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Valuing the Environment

Ismail Serageldin
Andrew Steer
Editors



Proceedings of the First Annual International Conference on Environmentally Sustainable Development

held at
The World Bank
Washington, D.C.
September 30–October 1, 1993



Environmentally Sustainable Development Proceedings Series No. 2

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Editorial Consultant

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Foreword

The First Annual International Conference on Environmentally Sustainable Development (ESD) was held at the World Bank on September 30 and October 1, 1993. This annual conference series was inaugurated a year after the 1992 Rio Earth Summit and a few months after the establishment of a new Vice Presidency for ESD within the World Bank. The purpose of the annual conference is to bring together experts and leaders from around the world to address how development might be made more sustainable in practice. Making development sustainable requires progress at several levels. First, in a number of areas the conceptual framework remains weak. Second, much needs to be learned with regard to the effectiveness of alternative policy packages to change behavior and improve living conditions. Third, capacity to implement a change in direction remains weak in many countries and needs to be strengthened. Finally, citizens and political leaders need to be persuaded that a better way of doing things is available, and

is worth the costs. This annual series of conferences is intended to make a contribution at all of these levels.

Some of the papers in this volume are technical and detailed. Others are broader in scope, assessing where we are heading a year after the Earth Summit. We hope all of the papers convey a sense of urgency that changes are necessary. The overarching theme of the volume is “valuing the environment”—in recognition that it is the failure to appreciate the importance of the environment that has led to such costly impacts on human health, ecological integrity, and economic productivity. Water is chosen as a special topic as an important illustration of this theme.

The editors wish to record their appreciation to Alicia Hetzner for her invaluable assistance in bringing this volume to publication.

Ismail Serageldin
Andrew Steer

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Overview

Ismail Serageldin and Andrew Steer

The value of the environment has been underestimated for too long, resulting in damage to human health, reduced productivity, broken social structures, and the undermining of long-term development. This is now recognized, at least in principle, by analysts and policymakers worldwide. But how can development be made more sustainable in practice? Some elements of the needed shifts in policy are clear, and were laid out and agreed by the world's leaders at the Rio Earth Summit in 1992. Of course, finding the political and social will to implement such policies is a different matter. Other elements of the needed shift are less clear and are not yet agreed, even in principle, by all policymakers. And in some areas, a good deal more research and evidence will be required before behavior and policies are changed. The papers in this volume—all presented at the First Annual International Conference on Environmentally Sustainable Development at the World Bank in September 1993—attempt to take stock of where we are in the journey toward sustainable development. They are divided into four sections.

The Road from Rio

The first group of papers is broad in scope. Authors were invited to assess how much progress is being made toward sustainability and to describe what kind of new development paradigm is required. In his opening remarks Sven Sandström notes the particular challenge for development institutions such as the World Bank. Despite substantial progress in main-

streaming environmental concerns into the Bank's activity, clearly we are still on the steep incline of the learning curve. Picking up this theme, Ismail Serageldin outlines the World Bank's fourfold agenda in seeking its role in making development environmentally sustainable:

1. Assisting our borrower countries to promote environmental stewardship, through lending and policy advice
2. Assessing and mitigating any adverse impacts associated with Bank-financed projects
3. Building on the positive synergies between development and the environment
4. Addressing global environmental challenges, primarily through the Global Environment Facility.

But he argues for more than this. The way we approach and address development problems needs to change if we are to complete the transition from a "development versus the environment" world to an "environmentally sustainable development" world. Our measurement of progress needs to be enriched by recent research on environmental accounting. We need to go deeper in implementing a "people-first" approach to development, in which the empowerment of the powerless is central to our activities. And we need to take issues of civic society and governance more seriously.

