted practices clearly illustrates without any uncertainty the positive evidence of the impact of information technology on sustainable forest management and the distribution of the benefits of the management regime among a host of involved stakeholders.

17.2.4.6 Technology and its Consequences on Poverty

Technology choices have been to a large extent dictated by efficiency issues with very little concern shown for equity and distributive issues. Technology has caused a widening of the equity gap between developed and developing countries, and within the developing countries, between the rich and the poor. This has become increasingly serious over the last few decades, as copyright right laws have been developed with the interests of the developed countries—the main developers of modern technology—taking primary precedence.

Technology development and adoption in developing countries have not addressed the ''needs'' of the poor but have been primarily driven by the need for quick profits. Technology is not value neutral. Technological systems in fact favor the interest of some groups over that of other groups. It is therefore imperative that societies, in their quest to address equity and effectiveness, understand the implications new technologies carry before introducing them (See Box 17.4; also Winner 1986; Smith 1998). It may in essence be the nature of the beast as most technology development in developing countries is spearheaded by the private sector. For example, although the Green Revolution significantly increased rice production, it also required substantial inputs which were beyond the reaches of the poor.

BOX 17.4

The Citizen's Eye-view of Technology

(Winner 1986, pp. 55–56)

''The important task becomes . . . not that of studying the 'effects' and 'impacts' of technical change, but one of evaluating the material and social infrastructures specific technologies create for our life's activity. We should try to imagine and seek to build technical regimes compatible with freedom, social justice, and other key political ends . . . Faced with any proposal for a new technological system, citizens or their representatives would examine the social contract implied by building the system in a particular form. They would ask, how well do the proposed conditions match our best sense of who we are and what we want this society to be? Who gains and who loses power in the proposed change? Are the conditions produced by the change compatible with equality social justice, and the common good? To nurture this process would require building institutions in the claims of technical expertise and those of a democratic citizenry would regularly meet face to face?''

At the global and national levels, donors may be able reconsider their funding for research or technological development which may respond to the needs of poor local communities but still meet global goals. At the local level, the challenge is to provide the institutional mechanisms that will allow local communities to adopt their ''own'' choice for the local context. This will in turn require legitimization and utilization of local knowledge and technology, decentralization of decision-making power, and prioritization of local needs.

It must be considered whether or not the new changes will bring positive impact to the local ecosystems and human-well being (and including their capability). Modern technologies that embrace and complement the use of traditional knowledge are known to do better in reducing poverty and maintaining local ecological integrity. Ideally, technology should be flexible enough to evolve under local conditions. It is also important to prevent oneself from falling into the trap of letting technology become an end in itself and not just a means to the end—goals of choice, human agency, poverty reduction, and improving human well-being through the sustainable management of ecosystem services.

It can also be said with high certainty that if technological interventions are to achieve their objectives, then certain catalysts are needed for the development and use of technology at the local level to reduce poverty through the sustainable management of ecosystem services. These enabling conditions include institutions, micro-credit, good governance, and efficient and non-corruptive bureaucracy.

Last but not least, if technology is developed for and/or introduced to communities, then the following basic questions must be addressed and answered to guide the development and implementation of technological interventions:

- Was the decision to adopt the technology driven by a participatory process involving all relevant stakeholders, especially the poor?
- Who are the beneficiaries of the technology and does the technology address the needs of the poor?
- What are the ecological implications of the technology and are there any groups of people who will be adversely affected by these ecological changes?

- Who will fund the research and development of the technology?
- Who will regulate the technology and how?

17.2.4.7 Technology and Some Lessons Learned

It is well established that unconditional transfer of technology from developed to developing countries is not always the solution. The emphasis should be on technologies adapted for local ecosystems, economic conditions, and finally the social and cultural environment. Generally, the successes and failures of technological interventions are often determined by the degree of planning, consultation, and resource commitment on the choice and application of technologies.

A summary of the findings is given in Table 17.1. The assessment examines the maturity of the technologies with a score ranging from 1 to 3. Technologies widely practiced and not just considered routine but also as a minimum requirement are scored at 3. These technologies can be considered to be mature technologies. Patents on these technologies are not an issue. Technologies with a score of 2 have had their effectiveness demonstrated and proven, but factors such as cost or the high level of human capacity required for application have prevented them from being widely used. Local application of these technologies still offers scope for incremental innovations to the technology. Technologies with a score of 1 often carry a great deal of uncertainty in relation to their impact on ecosystems. Being at the cutting edge, the level of scientific expertise and the number of cases of successful application with no second round impacts on the ecosystem required to address this uncertainty suggests that there is still a long way to go before these technologies are widely taken up. It should be noted that a score of 1 is very much associated with technologies of advanced, wealthier economies of the developed world.

Consideration is also given to the barriers to adoption of the technologies. The range is again 1 to 3. A score of 1 indicates a low barrier and 3 a very high barrier. With respect to infrastructure, a score of 1 is indicative of low costs as well as a low level of complexity involved in establishment, operation, and maintenance.

Technical skill requirements for a technology is based on a score of 1 if a low level of expertise (perhaps even accommodating illiteracy) is required. The higher the scientific expertise needed for a technology, the closer the score gets to 3. The same scoring structure applies to barriers of access. Barriers include cost and ease of access to intellectual property. The higher the barrier, the higher is the rating.

17.2.5 Consequences of Response Options on Human Well-being

This concludes the assessment of ecosystem management responses. The complexity of the links between ecosystem services and the various constituents of well-being together with the added convolution of drivers and responses mediating the links makes such a synthesis difficult. Nevertheless, some critical findings on the consequences of the four main classes of instruments assessed in the report on the various constituents and determinants of well-being do emerge and these are reflected in Table 17.2.

Positive implies an improvement in the constituent while *negative* constitutes a drop. *Conditional* means that the results are dependent on a number of context specificities which are elaborated in the concluding section. *Mixed* results indicate that both positive and negative impacts were experienced with some groups of individuals benefiting from the response while other groups fared badly.

Before discussing Table 17.2 findings in detail, it is important to distinguish the various types of poverty acknowledged in the poverty literature. Box 17.5 provides definitions of the various types of poverty that can exist. However, a systematic assessment of the impacts across these criteria is not tried here due to the lack of data. Instead, we attempt to get a grasp of key trends of the consequences on the various constituents and determinants of human well-being as used in the MA.

17.2.5.1 Security

Security as defined by the MA includes secure access to natural and other resources, safety of person and possessions, and living in a predictable and controllable environment with security from natural and human-made disasters.

The privatization of ecosystem services through the use of economic instruments have been found to perform relatively well in defining secure rights and access to provisioning services of ecosystems like access to timber, ownership of land, and access to water resources. However, in many cases it was found that access to these services was not equally distributed across stakeholders dependent on these services. For example, there have been instances whereby introduction of private land tenure—a combination of an economic and legal response—has reduced the ability of many communities to access common ecosystem services during times of economic and ecological stress (Rutten 1992). There is no doubt that economic responses have improved the security of some groups but at the expense of increased vulnerability and insecurity to other groups.

Technological and economic responses were found to be successful responses in increasing agricultural productivity. However, it is difficult to say with a high degree of confidence that a larger food supply had translated to a higher level of food security. Many other factors like good governance, increased transparency, and well-functioning markets were found to be critical in making sure that food security and a reduction in absolute poverty is achieved. Technological responses with a high degree of mechanization are conducive to food security in a very broad sense. However, these technological innovations may not guarantee, for example, through the creation of jobs, the necessary entitlements of the poor. Thus food can be available, but people might not have the means to access it if responses are not labor inclusive and, therefore, ineffective as a poverty reduction strategy.

Social responses have indirectly contributed toward enhancing the security of many local communities. Sacred groves—a form of a social response—have traditionally served as social nets during times of ecological as well as economic shocks. Although perceived as sacred and religious, traditional rules governing these groves allow individuals to have access to the ecosystem services during times of hardships. However, privatization has eroded many of these ecological safety nets in many developing countries leading to increasing levels of insecurity and poverty. If economic responses are to be adopted, then some form of social nets need to be institutionalized in order to replace sacred groves and other forms of social responses which provide buffers to increase security during times of stress.

17.2.5.2 Health

Economic and technological responses were found to be the main drivers causing land use changes as well as changes in biodiversity composition and levels. Changes in biodiversity have been to

Table 17.1. Popular Technologies for Sustainable Use of Biological Diversity and Ecosystem Conservation and Management. *Maturity*: 1 = application is still limited and impact on ecosystems uncertain; 2 = effectiveness demonstrated, but cost of high skill level needed may inhibit widespread use. 3 = mature technology that is widely practiced and considered a minimum requirement worldwide. *Barriers to adoption:* 1 = low; 2 = medium; 3 = high.