Nitin Desai, Undersecretary General at the United Nations responsible for overseeing follow-up to the Rio conference, provides an assessment of progress a year later. He notes that the intellectual contribution of Rio lay not in its coverage of the "classical" environmental agenda

(important though that is), but in injecting development into the environmental debate. Rio was essentially a political process, he notes. Agenda 21 did not attempt to explore intellectual frontiers but to push the political limits. At that level, progress since Rio is not so disappointing as some have suggested. In three of the four fragile ecosystems for which activity programs were identified, there has been movement, as there has in the global conventions. The prospects for increased financial flows remain bleak, of course, and there are a number of research topics that need urgent remedial attention.

In the keynote address, Jacques-Yves Cousteau weaves the context of the current environmental crisis and suggests the kind of change in mindset that will be required to halt the damage. As a start, we need to understand the great “divorce” that has occurred between humankind and nature. “Man the victim,” a part of nature, has become a manipulator of nature, with associated privileges and responsibilities. The burden for human beings now is to “invent from scratch a behavior that at the same time is biologically acceptable and morally satisfying.” While progress is being made, our moral codes do not yet penetrate our free-market economic system. We urgently need to recognize that the real goal of production is not the product but—as Georgescu-Roegen describes it—an immaterial “fluid,” the joy of living. We also need to recognize in our actions the value of diversity. Recent research in biology has taught us clearly the importance of species and genetic diversity for healthy ecosystems. The same principles apply to cultural and ethnic diversity in promoting the health of our society.

Wangari Maathai, founder of Kenya’s Green Belt Movement, describes the lessons that have emerged from the Movement over the past two decades, which may help guide other initiatives designed to make development more sustainable. The Green Belt Movement, a people-driven organization that supports tree planting and education, especially among women, has succeeded first and foremost because it addresses the *felt needs* of the participating communities: jobs, fuelwood, and an end to environmental degradation of the land. Afforestation programs, done correctly, can meet all of these needs simultaneously, and thus can engender remarkable support and

ownership at the community level. Although not aligned to any political party, an organization like this can, by empowering communities to improve their own futures, raise political activism for greater democracy and accountability in government. Industrial countries and international agencies have potentially important roles to play in supporting such initiatives and ensuring that aid programs involve true partnerships with local communities.

How Valuable Is the Environment?

Two major papers addressed the principles and practice of economic valuation of the environment. How does economic theory inform the environmental debate? How advanced are techniques for calculating environmental values? And how useful are they in the real world? Partha Dasgupta argues that economic theory has not received the respect or practice it deserves in environmental literature. Too often the presumption is made that conventional economics has little to offer in analyzing issues of sustainability. In fact, for some time modern economic analysis has offered a precise language for discussing the private and social management of environmental assets. He shows that the concept of sustainable development, as commonly used, is too loose to have practical application and, because of its static assumptions, can often confuse rather than enlighten practical policymaking. In contrast, the theory of “optimal development” offers a flexible, disciplined ethical framework for analyzing resource management issues over time, in a manner that takes the welfare of future generations fully into account. He shows that from this framework can emerge appropriate discount rates (which will differ according to circumstance), shadow prices of environmental assets, and required adjustments to the national accounts. To the extent that we are confused as to what policies to adopt, it is the fault of poor data, lack of knowledge of ecological process and of our own values—not of a lack of a consistent framework of analysis.

The paper by David Pearce takes stock of current practice, primarily in developing countries, in calculating the value of environmental assets. Beginning with a survey of well-tested techniques for capturing the “willingness-to-pay” for

water and sanitation services, Pearce shows how valuation techniques routinely influence investment decisions to improve services provided. Newer approaches whereby the value of assets—such as forests—that have both local and global value are measured are also surveyed. Using the example of forest conservation in West Africa, the paper shows that protection is socially desirable only when global benefits are taken into account, and when transfers are made from those who benefit to those who have to forego benefits from alternative land uses. Specifically, calculations of the valuation of global benefits of carbon sequestration in forests may well have a significant impact on international transfers in the years to come. Finally, the paper discusses how valuation techniques increasingly are being used to adjust national accounts to reflect natural capital in a manner analogous to humanmade capital. While good progress has been made in recent years on national income adjustment, there is not much evidence that such exercises are yet influencing national-level policymaking. This will require resolving a number of technical disputes among practitioners and developing simpler “short-cut” methods of adjustment. An appendix to this volume (by Peter Bartelmus, Ernst Lutz, and Jan van Tongeren) draws upon recent World Bank-United Nations work to provide a practical guide to adjusting national income accounts for the environment.