				Barriers to Adoption		
Technologies	**Purposes of Some Applications**	**Maturity Level**	**Problems and Conditions Associated with Success or Failure of the Technology**	**Technical Infrastructure Required**	**Technical Skills Required**	**Cost of Access to Technology**
Production Technologies						
Precision agriculture: sensor technologies for differential application of inputs to cropping systems: "controlled application as machines move across field"; GPS monitoring systems; software tools for analysis; and automated tools for application of chemicals, fertilisers, etc.	intensification of production (e.g., increasing yields)	1	generally believed to have the potential for supportive effects on sustainability; high level of site-specific agroeconomic conditions; high costs associated with infrastructure; technical facilities and particularly high costs associated with "customization'' needs; high level of expertise required in agricultural sciences as well as for technology intense operation systems; developing countries lack research and extension services.	3	3	3
Biotechnology: cellular and molecular biology	shortening time and cut costs of introducing innovative food varieties; breeding without limitations by species barriers; enabling improved varieties and breeds with introduction of traits for specific socioecological situations	1	costs associated with technical facilities and licensing of technologies; high level of scientific expertise.	3	3	3
Biotechnology: genetically modified organisms	more precise modification than conventional biotechnology; development of crops, animals, or bacteria with traits that cannot be introduced through classical breeding lines (e.g. herbicide tolerance, insect resistance, altered nutrition content, etc.)	1	biodiversity loss associated with monocropping; high level of uncertainty although no conclusive evidence exists at this stage about the environmental advantages and risks in the use of GM crops; considerable work has still to be done to address high levels of uncertainty related to controlling the spread of transgenes (with specific resistance traits) to non-targeted crops and weeds; genetically engineered fish (e.g., Atlantic salmon) and the difficulties of "containing" these populations has given rise to concerns that animals that can easily escape, that are highly mobile, and that form feral populations could compete more successfully for food and mates than their natural counterparts.	3	3	3

Integrated methods: organic farming	prohibition of synthetic inputs and mandatory "soil building" crop rotation system designed to maintain the functional integrity of the ecosystem	2	results on higher yields not conclusive; therefore serious consideration is needed on possibility of trade-off between lower yields and enhanced sustainability; probably stronger argument for system to be critical component of larger national mix of production systems; results show total energy use is less than for conventional farming. Less conclusive about energy efficiency (i.e., energy use per kg of output).	2	2	1
Fishing gear technology and fishing vessel technology			impact on environment and non-target species			
Aquaculture: fish stocking technologies	increasing intensity of fishing; raising yield kg/ha and fish/ha		conflicts for use of coastal resources and environmental pollution; high input demand for land, water, seed, capital investments in technologies (including research), and feeds and chemicals (antibacterials, parasiticides, fungicides, and anaesthetics); impact on environment of multiple users of land and water resources: need better integration of land, water management.			
Industrial production systems (feedlots, broilers)	intensifying production of meat	2	very high growth in these production systems—problems related to impact on ecosystems; although technologies exist, very weak commitment to internalizing costs associated with nutrient loading impacts on environment (absorptive capacity), particularly water resources.	2	2	1
	food processing (includes issues of access and nutrition); preservation and packaging (includes issues of access, health, and safety)	3	costs associated with development and enforcement of standards for food quality, balanced nutritional content, and labeling; unhealthy levels of salt, sugar, and fat contents.	2	2	1
Process Technologies						
Structural water supply and flood control systems; desalination plants; water reclamation plants; water harvesting techniques	integrated watershed planning and stabilization relevant to conservation of forest, dryland, mountain ecosystems, and inland waters.	3	costs of infrastructure; need for engineering and technician-based maintenance services	2	2	1
Artificial but specifically designed "wetlands" as a means of sewage treatment	wastewater management	3		1	3	1
Drip irrigation; sprinkler irrigation; underground and sub-underground irrigation; traditional methods such as Indian "pick-ups" or weirs	irrigation management for agriculture	2	traditional methods quite low cost; at commercial scale agriculture as well as for watershed planning purposes, costs of infrastructure and control mechanisms.	2	2	1
	erosion control, soil improvement technologies, and conservation farming	2		1	2	1

(continues)

Table 17.1. Continued.

Technologies	Purposes of Some Applications	Maturity Level	Problems and Conditions Associated with Success or Failure of the Technology	Barriers to Adoption		
				Technical Infrastructure Required	Technical Skills Required	Cost of Access to Technology
Protection and Conservation Technologies						
Use of host-specific weed feeders and pathogens as well as mechanical approaches; Use of micro-organisms to control insects and pathogens on crops; Biotechnological approaches.	control of weeds, invasive alien species and situational pests in agro-ecosystems; integrated pest management; genetic engineering to introduce resistance genes.	1	site-containment of application; scientific expertise; costs of licensing in technologies.	3	3	3
Dry room and cooling technologies (cryogeny, lyophilization); Aspirators to separate the mature seeds from surrounding dead material; X-ray machines to assess the proportion of empty or damaged seed in a collection; Genetic monitoring, in vitro insemination, gene pool sampling; gene storage, DNA banks.	preservation and storage technologies for ex situ storage of seed and gene collections; conservation technologies at sub-cellular level; breeding in captivity.	2	cost of equipment; for developing countries—infrastructure, overhead costs, and security of supply of electricity.	3	2	1
Identification, Observation, Monitoring, and Assessment Technologies						
Ecosystem identification and classification technologies (software)	characterization of heterogeneous landscapes in order to adapt management strategies that are sensitive to the spatial patterns and interactions	2	costs of licensing technologies; science-specific and high level of analytical skills.	2	3	1

Remote sensing (aerial surveys, satellite imagery, infrared photography)	landscape biological approach for biodiversity characterization; mapping of watercourses; assessment of susceptibility of agricultural land to soil erosion, vegetation changes, changes in the form and extent of inland waters and glaciers.	2	high cost of science and technology infrastructure; science-specific and high level of analytical skills.	3	3	1
Geographic Information Systems	simultaneous viewing of several geographic themes (e.g., water catchments and vegetation) for inference purposes; assessment of the spread of an invasive species.	2	high costs of technology platforms; long-term nature of research; science-specific and high level of analytical skills.	3	3	1
Geo-referencing, palm pilots	species distribution and range maps	2		3	2	1
Bioinformatics	graphics oriented tools for molecular sequence analysis, techniques in phylogenetic tree estimation, and testing; assigning functions to unidentified protein sequences	1	IPR; high costs of technology platforms; science-specific and high level of analytical skills.	3	3	3
Habitat, vegetation, and gene variation mapping, regional mapping	knowing spatial variation in vegetation characteristics is important to understanding and modeling ecosystem functions and their responses to climate change.	1		1	3	1
Telemetrics	range mapping (e.g., radiocollars, sensors placed in body parts of animals)	1		2	3	1
Monitoring techniques for fish stocks	fisheries and ecosystem modeling, fishery management, influence of fisheries on the ecosystem, fish population genetics	1		3	3	1

Table 17.2. Consequences of Responses on Constituents of Well-being

Response Category	Security	Health	Social Relations	Material Wealth and Livelihoods	Freedoms and Choices
Legal	mixed distributive impacts	limited information	negative; conflict with informal laws	positive, but conditional	mixed distributive impacts across different ecosystems
Economic	mixed distributive impacts	mixed distributive impacts	negative	mixed distributive impacts	mixed distributive impacts
Technological	mixed distributive impacts	mixed distributive impacts	negative	mixed distributive impacts	conditional
Social	positive	limited information	limited information	positive, but takes a long time	positive

BOX 17.5

Concepts and Measures of Poverty

Absolute poverty is the state of deprivation based on absolute universal standards. It is usually associated with hunger and undernutrition (and other standards of simple physical needs). It can be established across different cultures and societies. It is based on objective measures of poverty.

Relative poverty is the state of deprivation defined by social standards. It is fixed by a contrast between those others in the society who are not considered poor. Poverty is then seen as lack of equal opportunities. It is based on subjective measures of poverty.

Incidence of poverty is a measure of poverty based on the number of individuals who earn below a certain threshold. This measure is widely used but suffers from the limitation that it does not give any indication about the distribution of the poverty among the poor.

Depth of poverty is a measure of the average income gap of the poor in relation to a certain threshold. It defines how poor are the poor. It gives the amount of resources needed to bring all poor to the poverty-line level.

Temporary poverty is poverty characterized by a short-term deprivation, usually seasonal. It could be due to a shortage of water or food that is available only occasionally.

Chronic poverty is poverty defined by a permanent status of deprivation. It has both intra-generational and intergenerational features. It is much harder reduce due to its structural characteristics.

Monetary poverty is poverty expressed as an insufficiency of income or monetary resources. Most indicators like $1 per day or national poverty lines are defined in those terms.

Multidimensional poverty is poverty conceived as a group of irreducible deprivations that cannot be adequately expressed as income insufficiency. It combines basic constituents of well-being in a composite measure, such as the HPI (Human Poverty Index).

Other characteristics of poverty commonly used in the literature include rural and urban poverty, extreme poverty (or destitution), female poverty (to indicate gender discrimination), food-ratio poverty lines (with calorie-income elasticities), et cetera. Other indices that combine two dimensions—incidence and depth—of poverty are also widely used; examples include the FGT (Foster, Greer, and Thorbecke) and the Sen Index (Ray 1998; Fields 2001).

known to increase the occurrences of dome diseases. The most well known examples cited in Chapter 16 are Lyme borreliosis and the severe form of tick-borne encephalitis. Rural communities, and in particular individuals who have problems accessing medical facilities, are more vulnerable to these emergent diseases than individuals who have easy and cheap access to medical facilities.

Modern agriculture driven by technology and motivated by economic incentives has a major impact on both water supply and quality. The loss of natural vegetation from hillsides and riverbanks has increased the volume and speed of runoff. Increased occurrences of floods increase the prospect of diseases like cholera. Moreover, loss of natural vegetation decreases the natural purification of water percolating through soil and vegetation. This exposes both stock and humans downstream to a variety of zoonotic pathogens, including *Campylobacter, Cryptosporidium,* and *Giardia.* (See Chapter 16.) However, a cost-benefit analysis of the benefits accrued in the form of increased material well-being generated by technological and economic responses found that the costs of reduced health are few, and it is difficult to conclude with any certainty that the net benefit has been either positive or negative to local communities.

There is little and scattered information on the impacts of legal and social interventions on health status to make any definitive conclusions. For example, existing studies shed very little light on the health outcomes of communities living near protected areas. The focus has been on increasing the material and income welfare of the local communities with very little information on health status. It is an area worth studying in the future. An important lesson we can learn, however, is the need to address the multiple services ecosystems offer, and lack in one constituent may imply an increase in another constituent of well-being.