Managing Water

Water resource management was selected as a special topic to illustrate the importance and difficulty of recognizing environmental, health, and productivity values in making decisions about allocation and use. No natural resource is more vital for life than water, yet current use practices are not sustainable from either an economic or an environmental perspective. Michel Petit begins the section by describing the World Bank’s efforts to improve water management through its new Water Resources Management policy. Based on the Bank’s experience of having lent more than \$34 billion for water development over the years, the new policy seeks to balance two considerations: the need for a holistic management approach that gives due weight to longer term factors and to protecting ecosystems; and the

advantages of relying more on markets and pricing to allocate water among competing uses. Under its new policy the Bank is assisting countries in managing water at the river basin level, establishing strong legal and regulatory frameworks for pricing and environmental protection, decentralizing implementation to local authorities and autonomous entities, leveraging the initiative and skills of the private sector, involving local users in decisionmaking, and adapting and adopting low-cost and efficient technologies.

The summary of the Bank’s new water policy is followed by presentations of the experience of managing water in two countries known for their leadership in this field: France and Pakistan. Ivan Chéret’s paper on the French experience traces the evolution of water management over the past three decades. The 1964 Water Act was a milestone in French water policy. Spurred by the sharply growing demand for water, coupled with rapid urbanization and industrialization, the 1964 Act introduced the concept of water quality objectives and established the *river basin* as the central unit of decisionmaking. Basin Committees (or water “parliaments”), which represent all public and private stakeholders, set policy on both quality and quantity issues. Policy is implemented by Water Boards, also corresponding to the six major river basins of the country. Three instruments are available to the water parliaments in ensuring appropriate allocation and use: regulation, incentives, and dialogue. Economic instruments are widely used to combat waste and pollution, with carefully calibrated effluent and user charges supplemented by financial assistance for investment in water saving and pollution reduction. Management of the water system is often delegated to private operators, while the community or government retains ownership of equipment and assets. The basic law was strengthened in 1992 to enhance the powers of local communities, establish a unified legal structure, and take into account new pollutants, especially from agriculture.

How applicable is the French system to other countries’ circumstances? This question is addressed in brief papers by Janusz Kindler for Poland and Roberto Franco for Brazil. Both of these papers argue that the French model, with its emphases on stakeholder participation in decisionmaking, public-private partnerships,

river basin focus, and the use of a heterogeneous package of regulations and incentives for quality and quantity control, is potentially strongly applicable to their countries, although both papers note the political obstacles to introducing such systems.

A paper by Shams ul Mulk describes the evolution of water management in Pakistan. As in France a major change in water policy occurred in the early 1960s, although for different reasons. In Pakistan it is the growing demand from irrigated agriculture that has dominated water policy. Beginning in the 1960s, green revolution technologies, combined with increased irrigation and chemical inputs, offered fourfold increases in wheat and rice yields. The Water and Power Development Authority (WAPDA) had the task of preparing comprehensive water plans and undertaking a massive series of investments in irrigation and power generation. While this system has been remarkably successful in enabling dramatic increases in food production, weaknesses—including weak financial sustainability, inadequate participation of beneficiaries in project design and maintenance, poor inter-provincial water allocation mechanisms, and inadequate attention to the ecological functions of water—have needed to be addressed in subsequent laws and policies.

Two brief papers assess the relevance of the Pakistan experience to Egypt (Mahmoud Abu-Zeid) and to Mexico (Fernando Villarreal). Both note a good deal of similarity in the piecemeal development of policymaking in Pakistan, whereby the early push for investments in agricultural growth is followed by a recognition that it could have been done better, and a growing awareness of the importance of financial, environmental, and social sustainability of water management. A final “round-up” paper by David Kinnersley notes that a common thread to the papers on water might be titled “towards a new coherence,” whereby technical expertise in the design of water systems is supplemented by environmental and social expertise. He identifies the two factors that most seem to separate the newer, more sustainable approaches from the older crisis-ridden approaches as involvement of local stakeholders and a pricing system that reflects water’s true scarcity.

The Road Ahead

The volume ends with a series of statements made during the roundtable that concluded the conference. Participants were asked to assess the prospects for real progress in the coming years and to identify key issues requiring remedial action. The participants, all recognized leaders in the field of sustainable development, included Elizabeth Dowdeswell, Kamal Nath, Kamla Chowdhry, Herman Daly, Saad Ibrahim, James MacNeill, and Mohamed El-Ashry. Ismail Serageldin then made closing remarks. Among the many insights shared, a number of common themes emerged:

- First, while further progress is urgently needed in applying valuation and other techniques, we know enough to take action today. While we need to refine our understanding of sustainable development, we must not allow the intellectual stimulation of the exercise to divert us from the action needed now. As the Zen proverb says, “After enlightenment, the laundry.” In this regard the action stemming from the Rio Earth Summit has been disappointing.
- Second, among the changes needed is the forceful introduction of environmental values into the everyday incentives facing citizens, corporations, and policymakers. Charges, taxes, and national income accounting need to reflect scarcity values of environmental and natural resources. As we strive to refine our estimates of these values, the perfect should not be the enemy of the good.
- Third, while Rio brought the North and South together in an agreement of potentially historic consequence, it is clear that real progress will require much more “active listening” between and among nations. The agendas of rich and poor nations are not identical, and the trade-offs as well as the complementarities between economic growth and environmental protection need to be carefully weighed. A recognition of the disproportionate share of the global atmospheric commons enjoyed by industrial countries, and a willingness to pay for it, could be a crucial way of financing investments in developing countries.

- Fourth, progress will require that what may to some seem obstacles to sustainable development be turned into opportunities. For example, the globalization of the world economy, although carrying the prospect of social and environmental damage, also carries prospects for benign technology transfer and the opportunity for introducing principles and policies for environmentally responsible economic development. So, too, even the current shortages of financial resources can be used to lend force to the argument for a new approach.
- Fifth, the social dimension of ESD requires much greater attention. Listening to people is essential for ascertaining their valuation of priorities and for designing solutions that will work. A recognition of the role of societies in managing natural resources and motivating changed behavior is also vital.
- Finally, changing hearts and minds is as important as changing policies. Indeed, it is only through a much deeper appreciation of the urgency of the needs of today's poor and the potential threats facing the citizens of tomorrow that the required policy changes will be formulated, sustained, and enforced. Economic values can help direct the needed change in course, but ethical and moral values must provide the motivation.

Part One

The Road from Rio

Introductory Remarks

Sven Sandström

We all know that environmental issues are complex and that we still have much to learn. At the World Bank we are very aware of the steepness of the learning curve and the importance of listening to and learning from our partners in the field. We hope to make this First International Conference on Environmentally Sustainable Development an annual event and thus benefit from bringing together people from all over the world for an exchange of views. The scheduling of the conference immediately after the World Bank/International Monetary Fund Annual Meetings is quite deliberate. Our hope is that many of the economic and finance officials attending the meetings will be tempted to stay on and participate in the important topics that will be debated here.

The World Bank is first and foremost a development institution, but experience has taught us that development that does not safeguard the environment will surely fail over the longer term. Equally, programs for environmental protection that exclude development also will fail.

The main message of *World Development Report 1992* was that promoting development and protecting the environment are mutually reinforcing—with many “win-win” links between the two. This was also the main message of the Earth Summit.