17.2.5.3 Material Wealth and Livelihoods

The MA defines material wealth and livelihoods to include the necessary material for a good life, secure and adequate livelihoods, income and assets, enough food at all times, shelter, furniture, clothing, and access to goods.

Responses designed to improve access to natural resources are central to increasing material wealth, providing livelihoods to the rural poor, and are central to the reduction of rural poverty. It is known with a high degree of certainty that at a local level, protected areas have often had a detrimental effect on poverty reduction because rural people have been excluded from a resource that has traditionally provided income generating and livelihood activities. This is not to say that protected areas themselves have caused poverty, but the way in which protected areas are presently designed have contributed to poverty or inhibited poverty reduc-

tion efforts. The effects of local equity and rural development are mixed, and financial returns have often proven insufficient to lift community partners out of poverty. Responses need to be developed within efficient and accountable systems of governance, raising the bargaining power of communities in order to reduce poverty.

In forest management, a combination of legal, social, and economic responses has demonstrated the potential for poverty reduction. Small private ownership of forests can deliver more local economic benefits and better forest management than ownership by larger corporate bodies. This is true only when a good knowledge base, capacity to manage, effective market information, good organization between smallholders to ensure economies of scale, and long-term tenure and transfer rights are available. Private ownership (or ''family forestry'') is very common in Western Europe and in the southern United States, and is increasingly common in Latin America and Asia.

Responses allowing the use of wood as a fuel contribute to secure livelihoods and reduce poverty by guaranteeing the subsistence and domestic energy of poor rural households. However, wood is the least efficient source of energy for the poor. Technologies helping them to convert wood and charcoal into modern forms of energy can improve their livelihoods. Interventions based on market demand for fuelwood can provide an important source of income for the poor, but reliance on it can also impede progress out of poverty, especially with large and rapid structural changes in urban market demand for fuelwood.

Waste management policies are not only important in developing countries. Responses involving recycling and resource recovery schemes can provide jobs and help reduce unemployment and poverty in industrial countries. For developing countries, it is often argued that a fruitful response option would be private sector-driven operational schemes coupled with government provision of basic facilities in landfill, incinerator, and sewage treatment plants, among others.

The legal responses of the CCD (in terms of reversing desertification processes, such as soil erosion) are central to the poor's livelihoods, and their struggle to conserve and use dryland ecosystems resources in a sustainable fashion. Those policies are central to reducing chronic poverty. However, strategies based on integrated responses, developed through participatory mechanisms, have been found to be more effective in reducing chronic rural poverty. For instance, integration into mainstream national planning and/or poverty reduction processes, such as sustainable development strategies or the poverty reduction strategy papers have been found to provide a coherent and effective framework for poverty reduction efforts. In this manner, issues relating to the distribution of benefits in an equitable and fair manner are taken explicitly into account in the planning framework.

Social responses, such as consumer campaigns and media exposes, addressing the underlying causes of forest loss and degradation, can help with the provision of solutions compatible with forest community management, especially in developing countries. However, it should be acknowledged that these responses could take a long time to effectively change individuals' behavior.

17.2.5.4 Social Relations

The MA defines good social relations to include social cohesion, mutual respect, good gender and family relations, and the ability to help others and provide for children.

The limited articulation of international and national conventions and regulations linking biodiversity and local and indigenous knowledge has contributed to a breakdown of local rules over the use of ecosystem services, leading to conflicts within local communities as well as with outside communities. The previous section on social responses concludes that these conflicts have deteriorated the social fabric of many communities. However, recent initiatives like Article 8(j) of the CBD specifically address indigenous peoples and their knowledge. The formal recognition as well as encouraging the participation of local communities ''in developing policies for the conservation and sustainable use of resources, access to genetic resources and the sharing of benefits, and the designation and management of protected areas'' is hoped to reduce the conflicts and improve the social fabric that used to hold communities together. Of course, it is too early to comment on how successful these initiatives are.

The forces of globalization and privatization have improved the material welfare and livelihoods of many communities in developing countries but have also initiated a collapse of many traditional institutions in these countries. These in turn have tended to stratify many societies and cause a breakdown in social relations and an increase in communal conflicts as witnessed in the Narok district in Kenya (Amman and Duraiappah 2001; Rutten 1992).

The Green Revolution no doubt increased the livelihoods and food security for many people in developing countries. However, the extent to which the technology addressed the needs of the rural agrarian poor has increasingly come into question, as evidence points out that the increased need for irrigation and fertilizers excluded many of the poor from using this technology due to limited financial resources. The dichotomy between technological responses and traditional knowledge has been another major cause for the breakdown of social relations within communities, especially rural communities.

There is limited information on the impact social responses have had on social relations. The expectations of a strong positive correlation between the two did not emerge but this is more due to lack of research on the topic rather than the lack of a relationship.

17.2.5.5 Freedoms and Choices

The MA defines freedom and choice to include having control over what happens and being able to achieve what a person values doing or being.

There is no doubt that markets increase choices. But the central question we need to answer is do markets discriminate across individuals? The answers are mixed. Some individuals have definitely benefited from the liberalization of markets and the use of economic responses to allocate ecosystem resources. However, there is also increasing evidence of large segments of populations in developing countries being excluded from this process.

Multilateral environmental agreements—a legal response—play crucial roles in the conservation and protection of the environment, and they are inextricably linked to the alleviation of poverty in developing countries. However, few MEAs address poverty reduction as a priority in these countries. As emphasized in the discussion of legal responses, many MEAs (for example, the CBD) recognize ''that economic and social development and poverty eradication are the first and overriding priorities of developing countries'' (CBD, Article 20.4). However, those responses are based on the role of economic growth in reducing poverty. There is by now an extensive body of literature on ''pro-poor growth'' (Fields 2001; Ravallion 2004) that highlights the limiting effects of those responses that are capital-intensive and based on highly qualified jobs. In other words, MEAs based on approaches to conservation that ignore the need to create jobs in the short run will have a limited impact on reducing poverty. To date, pro-

tected areas have reduced the options and choices available to local rural communities for securing security and livelihood opportunities.

At the national level, land tenure programs have contributed to better ecosystem management and are instrumental in poverty reduction in some ecosystems. However, their success has been found to be dependent on the type of ecosystem. For example, private land tenure systems in drylands have been less successful in ensuring that pastoralists have access to various ecosystem services like provisioning of water and pasture. But even in the case of communal land tenure systems, studies point toward greater transparency and fairness in the allocation of resources within the communal system across all stakeholders.

Genetically modified organisms have also come under increasing criticism for reducing the diversity of the seed bank and for increasing the dependency of many farmers, especially in the developing countries, on large multinational companies who control the patent rights for the GMOs. In this regard, the vulnerability of developing countries is exacerbated by resource and skills constraints in terms of studying and developing national and local impact assessment methodologies and regulation frameworks. The freedom and choices for farmers in developing countries have been reduced. However, developing countries do stand to gain tremendously in terms of food security and broader human well-being, particularly in the area of health with improved nutrition, if the level of uncertainty over ownership associated with these technologies can be reduced significantly.

Social responses which advocate participation and the use of democratic structures to change have contributed to the freedom and choices of individuals. For example, setting up community-based forest management initiatives allows the flexibility of local communities to harvest the forest for income opportunities but also allows the communities to use non-wood forest products for personal use.

17.3 Development and Poverty Reduction Responses: Effectiveness and Consequences for Human Well-being and Ecosystem Services

Development and poverty reduction strategies have assumed a variety of forms and shapes. It is important to note the impact of these responses on ecosystem services. Quite often poverty reduction policies have been based on different conceptions of development, and on different measures of poverty. It is common to find poverty reduction responses that identify poverty not as a deprivation of constituents of human well-being but as a deprivation of income. In these cases, the optimal strategy consists in increasing the economic entitlements of the poor. This can be achieved by improving governance, enhancing the asset bases of the poor, improving the quality of growth, and reforming international and industrial-country policies. These recommendations, as put forward by the World Bank (2002) report, *Linking Poverty Reduction and Environmental Management,* are centered in the economic dimension of well-being. Emphasis is given to the notion of ''livelihoods'' in analyzing the impact of poverty reduction strategies on ecosystem services and human well-being.

It has been widely acknowledged by policy-makers and other stakeholders that poor people are heavily dependent on the state of ecosystems and on ecosystem services, and to a large extent the overall responses address this interdependence. When the ecosystem is degraded, the well-being of these poor populations is severely affected not only in economic terms, but also in cultural and spiritual terms. This seems to be the core message behind those responses that articulate actions toward poverty reduction.

One important development intervention that encompasses all different dimensions of human well-being is the Millennium Development Goals. The MDGs consist of a set of goals and targets to be achieved by most countries by 2015. The goals are not restricted to a livelihood analysis, instead encompassing a broader, multidimensional view of development. The goals that are closer to the management of ecosystem services are: halving extreme poverty and hunger, achieving universal primary education, promoting gender equality, reducing child mortality, improving maternal health, combating major diseases, and achieving environmental sustainability. It is important to note the impact of those policies on the provision of ecosystem services.

The world has seen a proliferation of policies addressing the problem of increasing environmental degradation and increasing poverty in these last years. As Perrings (1996) has argued, ''One of the most striking coincidences of the last decade has been . . . deepening poverty and accelerating environmental degradation in the arid, semiarid and subhumid tropical regions—the drylands—of sub-Saharan Africa.'' There are several elements of the MDGs that are closely linked with ecosystem services. For instance, it is known that there are 1.3 billion people living in fragile areas (World Bank 2003), with a majority living with less than one dollar a day. For these people, improvement in their food security and health status depends on the state of the ecosystems in which they live and the services these ecosystems are able to provide. Of course, access to other assets such as human, physical, financial, social, ''state provided'' infrastructure, in particular education and health services, political and institutional, also play an important part in defining the well-being of the poor.