Working with our partners, the Bank has been following up on the consensus reached in Rio and moving from words to action. For example: environmental assessment is now integral to the preparation and the implementation of all the projects that we finance; lending for environmental purposes is the fastest growing segment of our portfolio, amounting to \$2 billion during

our 1993 fiscal year; we are assisting all our poorest member countries with the design and implementation of national environmental action plans (NEAPs); and we are working with the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP) to address international issues through our strong support for the Global Environment Facility (GEF). In short, environmentally sustainable development is being mainstreamed into the Bank’s overall work on poverty reduction.

Our newly created Vice Presidency for Environmentally Sustainable Development is building up our stock of skills and expertise, and at the same time ensuring two-way communication with our colleagues outside the Bank. This conference is an important part of the dialogue. Its main objectives are to:

- Provide a forum for a candid exchange of ideas among environmentalists, economists, social scientists, policymakers, and others on environmental strategies
- Take stock of where we stand a year after Rio
- Raise awareness and focus on priorities in line with Agenda 21
- Enable Bank staff to interact and listen to our colleagues in other organizations and to share lessons of experience and best practice.

The bottom line is not only to identify ways in which the Bank’s work can more effectively promote sustainability but also to improve understanding among the groups who make up the environmental community. Given the magnitude and complexity of the environmental challenge, *partnership* is the key to progress—and this conference is an important step in that direction.

The Rio Earth Summit: A Year Beyond

Nitin Desai

Let me try to place Rio in perspective. Many of us share the concern that the drive and dynamism that was shown in Rio seems to be dissipating, that actions to implement what was agreed in Rio have not materialized. This may partially be a natural reaction to the fact that we are switching modes from focusing on policy development to focusing on policy implementation. Reviewing policy implementation can never be quite as exciting and attention-getting as developing agreements among diverse nations.

But there is more to it. First, we should understand what the Rio process was because, in my view, process is as important as product. Rio was, above all, a *consensus-building process*. Consensus-building among *governments* was the most important element, and getting that consensus—on a program of action for sustainable development, Agenda 21; the Rio Declaration; the Climate Change and Biodiversity Conventions, which were signed at Rio—was the centerpiece of that process.

However, Rio was much more than that, which is why it attracted attention. It also involved the process of consensus-building in the *scientific community*. We would not have had the climate change treaty without the parallel process of consensus-building through the Intergovernmental Panel on Climate Change (IPCC) process. A similar process operated for the Biodiversity Convention and Agenda 21.

Rio was also a consensus-building exercise among the *non-state actors* important in determining production and consumption decisions: business groups, trade unions, local authorities,

and farmers. A variety of processes led not just to a statement of demands from such interest groups and governments but to what is much more interesting: commitments by these groups on what they need to do to pursue sustainable development: a business charter, the trade unions' statement, and the statement that came from the Farmers' Association in Reykjavik, the local authorities, and others.

Finally, Rio was a consensus-building process among *nongovernmental organizations (NGOs)* and *activist groups*. It is essentially because of the activities of NGOs, who represent the common interest at the field, national, and international levels, that this issue is on the political and decisionmaking agenda. These groups saw the Rio process as a vehicle to push the ideas and agendas that they had been pursuing, sometimes in the wilderness, for many years. One of the most interesting and exciting things about the NGO process in Rio was how soon even the activist NGO groups switched from focusing attention only on what they wanted others to do to what they themselves ought to be doing.

The end product of this process, Agenda 21, is a vast sprawling program of action with 40 chapters, 115 program areas, and 2,500 activities. We can group what governments talked about and agreed around a few major themes.

1. One set of themes came from the classical environmental agenda: management of toxic chemicals, hazardous wastes, and pollution management. This set was understandable as an extension of an agenda that had been started much earlier in Stockholm and pur-

sued by the United Nations Environment Programme (UNEP) and others. Rio must be seen as accelerating global action on common environmental problems.

2. The hallmark of Rio is that it *injected development into the environmental debate*, development not in a simplified, purely conceptual sense but in terms of programs: for sustainable agriculture, human settlements, cleaner production technologies, and fresh water.