Similarly, some of the central effects of poverty reduction strategies are on people's nutrition and on women's degree of independence within the household. Poor women are also often subjected to indoor pollution and heavy workload that increases their exposure to other environmental risks.

Warburton (1998) has shown how the use of successful responses to ecosystems depends on community values and community participation. According to her, a participatory approach to sustainable development, based on community-driven strategies, would promote capacity building at the local level, and improve mechanisms of sharing experience and knowledge between community groups at national and international levels. The same reasoning is pursued by *Agenda 21.*

Sectoral responses would then be defined according to the particular characteristics of the natural resource sectors. For instance, a development strategy involving secure land tenure would be conducive to sustainable activities preventing land degradation. A more comprehensive understanding of the development and poverty reduction strategies would then allows us to conclude ''without a doubt that the poor do not initially or indirectly degrade the environment'' (Duraiappah 1998). This is an important conclusion that suggests that responses should focus on (1) correcting institutional and market failures, and (2) providing proper incentives to agents to use the resources sustainably.

The impact of regional variations in the poverty-environment links—adding the gender dimension—has been explored by Agarwal (1997). She analyzes the particular processes of nationalization and privatization developed in India that have undermined traditional institutional arrangements of resource use and management. Responses to development problems in India have led to a continuing commercial exploration of forests and appropriation of village commons. Her work corroborates Jodha's (1986) study on the village commons. The Green Revolution in India has led

to high environmental costs over time. Some of these responses emerged from the organization of civil society groups, such as women's and environmental groups, indigenous movements and peasants' participation. Agarwal calls attention to the fact that, ''the processes of environmental degradation and appropriation of natural resources by the State, and by small numbers of individuals, have specific class-gender implications, manifest in the erosion of both livelihood systems and knowledge systems, but it is women and female children of poor rural households who are affected most adversely.'' (Agarwal 1997)

This gender bias not fully addressed by some responses is also confirmed by Ezzati and Kammen (2001), who have shown that women are twice as likely as men to have an acute respiratory infection due to their exposure to high emissions from domestic activities. Some development policies dismiss the distributive impacts of environmental degradation, ignoring that the poor are most dependent on environmental income in relative terms and the non-poor who use more the natural resources in absolute terms (Cavendish 1999). If these impacts are assessed in the space of the constituents of well-being, there are great inequalities found among the rich and the poor in terms of environmental health problems, such as illnesses due to unsafe water, indoor air pollution, or exposure to disease vectors.

Development practices will have an intrinsic role in the promotion of human well-being and an instrumental role in the fostering of ecosystems and ecosystem services. The promotion of adaptive participatory management has important consequences on stakeholder behavior and capacity building strategies that affect directly the well-being of societies (Gadgil 1999).

Distributive issues are at the core of the analysis of the impact of development policies on ecosystems and human well-being. The use of watershed projects, as a development strategy, has been widely pursued by governmental agencies. On the one hand, there are potential benefits for the poor that could arise from a watershed or a catchment: it could raise agricultural production and conserve common natural resources that are so important to the poor. On the other hand, it could benefit landholders while harming landless people. Kerr finds the projects most successful in achieving conservation and productivity benefits also have the strongest evidence of skewed distribution of benefits toward larger landholders (Kerr 2002). The analysis is limited and the extent of trade-offs is not known, but it is clear that satisfaction with watershed projects is positively correlated to land holding size, and many landless people strongly resent their loss of access to common lands.''

This might happen for a variety of reasons. It is important to remark, however, that most watershed projects have not benefited the poor directly. Moreover, they have not been very friendly toward women, since they have only employed male staff members who are less sensitive to gender concerns.

In the context of tropical forests, emphasis should be given to what Wunder (2001: 1818) named ''the dynamic potential of natural forests,'' that is, the sustainable production of benefits to the poor. This could be challenged by the existence of ''vicious circles'' where the poor need to use environmental resources, causing degradation, which aggravates poverty, and so on. In terms of development policies and responses, Wunder argues that ''at the global level, the shift toward a people-centered conservation paradigm has not succeeded in slowing down the loss of tropical forests and their biological diversity,'' with perverse consequences to the poor. With regard to deforestation, evidence from Brazil shows a pro-cyclical pattern of deforestation.

Much work has been done on the construction of indexes for assisting responses to the poverty-environment nexus. (See Box 17.6.) Good examples comprise Lindenberg's (2002) index of household livelihood security at the family and community level, Sullivan's (2002) index of water poverty, and Levett's (1998) sustainability indicators. Although these examples are far from being comprehensive, they properly illustrate the proliferation of general attempts to integrate well-being and ecosystem services in the formulation of development policies. It must, however, be noted that their impact has been systematically ignored by mainstream economists.

A recent study that synthesized data from 54 household income studies from 17 countries, mostly in East and Southern Africa and South Asia, found that 22% of household income comes from ''forest environmental resources'' such as harvesting wild foods (bushmeat, insects, and wild fruits, and vegetables), fuelwood, fodder, medicinal plants, and timber (Vedeld et al. 2004). The income is about evenly split between cash and products consumed directly. Wealthier families harvest more forest products. However, these activities generate a much higher proportion of poorer families' total income. Villages farther away from markets and with lower educational levels get more of their income from forests. Forest environmental income was of particular significance as an additional income source in periods of both predictable and unpredictable shortfalls in other livelihood sources. This study concluded that the omission of forest environmental income in national statistics and in poverty assessments leads to an underestimation of rural incomes, and a lack of appreciation of the value of the environment in the context of poverty reduction strategies.

Poverty alleviation policies based on structural adjustment policies are very controversial because they have not been able to solve ''the problem of the counterfactual'' (Killick 1995), that is, ''Do adjustment programs result in a better poverty situation than would have obtained without them?'' Whereas it is correct to point out the adverse effects that accompanied adjustment policies, it is technically difficult to isolate the effect of the causes of the initial crisis. The subsistence farmer, the urban very poor, the smallholders in isolated rural areas, all seem to suffer with the introduction of structural adjustment programs. The impact on ecosystems has rarely been discussed by analyses of such programs. The emphasis has been given to short-term macroeconomic policy measures with fundamental fiscal reforms in the public sector.

New poverty reduction strategies have been developed in these last years, covering a wide range of policies, scales, and

BOX 17.6

Weighting Human Well-being in Development Policies

One important issue in assessing the impact of ecosystem services on human well-being is how the well-being of different individuals is weighted in a social well-being function. When handling multidimensional aspects of well-being, another aspect to be considered is how to weight those different elements. Should we give the same weight to each and every aspect, or should we examine alternatives weights? John Rawls (1971) has put forward the view that a lexicographical ranking called *maxmin* should be adopted, according to which, social well-being increases as the well-being of the worst off in society increases.

More recently, participatory approaches have suggested that emphasis should be given to the *mechanism* of setting priorities rather than on priorities itself. This is a fundamental issue for assessing the impact of the interlinkages between well-being and ecosystem services.

actors. More often than not, as mentioned above, the impact of those policies on ecosystems and ecosystem services is largely ignored. Their focus seems to be on institutional and macroeconomic stability, generation of sectoral growth, and reduction of the number of people living with less than $1 per day in poor countries. The most articulated of those strategies is the poverty reduction strategy paper. PRSPs aim to target poverty reduction by articulating macroeconomic, structural, and social policies in those countries interested in following a partnership with the World Bank and the IMF. They are comprehensive and results oriented, and promote a sense of ownership among those governments that are committed to them. Countries are supposed to prepare an interim PRSP (I-PRSP) and then update their PRSP every three years.

PRSPs are quite important elements in poverty reduction strategies for more than 40 countries all over the world. Many of these countries depend on the approval of their PRSPs or I-PRSPs as a condition to the IMF's Poverty Reduction Growth Facility program, the World Bank's concessional lending, and the Highly Indebted Poor Countries Initiatives. PRSPs' analysis of the impact of poverty on ecosystems is assessed through poverty-environment links. As mentioned in the *PRSP Sourcebook,* "In the context of a PRSP, environment and poverty are linked in two major ways. One is that poverty alleviation should not damage the environment of the poor, which would only undercut gains in one area with losses in another. The other main link is that improving environmental conditions can help to reduce poverty." (World Bank 2004: 376)

PRSPs link environmental impacts on health and security of poor people, proposing a "systematic mainstreaming of environment in PRSPs." PRSPs include issues like water supply and wastewater disposal, solid waste removal, indoor and urban air pollution, land degradation, deforestation, loss of coastal ecosystems, and fisheries. However, they reduce proper environmental management to the provision of 'sustainable livelihoods'. In policy terms, they focus on sectoral policies and programs on health, infrastructure, public works, agriculture, et cetera, giving a very broad meaning to environmental policies. They explore poverty dimensions, such as those of economic opportunity, natural resource utilization, empowerment and public actions. The potential consequences for the poor are potentially quite striking. Yet successful responses depend on the implementation of democratic participatory processes at a local level.

Participatory poverty assessments are a promising tool of poverty reduction strategies. PPAs use participatory techniques to evaluate poverty assessments. They are able to reveal many different aspects of poverty, such as vulnerability, powerlessness, isolation, insecurity, ill health, physical violence, and fragile environments that condemn the poor to lives of multiple deprivations (Robb 1999). They are usually good to reveal the depth and severity of poverty, which are normally hidden by monetary poverty lines. RRA (rapid rural appraisal) techniques and PRA (participatory rural appraisal) have developed the core elements behind current uses of PPAs. Here again, not much has been said on the impact of those strategies in terms of ecosystems and ecosystem services. This remains a challenge to be met.

To conclude, it could be said that the impact of poverty reduction strategies on ecosystems and ecosystem services has not been fully explored in the international policy-making processes. More information is needed to assess the impact of those responses on poverty reduction according to specific analytical categories. The most important poverty reduction strategies tend to emphasize institutional and macroeconomic aspects at the expense of poverty-ecosystem links. When these strategies refer to ecosystems or the environment, they tend to frame the consequences of poverty alleviation strategies in terms of the livelihoods approach, narrowing down the poverty issue to its economic dimension. Successful responses should therefore include broader notions of poverty and try to mainstream the role of ecosystem services in the main poverty reduction programs.

17.4 Critical Choices for Response Success

The assessment identified a number of elements that play significant roles in the selection of responses and the subsequent consequences of these responses on human well-being and poverty. The five more critical elements identified from the assessment include: (1) heterogeneity of stakeholders, (2) spatial, temporal, and administrative scales, (3) type of ecosystems and the underlying dynamics, (4) policy coherence and interdependency, and (5) enabling conditions or instrumental freedoms.

17.4.1 Heterogeneity of Stakeholders

Most responses, particularly economic and market-based responses, focused on improving the aggregate welfare of communities or societies. However, numerous authors have complicated the concept of "community." Communities are notoriously difficult to define, with boundaries between them often blurred and overlapping (See Chapter 14; Cavendish 1999; Barrow and Murphree 2001). Within communities, differentiation exists based on socioeconomic positions, gender, and positions with local government structures. Ecosystem management may have different impacts on the well-being of different groups within communities. Local elites may have better opportunities to capture benefits, while the burden of conservation may be put on other groups in the communities. This entails that the tradeoffs and synergies between different ecosystem services may not be similar for every person, especially women (see Box 17.7), within a community. Decision-makers will need to incorporate these differences when designing responses and evaluating their consequences.

The assessment of Part II chapters shows very clearly that a variety of stakeholders live in ecosystems and use ecosystem services for different purposes and in varying degrees and intensity. For example, in the case of forests ecosystems and the provision-

BOX 17.7

The Gender Dimension

Each of the response options has a gender dimension that can be more or less relevant to poverty reduction according to the nature of ecosystem services. The phenomenon known as the "feminization of poverty" should be acknowledged since there is great inequality in the distribution of resources and capabilities along gender lines. Considering gender issues means not only awareness of women's disadvantages in terms of a wide range of variables, but also incorporating the issue of discrimination against women in the use of resources. This might be revealed in the disproportionate time that many women in dryland areas spend searching for clean water. Interestingly, responses that take into account an active role for women provide a very positive balance for soil conservation, promoting biodiversity with the introduction of new technologies (UNFPA, 2001). Responses involving women in environmental and health decisions have proved to be important to target poverty reduction and to conserve ecosystems successfully.

ing service of fuelwood, the poorest tend to be disadvantaged by shifts to bring remaining common pool resources under sustainable management through economic (prices) and legal (tenural) responses. (See Chapter 8.) Fuelwood harvesting tends to be restricted in this process, and women's needs for fuelwood commonly have lower priority than those of men, who use forest products for sale. Weak tenure rights over the resource can also mean that poor (low-income) rural producers and traders are progressively excluded from access to the resource and markets as trade grows. (See Chapter 8.)

Another example is the establishment of protected areas in upper watersheds. Protected areas, a form of regulatory control over land use, has had mixed results because many of them fail to recognize the rights of local populations or communities who have depended on such areas to support their livelihoods, and exclude them from access to benefits. (See Chapter 5.) Age, gender, ethnic group, and wealth status play a role in who maintains and decides what diversity to maintain and where.

In similar manner, culture has been found to play a significant role in the success or failure of technological interventions, which change landscapes and disrupt the cultural and religious relationships communities have with ecosystems. (See Chapter 14.) Moreover, it was shown that technological responses usually cater for quick profits and require certain amounts of investment that usually exclude the low income.

Table 17.3 tells us which characteristics of stakeholders should be considered when designing and implementing a response. The table is read as follows. If water markets—an economic response—are being considered to improve the efficient allocation of water, then high considerations must be made for individuals with low income and more specifically women who may actually experience a drop in well-being with market determined prices. Table 17.3 also tells us, for example, that low considerations can be given to the cultural and religion background of individuals when water markets are created. There was limited information available to consider if formal education and the rural/urban divide were important attributes to consider when designing economic responses.

17.4.2 Temporal, Spatial, and Administrative Scales

Temporal, spatial, and administrative scale effects were also found to play critical roles in determining the success or failure of responses. The role these scales have on the consequences on human well-being and poverty are indirect in the sense that failure of the response to mitigate or reverse ecosystem degradation inadvertently causes a drop in human well-being and an increase in poverty.

17.4.2.1 Temporal Scales

Changes in ecosystems and their corresponding services can occur over a range of time horizons. Losses in provisioning services occur in a relatively shorter time span than losses in the regulating and supporting services. For example, the extinction of the Peruvian anchovy stock within a span of 15 years is a telling story of how fast a renewable resource can come so close to extinction. On the other hand, climate change caused by the emission of anthropogenic greenhouse gases occurs over a time scale of a century or more. It is also known that the longer the time frames, the higher the degree of uncertainty over the loss in ecosystem services and the consequences on human well-being.

Do temporal properties have an influence on the type and success of intervention strategy to be adopted? The answers are mixed. The main factor that underlies temporal dimension is the level of uncertainty. (See Figure 17.1.) If the loss in ecosystem service and/or the impact on human well-being is highly uncertain or unclear but is expected to occur within a short time span, then the precautionary principle is recommended to be adopted and a policy regime consisting of a hybrid of regulatory, economic and legal interventions can work relatively well. An example of the precautionary principle in practice is the Cartagena Protocol. This protocol requires advanced informed agreement procedures and careful assessment of risks before movements of living modified organisms are permitted. Such risk assessment should be based on the precautionary principle.

However, if there is uncertainty and the impacts are expected to occur only in the distant future, then economic interventions in the form of permits, taxes, and incentives for technological innovation, together with social interventions in the form of changing values and attitudes, work well.

In the event that there is very little uncertainty whether an impact will occur, and it is expected to happen in the near future, then regulations supported by legal interventions have proved to

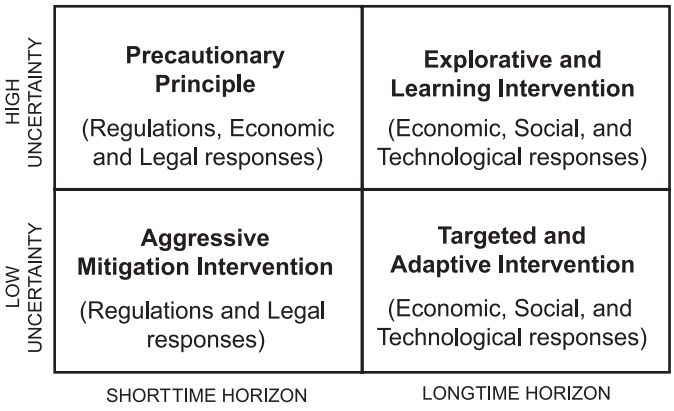

Figure 17.1. Relationship between Uncertainty, Time, and Interventions

Table 17.3. Stakeholder Characteristics That Can Influence the Consequences of Responses on Human Well-being and Poverty

	Economic and Financial Responses	Legal Responses	Technological Responses	Cultural Responses
Gender	high consideration	high consideration	medium consideration	high consideration
Culture and religion	low consideration	medium consideration	high consideration	high consideration
Formal education	imited information	high consideration	high consideration	high consideration
Income level	high consideration	low consideration	high consideration	limited information
Urban/rural divide	limited information	low consideration	limited information	high consideration

be the best intervention strategy. The Montreal Protocol to protect the ozone layer is an example of a legal response. However, if the impact is known to occur but only in the distant future, then a combination of social, economic, and technological intervention strategies will be the best response strategy. The adaptive strategy to mitigate the impacts of climate change in many developing countries is an example of response strategy falling into this class. It is therefore critical in the design of responses that the degree of uncertainty is explicitly recognized and incorporated in the design stage of the response.

17.4.2.2 Spatial and Administrative Scales

Spatial scale relates to the geographical boundary over which ecosystem services are provided while *administrative scale* denotes the type and level of authority overseeing the management of the ecosystem or ecosystem service. Chapter 5 on biodiversity stresses the importance of the principles of decentralization or subsidiarity as guiding principles for the management of ecosystems for reasons of efficiency, democratic legitimacy, and ethics. Institutional diversity and nested institutional arrangements may be the ways forward, as all levels of authority have their strengths and weaknesses.

The wood and fuelwood chapter shows that national government policy and regulation used to create the major signals influencing wood producers have often had negative environmental and social impacts. (See Chapter 8.) Now, the set of response options has widened to include voluntary, market-based, and multistakeholder actions at decentralized and international levels. The chapter concludes by saying that it is important to have a set of responses, so that each targets a specific problem, but also works well with the others. Such coordination is particularly needed at the national policy level (and can be done through national forest plans and processes) and at the forest manager level. Decentralization of authority and responsibility to local government, communities, and the private sector is also a common shift in many parts of the world, especially larger countries such as Indonesia, China, and Brazil. This shifts power closer to the people most affected by local resource use and can improve management where local institutions are adequate and accountable. But it is critical that there is a close relationship between the different scales of responsibility in order to minimize the potential for conflicts.

In the case of water resources, the objective of integrated water resource management is a general response to conflicts between various interests in water resources. These may include conflicts among individual users, among different sectoral interests, among political jurisdictions, between livelihood interests found at local scales, and larger scale interests driven by geopolitical considerations, and more generally between environmental and economic objectives associated with regulatory and provisioning services of freshwater ecosystems. Therefore, IWRM is primarily a problem of developing more appropriate forms of governance and institutional arrangements for management of shared waters, which cuts across spatial and administrative scales.