We subsequently did an exercise in which we asked a group of people to look through the programs of Rio and label them as developmental or environmental. Except for a handful of programs that were clearly environmental, the group could not agree on whether any particular program could be labeled clearly developmental or clearly environmental. This was the success of Rio: the extent to which it tried to integrate a classical developmental agenda with a classical environmental agenda.

For example, Rio is not just a general call to address poverty. Rio and Agenda 21 attempted to integrate two different strands of developmental action. One strand focused on resources and the programs for water, resource, and land management. The other strand delivered assistance to poor households to help them improve their livelihoods. Both strands have existed for a long time in developmental programs. Agenda 21 attempted to link these two programs by saying that if there is a program for rangeland management in Africa, include in it a component that also takes into account the Masai herdsmen and their livelihood. If there is a program for decertification management in the Sahara, then include in it the nomads who depend on the resources of that desert for their livelihood. Conversely, if we target antipoverty programs, include in them a resource management component. This attempt to integrate developmental and environmental concerns is clear, for instance, in Agenda 21's discussion of forests and fresh water.

3. Another characteristic of Agenda 21 is that it addresses *the means of implementation*. The two key issues are finance—providing assistance to developing countries to implement the commitments which were included in Agenda 21—and *technology transfer*.

Where do we stand on these issues? Concerning the narrow, purely environmental objectives

of Rio, progress continues. We continue to make progress in the climate negotiations, the biodiversity negotiations, and even in the Basel Convention on Hazardous Wastes. I am very hopeful that we will have a strong process on chemical safety. In these areas Rio has helped expedite actions that were underway and to secure commitment.

Although it is perhaps not an area of major concern, I do not yet see a real commitment to pursue the other programs dealt with in the Rio process that “appear” to concern national problems. An artificial distinction sometimes is made between national and global issues. Is forestry a national issue? A global issue? Is land management a national issue, a global issue?

In addition, little has happened regarding the commitments to implement the programs that dealt with objectives that are not purely environmental but that include a developmental component. These are the programs that deal with the critical issues relating to sustainability of consumption patterns; poverty; population; and land, water, and forest resources in developing countries.

I am not saying that nothing has begun. In the four ecologically fragile areas identified in Agenda 21—countries prone to decertification and drought, small island countries, coastal areas, and mountain areas—strong processes for action have begun in the first two. These processes could crystalize many Agenda 21 commitments regarding land, water, and forest resource management problems.

There is also a lack of precision and clarity in the pursuit of one dimension of the means of implementation: what was called technology transfer, but which we now are thinking of in a more complete way as including education, training, public awareness, technology development and transfer, and science. All of these are essential interventions in addressing the capacity of individuals, communities, and countries to cope with the problems of sustainable development. There is some movement in these areas, but much more will have to be done to give practical expression to the commitments made at Rio.

I come finally to the issue of finance, perhaps for many countries one of the greatest disappointments of all. This issue took a long time to negotiate at Rio, but the commitments have not come

forth. The picture for development assistance is bleak. Fortunately, the reform of the Global Environment Facility (GEF) is underway and should be completed by December. But finance is partly tied to the lack of commitment on supporting sustainable development projects and programs in developing countries. Looking ahead a year or two, if I were to come back to this conference and have to repeat what I just said, we would have lost the opportunity that Rio presented. We still have time, and I do hope that specific financial commitments will be forthcoming.

Rio was essentially a political exercise. People describe Agenda 21 as a road map, but it is a road map with great uncharted territory around the roads. It was not an attempt to explore intellectual frontiers. It was an attempt to push the political limits of agreement, in which it succeeded. Conferences such as this one can play an important role in filling out that uncharted territory, which we will need to do if we are going to translate the commitments of Rio into action, on both the programmatic and the finance sides.

It would be invidious of me to suggest the priorities for action, but I will mention two that strike me, as a former practitioner of the not-very-reputable art of economy-wide planning. The first is the way we look at *sectoral planning*. We have inherited approaches to sectoral planning that are very product-oriented: special programs for rice, for fertilizer development, for pesticides. We have lost a focus on the area, the ecosystem, the region, the farm. For this reason we end up with agricultural projects that fight the local climate or local topography rather than working with them. Sectoral planning is one

example of an area in which we need a dramatic shift in the way in the way we integrate projects, programs, and plans at the field level. Much more work needs to be done in methods of sectoral planning for land, water, forest management, human settlement management, and for industrial management.