Lack of authority is particularly prevalent in transboundary basins, given the absence of a single legal authority and the need to rely on voluntary agreements among countries that occupy the basin. An example of this is the International Commission for the Protection of the Rhine. Given the generally heterogeneous nature of environmental as well as socioeconomic conditions, effective management of freshwater resources to support multiple and often conflicting uses often requires numerous site-specific responses that are beyond the capacity of centralized authorities. Although a basin-wide approach is necessary for some aspects of management of freshwater resources such as overall water allocation, flood forecasting, and emission of persistent pollutants, others, such as problems associated with land and water relationships, and operations and maintenance of irrigation canals, may best be resolved locally because it allows for more direct engagement of stakeholders and more appropriate responses to site-specific circumstances.

In general, land-water relationships are more effectively addressed at smaller scales at which land use impacts can be more readily detected, benefits are more tangible, and at which agreements can be tailored to local conditions. Interventions at these smaller scales are also unlikely to be effective beyond the level at which their consequences are at least measurable. For example, soil conservation management practices aimed at reducing erosion may be beneficial on-site but will not be of significance in reducing downstream sedimentation in basins where erosion rates are naturally high or where there is insufficient cooperation by upstream stakeholders so as to implement practices over a wide enough area.

The implied solution to spatial and administrative scale conflicts is the need both for decentralized approaches for many aspects of resource management and decision-making, and for mutually supportive governance at more centralized levels, so as to insure that human well-being and poverty reduction measures and other localized interests are adequately represented and considered in basin-wide decision-making processes. Therefore, the issue at hand is not the type of response, which should be used for different spatial or administrative scales but more of a concern of getting into place the appropriate governance and institutional frameworks to support the implantation of responses in an efficient, democratic, and ethical manner so that human well-being is increased and poverty reduced.

17.4.3 Ecosystem Dynamics and Interaction

The biodiversity chapter explicitly states that the success or failure of any response to conserve biodiversity will depend on the ecological setting in which it is applied. One of the main reasons for the limited success of protected areas is the failure to account for the distribution of biodiversity within different ecosystems. Therefore, the fixed land percentage criteria used for determining protected areas fails to capture the fact that different ecosystems vary in terms of internal heterogeneity or diversity with more diverse types arguably deserving a higher target. Moreover, different ecosystems vary in terms of likelihood of persistence in the absence of conservation action (for example, because of differences in geographic extent); percent targets can run counter to types with greatest need for protection, because models of probabilities of persistence suggest that geographically extensive habitat types may have a reasonable probability of persistence of their components even in the absence of action, and so require a *smaller* not larger percentage area protection. (See Chapter 5.)

Ecosystems are not homogenous. For example, dryland ecosystems cannot be perceived as being in equilibrium, but in continual transition—in climatic conditions, production systems, demography, and social institutions (Mortimore 1998). Attempts to use economic responses like private land ownership may work well in specific areas within ecosystems, which are characterized by stable rainfall and predictable climatic variations. However, if the larger ecosystem is characterized by more unstable precipitation patterns and introducing private land tenure in these systems may prove fatal (Amman and Duraiappah, 2004).

It should also be recognized that there is a high degree of synergy and interdependency among the different services, for example, the well-established strong inter-linkages among biodiversity and hydrological and nutrient cycles (see MA *Framework for Assessment*). Overuse of provisioning services, such as excessive biomass harvesting, can impair the productivity of the regulating and supporting services, such as water and nutrient cycling, which in turn have a negative impact on the ability of the ecosystem to produce goods, such as biomass. This feature of interdependency among ecosystem services is normally not taken into account in management and policy decisions, especially at watershed and national scales.

Integrated responses that address degradation of ecosystem services across a number of ecosystems simultaneously and also explicitly include objectives to enhance human well-being are increasingly being used. Integrated responses occur at different scales and across scales, and use a range of instruments for implementation. Increasingly they are associated with the application of multistakeholder processes and with decentralization; they may include actors and institutions from government, civil society, and the private sector. However, the limited information available to date on integrated responses makes it difficult to come to any decisive conclusion at this moment.

17.4.4 Policy Coherence and Interdependency

The assessment of the well-being–poverty–ecosystem nexus reveals that it is governed by a complex system of institutions, organizations, and instruments (Duraiappah 2004). These range from the international scale right down to the local community. Moreover, within each level, there is again a multitude of instruments, organizations, and institutions at work. Figure 17.2 shows that the links between scales is not linear, but there are many instances where there is a direct link between the international level and the local level policies. But the critical point to keep in mind is the need for coherence at all these scales and levels if the goals of poverty reduction through the sustainable management of ecosystem services are to be even remotely achieved.

Chapter 8 on wood and fuelwood finds that policies, institutions, and interventions that work toward ecosystem well-being are uncoordinated with those that work toward human well-being. This same finding is similar to the one that many PRSPs make no explicit mention of ecosystems.

Frameworks for natural resource management that are developed more locally and then linked to national objectives have shown to be more flexible and responsive to local interests. Relevant local stakeholders can develop these frameworks, with special support given to the disadvantaged poor to negotiate for their interests.

17.4.4.1 Instruments and Institutional Coherence

There are 13 global multilateral environmental agreements and/or conventions and approximately 500 international treaties or other agreements related to the environment. Couple this with an equally large number of poverty reduction plans and development strategies, and we get a complex policy arena with the potential for many conflicting objectives and goals. There has been a concerted action by the secretariats of the CBD, CCD, and Ramsar to coordinate their action plans, but our findings suggest that more is needed. A valuable input to the process will be to consolidate the various action plans under each of the conventions into an integrated response strategy and this strategy to be integrated within the larger and broader development and/or poverty reduction frameworks used in the respective countries.

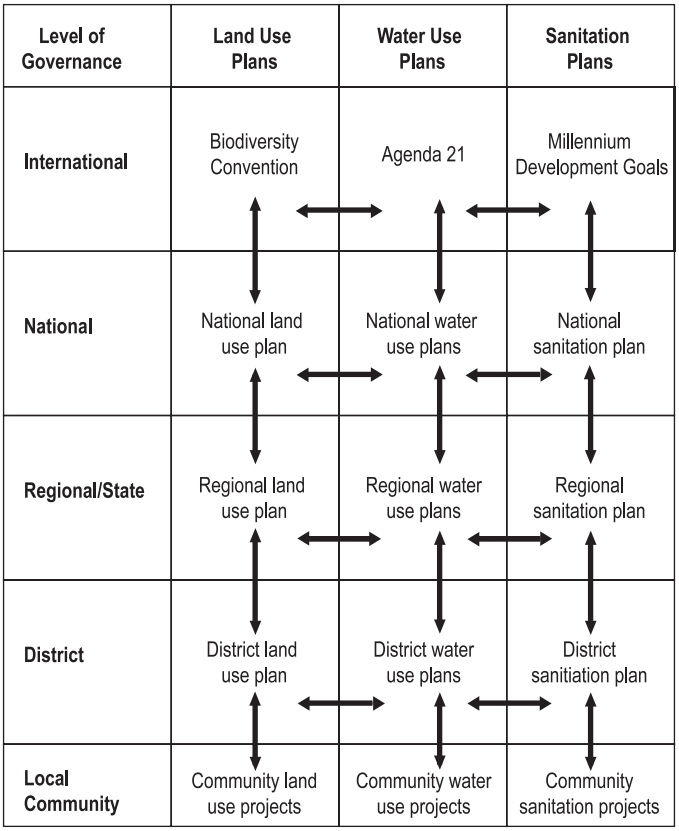

Figure 17.2. A Schematic Illustration of Vertical and Horizontal Policy Coherence

The initial findings at the national levels point to a fragmented approach with a few countries recognizing the need for policy coherence but they do not have the capacity and resources to carry out such a process. If the international community wants to see an improvement in the management of ecosystems as well as reductions in poverty, then additional resources should be set aside for developing systems that encourage the integration and coherence of instruments, organizations, and institutions.

17.4.4.2 Organizational Coherence

At the international level, each MEA has its own secretariat. At the national level, the responsibilities for the environment, poverty reduction, and development strategies are spread across a variety of ministries. It is imperative for these conventions at the international and ministries at the national level to work together toward common goals and objectives. If policy-makers are to reduce inter-ministerial conflicts, then it is imperative that an organizational matrix should be drafted to allow policy-makers to see who (which organization) is responsible for what (institutions and instruments).

17.4.4.3 Vertical Coherence

There is a need for vertical integration of the various policies, plans, and/or strategies. International conventions must be coherent with national policies and these in turn must be coherent with local policies. The many cases reported in the chapter on biodiversity show the impact of international environmental law upon national law, demonstrating that domestic courts play a vital role in the application of international environmental agreements. (See Chapter 5.)

In the case of biodiversity conservation, the greatest benefits were realized when intentional ecosystem planning achieved coordinated adoption over large areas. However, even when adoption was limited to individual farm-level activities, significant benefits to ''wild'' biodiversity were recorded. Of the 36 cases, 28 principally benefited poor, small-scale farmers. Enhanced ecosystem productivity and stability reduced production-associated risks, raised food and fiber production, and improved human well-being.

17.4.4.4 Horizontal Coherence

Horizontal coherence refers to coherence at the international level, at the national level, and the local level. This requires actors at the international level to work together and make an effort to ensure that their policies complement each other (OECD 2001). International cooperation through multilateral environmental agreements requires increased commitment to implementation to effectively conserve biodiversity. However, unless these are implemented on the ground, they are not effective. The CBD, in its Preamble, recognizes ''that economic and social development and poverty eradication are the first and overriding priorities of developing countries.'' The CBD (Article 20.4) and UNFCCC (Article 4.7) also state that ''eradication of poverty'' is one of the commitments by the parties. The CCD also has several provisions toward alleviating poverty and creating an enabling environment to achieve sustainability objectives. A positive signal has been recent attempts (for example, through joint work plans) to create synergies between conventions. However, the link between biodiversity conventions and other international legal institutions that have an impact (such as WTO) are weak.

The same is true for the national level. Ministries must work together to aim for a common goal. Their plans and strategies must be complementary to each other, and trade-offs among their plans must be highlighted, discussed, and agreed upon before actions are implemented. For example, the chapter on biodiversity (see Chapter 5) stresses the importance of integrating biodiversity issues in agriculture, fishery, and forestry management—in many countries the responsibility of various ministries—in order to achieve two-fold gains in encouraging sustainable harvesting and in minimizing the negative impacts on biodiversity.

Responses have in general been developed and implemented in a sectoral manner. The sectoral approach has usually led to many conflicting objectives, and even when objectives are similar, different approaches and responses inadvertently lead to a worsening of the situation rather than an improvement. The overall objective for policy coherence will be to:

- reduce fragmentation,
- reduce duplication, and
- reduce transaction costs.

17.4.5 Enabling Conditions: Toward Adaptive Management and Evolving Strategies

Adaptive management has been cited as an ideal approach to address poverty reduction and ecosystem management in many of the chapters in Part II of this volume. The chapter on water (see Chapter 7) defines adaptive management as an integrated response option that provides a way to build on a base of imperfect knowledge, while the integrated responses chapter (see Chapter 15) defines it as learning by doing. Adaptive management necessitates multiple instruments, including a mix of law, economic instruments, voluntary agreements, information provision, technological solutions, research, and education. The key word in adaptive management is flexibility. Equally important in adaptive management are the management structures that exist and the potential for change within those structures, whether they are institutions, property rights, or communities. In order to provide flexibility and the environment for change to occur, a number of ''enabling conditions'' are required.

Chapter 15 highlights integrated coastal zone management as an adaptive management approach. ICZM initiatives created enabling conditions for stakeholder involvement in coastal management decisions, and for partnerships that have helped to break sectoral barriers. However, the chapter also highlights where ICZM processes have failed to identify all relevant stakeholders and create conditions for their effective participation. This is because these partnerships have not always demonstrated transparent and democratic methods for selection of the participating organizations and individuals who truly reflect the needs of the coastal area.

Many of the various enabling conditions found to be critical in the successful implementation of response strategies within an adaptive management strategy were found to be closely related to what Amartya Sen calls ''instrumental freedoms'' (Sen 1999). Sen identified five instrumental freedoms—participative freedom and political feasibility, social opportunities, economic facilities, transparency guarantees, and protective security—critical for reducing poverty and improving human well-being. He stresses that these freedoms should not be seen as exclusive of each other or as substitutes, but as inclusive and complementary. Therefore, some or all of the other instrumental freedoms—participative freedom and transparency guarantees—are required in order to provide, for example, economic facilities (Dreze and Sen 2002).

Individuals live and operate in a world of institutions and, therefore, there is a close relationship between instrumental freedoms and institutions. For example, Sen goes on to state that our opportunities and prospects depend crucially on what institutions exist and how they function. Not only do institutions contribute to our freedoms, their roles can be sensibly evaluated in the light of their contributions to our freedom (Sen 1999).

But the relationship is more complex than appears at first glance. Although institutions are responsible for the provisioning of the freedoms, it should also be acknowledged that the type, efficiency, and effectiveness of institutions are determined by the instrumental freedoms available in the country (Sen 1999, Chopra and Duraiappah forthcoming). (See Figure 17.3.) Therefore, communities having limited instrumental freedoms would find difficulties in changing, revising or adapting existing institutional structures, which are needed to successfully implement adaptive

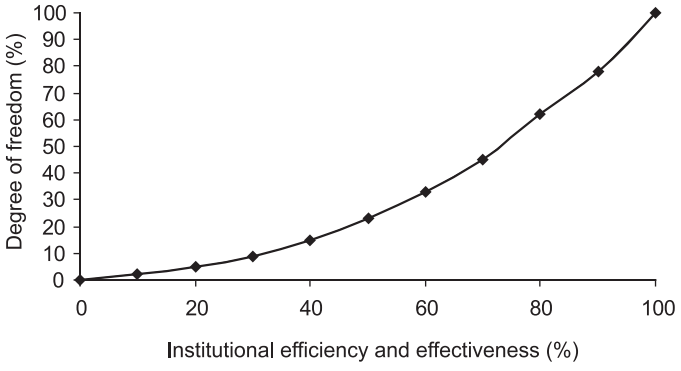

Figure 17.3. Relationship between Degree of Freedom and Institutional Efficiency and Effectiveness (Chopra and Duraiappah forthcoming)

strategies to improve well-being and better management of ecosystem services.

The assessment of the various intervention strategies in Part II of this report point to the fact that no intervention strategy operates in a vacuum. The assessment repeatedly highlights that the success or failure of many responses were largely influenced by the various institutional frameworks that were in place in the country for providing the various instrumental freedoms. For example, in the case of biodiversity, one of the critical assessment findings that evolved is the democratic and representative participation of local communities. The participation process worked relatively well in conserving biodiversity, and worked well for improving the well-being of local communities when institutions supporting democratic participation were in place. (See Chapters 5, 7.)

Another example of a successful intervention strategy that worked relatively well is the use of water permits in the United States. Local communities together with local authorities developed a water permit system that worked relatively well. The main reason for the success of this initiative was the presence of well-functioning markets—an economic facility, together with a trusted legal system, the transparency guarantee, which individuals could rely on in cases of litigation. In many developing countries, these institutional frameworks come at a very high cost in the form of high transaction costs and corruption. (See Figure 17.4.) These high costs practically prevent poor communities from adopting adaptive management strategies, which require as a prerequisite flexible institutional structures which can be changed or revised without too much cost and effort.

Moreover, the clarification of property rights or tenure security—another form of transparency guarantee—was considered as a prerequisite for the use of economic instruments. It is well established, however, that tenure security is absent in many developing countries and explains the limited success market-based instruments have had in these countries. In a majority of instances, the use of market-based intervention strategies often resulted in critical water supplies being captured by a small minority who had resources and political power. It was found that, in cases where formal tenure security is unreliable and uncertain, intervention strategy in the form of informal arrangements among the relevant stakeholders worked relatively well. However, it should be stressed that institutions ensuring equitable participation in formulating these informal institutions were present to ensure fair representation and access to ecosystem services. Experiences from the use of ICZM—an example of an adaptive management strategy—suggest that this approach can only work effectively if institutional structures can be revised, amended, or changed relatively quickly and efficiently; and this was found to occur in cases whereby a number of critical instrumental freedoms, especially participatory freedoms and transparency guarantees, are available.

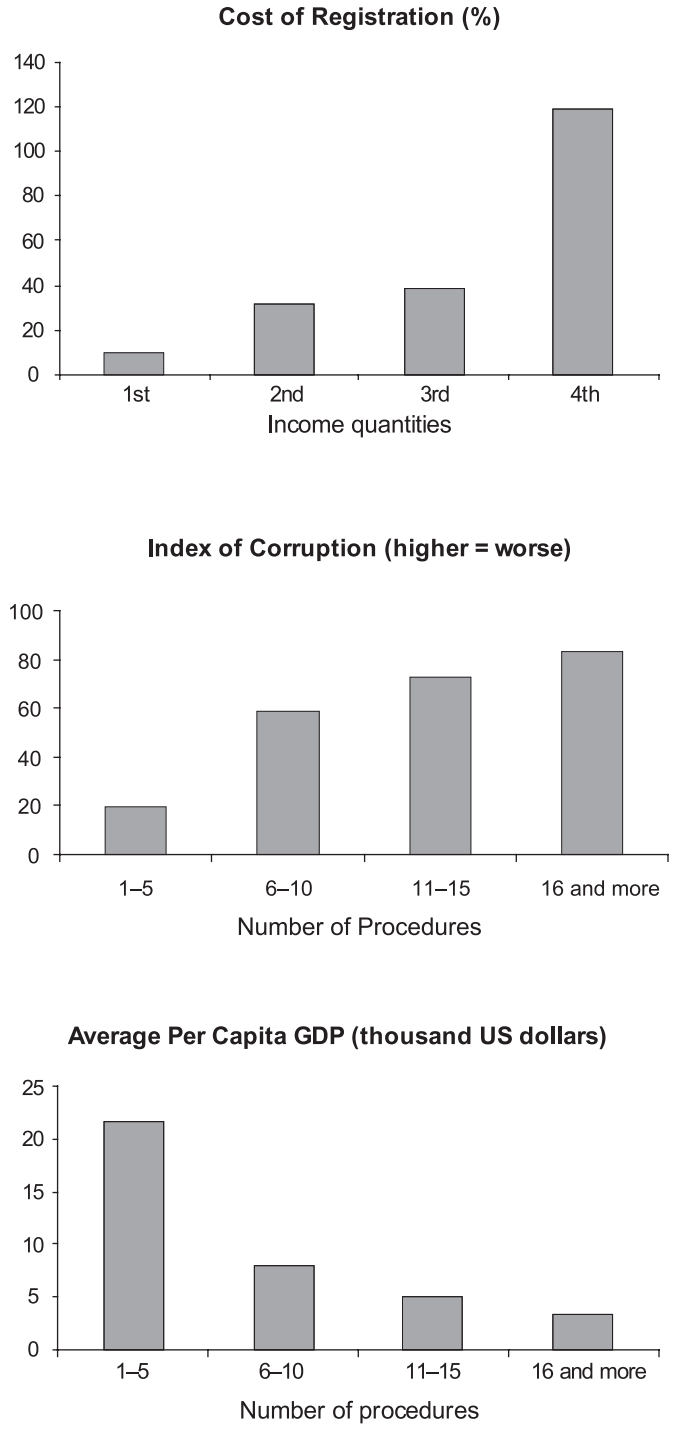

Figure 17.4. Relationship between Corruption, Transaction Cost, and Administrative Bureaucracy (World Bank 2002)

17.5 Key Findings on Consequences and Effectiveness of Responses

We shall not end the chapter with a conclusion but with some answers to the key questions (see Box 17.1) posed by decision-makers and potential users of the MA.

1. How effective are international agreements for addressing concerns related to ecosystems and human well-being, and what options exist to strengthen their effectiveness?

Bilateral and multilateral instruments have been, in general, effective in achieving their stated goals especially when reciprocity is high. It was found that in most treaties, the limited and focused nature of the goals and mechanisms developed were not able to address the broader issue of ecosystem services and human well-being. It has to be acknowledged that these agreements were never intended to address such broad issues. However, where appropriate (for example, water, forestry, biodiversity), considerations of such issues may need to be incorporated explicitly in the agreement if poverty reduction efforts related to ecosystem services are to be effective. Options to strengthen the effectiveness of international environmental agreements in this regard include the inclusion of appropriate goals in the design of the agreement (both in terms of objectives and operational mechanisms), the way

the instrument was negotiated, the consistency with other governance initiatives (for example, PRSPs and trade and finance regimes), and the context in which it is to be implemented.

2. What is the scope for correcting market failures related to ecosystem services (internalizing environmental externalities)? How much of a difference would this make for ecosystems and human well-being, and what are the necessary conditions for these approaches to be successful?

There is considerable scope for correcting market failures and internalizing environmental externalities. However, a number of caveats need to be mentioned. First, markets work relatively well in mitigating polluting activities, which degrade ecosystems. Markets were also found to do a relatively good job in the efficient allocation of provisioning services (natural resources), but only when effective and efficient institution structures are in place. However, markets have difficulty in assigning right prices and allocations for regulating, supporting, and cultural services. It is also recognized that market instruments are not designed to address distributive issues especially in the constituents of security, health, social relations, and freedom and choices. It is therefore recommended that efforts be directed at creating markets for provisioning services, while implementing regulatory mechanisms/instruments for the maintenance of regulating, supporting, and cultural services as well as ensuring equitable allocations of all services across stakeholders.

3. What is the potential impact on ecosystem services and human well-being of removing ''perverse subsidies'' that promote excessive use of specific services? What tradeoffs may exist between ecosystem and human well-being (especially poverty) goals?

There is no doubt that many subsidies (especially in the agricultural, forestry, and fisheries sectors) have negative effects on ecosystem services. There is tremendous potential for removing perverse subsidies, but there will be a need for compensatory mechanisms for the poor who may be adversely affected by the immediate removal of subsidies. Studies show that the removal of some subsidies—especially in the fuel, food, and water sectors—will have distributive impacts and that compensation in the form of monetary and non-monetary measures will be required in the short term in order to prevent some individuals or groups from falling into poverty.

4. What more can be done to strengthen national-local legal frameworks for more effective ecosystem management to reduce poverty and increase human well-being? And are there scale effects which make legal responses at one level more effective in addressing ecosystem services?

In general, the success of legal frameworks is higher when they are designed at the lowest possible administrative level because they can then take the contextual factors into account. At the same time, in order to ensure a level playing field and access to global knowledge and resources, bilateral and multilateral agreements may also need to be made. It is important to note that what may appear to be a national issue (for example, an agreement between a government and a company) may actually be subject to international trade, investment, and environmental laws, and also to private international law. This, in turn, requires a careful design, whereby decentralized legal frameworks are closely coordinated with higher-level legal structures.

5. What are the strengths and weaknesses of an increased focus on technological advances for addressing concerns related to ecosystems, human well-being, and poverty alleviation? What steps can be taken to increase the likely benefits for ecosystems and human well-being of technological change, and decrease the risks and costs?

It is clear that technology can improve the flow of provisioning services. Technology can substitute to a limited extent supporting and regulating services but usually at high costs, and are unsustainable in the long run. It should also be recognized that technology responses can clearly have distributive impacts with losers and winners if improperly implemented. The assessment recommends that if technologies are to be introduced, and then efforts should be made to integrate local knowledge and preferences through a participatory process.

6. How important is governance/institutional reform to the achievement of effective ecosystem management, and what are the characteristics of that reform that are most relevant to the pursuit of goals related to ecosystems and human well-being?

Institutional reform is critical in both industrial and developing countries. The transition to ecosystem services requires new institutions that can accommodate scale issues that transcend traditional administrative or political boundaries, and be flexible to changing ecological conditions. Access to institutions in a relatively efficient, transparent, and costless manner was found to be quite effective in encouraging sustainable management of ecosystem services by empowering the rural poor. Institutional reform to increase instrumental freedoms provides local communities the flexibility to adopt adaptive management strategies in response to ongoing social, ecological, and economic changes.

7. What are the strengths and weaknesses of greater stakeholder involvement in decision-making in the management of ecosystem services? How can decision-makers find the right balance?

Stakeholder participation does not guarantee well-functioning ecosystems. It is a misnomer to assume that local communities, poor and rich, will conserve and manage ecosystems in a sustainable manner. There is a need for education, knowledge sharing, and information dissemination if participatory processes are to work efficiently and effectively. However, participatory processes are time consuming and costly. There is a need to clarify issues that can benefit from a participatory process, and not adopt an approach, which requires all issues and decisions to be made through a participatory process. This is a challenge, as little information is available to make any distinctive recommendations on the lessons learned.

8. What tools and mechanisms can promote effective cross-sectoral (water, agriculture, environment, transportation, etc.) coordination of policy and decision-making?

Integrated responses are gaining in importance in both developing and industrial countries, but they have had mixed results. Integrated responses address degradation of ecosystem services across

a number of systems simultaneously and also explicitly include objectives to enhance human well-being. Integrated responses occur at different scales and across scales, and use a range of instruments for implementation. However, experience shows that place-based integrated assessments show more promise in addressing the ecological and human well-being issues at hand than the present sectoral or thematic approaches. Increasingly, integrated responses are associated with the application of multistakeholder processes, decentralization, and the inclusion of actors from government, civil society, and private sector. Examples include some Multilateral Environmental Agreements, environmental policy integration within national governments, and multisectoral approaches such as ICZM and IRBM. Although many integrated responses make ambitious claims about their likely benefits, in practice the results of implementation have been mixed in terms of ecological, social, and economic impacts.

9. What design characteristics of ecosystem-related responses are helpful in ensuring that they provide benefits for poverty reduction?

Responses need to:

- *Recognize complexity.* Responses must serve multiple objectives and/or sectors; they must be integrated within national poverty reduction strategies.
- *Be implemented at the appropriate scale.* The scale of a response must match the scale of the process; often, a multiscale response will be most effective.
- *Acknowledge uncertainty.* In choosing responses, we must understand the limits to our knowledge, and we must expect the unexpected.
- *Be made through an inclusive and participatory process.* It is instrumental that information is available and understandable to a wide range of affected stakeholders and that responses are designed in an open and transparent fashion.
- *Enhance adaptive capacity.* Resilience is increased if we put in place institutional frameworks that allow and promote the capacity to learn from past responses and adapt accordingly.
- *Establish supporting instrumental freedoms.* Responses do not work in a vacuum, and it is therefore critical to identify the necessary supporting instrumental freedoms needed in order for the response to work efficiently and equitably.
- *Establish legal frameworks.* If the agreement is legally binding, it is generally likely to have a much stronger effect than a soft law agreement such as the Declaration and the Action Plan of the World Summit on Sustainable Development.
- *Have mechanisms for implementation:* Where financial resources are not forthcoming, the design of market mechanisms may increase the potential for implementation.
- *Establish implementing and monitoring agencies.* The establishment of subsidiary bodies with authority and resources to undertake specific activities to enhance the implementation of the agreements is vital to ensure continuity and preparation and follow-up to complex issues.
- *Be coordinated with other responses.* The literature indicates that it is further vital that responses designed for one regime do not necessarily lead to problems in other regimes.
- *Integrate traditional and scientific knowledge.* Identify opportunities for incorporating traditional and local knowledge in designing responses.

10. What have been the consequences of macroeconomic responses like poverty reduction strategies for ecosystems and their services?

Most macroeconomic responses, especially structural adjustment programs and poverty reduction strategies, have paid relatively little or no attention to the sustainable management of ecosystem services. However, there is an increasing trend toward better integration of the environment in poverty reduction strategies, although the main emphasis has been on the efficient allocation of provisioning services. In many instances, this has led to deterioration in the regulating and supporting services. Therefore, communities and individuals who depend on these ecosystem services directly for some of their constituents of well-being face the possibility of a downward spiral of poverty when these ecosystem services deteriorate.

11. What has been the net impact of trade liberalization, globalization, and privatization on ecosystems, their services, and human well-being?

Trade liberalization has no doubt increased the rate of use of ecosystem services. The ecological footprint of many industrial countries is much larger than their carrying capacity. This has primarily been made possible through increased trade. Privatization, which goes hand in hand with globalization and liberalization, has improved the efficient use of the provisioning services of ecosystems. However, this has led to an increase in relative poverty. For example, privatization of land in countries with weak institutional frameworks has caused many of the poor to lose the lands they have been living on for generations. The fundamental premise for globalization, liberalization and privatization to be equitable is the presence of a number of key instrumental freedoms supported by strong institutions.

Note

1. This section draws from the work on UNEP/CBO/SGSTA/9/INF/13.

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