The second, related area is the *methods or policy instruments* to realize these objectives. Plans are not implemented directly. A good agricultural plan for an area will not get implemented simply by drawing up that plan. Governments do not own that land. Governments do not take decisions on what to do with the land. Many here—pioneers like David Pearce, Partha Dasgupta, Robert Repetto—have worked in this area. We need to develop specific proposals on taxes, fees, and charges, and on ownership and property structures. These changes are necessary to give more practical expression to what has been stated in Agenda 21 about sustainable agriculture, forests, and human settlements.

I want to mention *expanding the boundaries of our analysis*. We tend to think as economists, scientists, or technicians, but increasingly we feel the need to integrate these disciplines. We need people, for instance, in the area of climate change who have enough science to be able to talk about carbon cycles, enough engineering to be able to talk of energy efficiency, and enough economics to talk about energy taxes. Where are such people? Where are the research programs that bring together such groups for this purpose?

I welcome the initiative of this conference and look forward to substantial contributions from it to fill out the uncharted areas in Agenda 21.

Promoting Sustainable Development: Toward a New Paradigm

Ismail Serageldin

It is a privilege to be here with you at the First Annual International Conference on Environmentally Sustainable Development to discuss the most pressing issues of our time, namely, how humanity will have to reassess its development practices to promote the well-being of the disadvantaged, the weak, and the poor while respecting the limits of our ecosystem, both as provider of materials and as sink for the wastes of production.¹

The starting point of my discussion will be the consensus around environmentally sustainable development that was dramatically manifested at the Rio Earth Summit in 1992. My remarks therefore will be in two parts.

First, I will sketch out what the Earth Summit in Rio achieved and what the World Bank has been doing since Rio. Second, I will address the more profound issues of the shift in the development paradigm with which we are grappling to give meaning and substance to the idea of Environmentally Sustainable Development.

Rio and the Ongoing Journey

Rio was very much a process, in which we learned about the interdependence that links us all as co-travellers on Spaceship Earth, and in which we started to define the mutual responsibilities that we all have to one another, to future generations, and to the globe. At Rio people said enough to air pollution, enough to water pollution, enough to the problems of pollution on land that are frequently accompanied by human degradation of unspeakable proportions. Enough of

the destruction of our patrimony of natural resources.

From the World Bank's point of view, however, this does not translate only in terms of the protection of the pristine environment and the conservation of the rare orchid, important as these may be. For us, it is very much about people. It is about recognizing the need to give to people the rights to clean air, clean water, and fertile soils.

Today, such rights are denied to a vast part of humanity.

- One billion people live on less than a dollar day.
- One billion people do not have access to clean water.
- 1.7 billion people have no access to sanitation.
- These three figures together result in two to three million imminently avoidable infant deaths a year.
- 1.3 billion people, mostly in cities in the developing world, are breathing air below the standards considered acceptable by the World Health Organization.
- Seven hundred million people, mostly women and children, suffer from indoor air pollution due to biomass burning stoves that is equivalent to smoking three packs of cigarettes a day.
- Hundreds of millions of poor farmers have difficulty maintaining the fertility of the soils from which they eke out a meager living.

To this stock of problems, we are adding a flow of new challenges due to population growth that averages 90 million persons a year.

Collectively, this means that, over the coming generation, food production will have to double in ways that are less dependent on pesticides and chemical fertilizers than we experienced in the previous generation. It means that the cities of the developing countries will have to cope with an increase of at least 160 percent over their current sizes. Finally, it means that the management of our natural resources should be done in a much more thoughtful fashion than that practiced to date, which led to the ravages and despoliation with which we are all familiar.

Against this set of current and future challenges, we, the citizens of the earth, have three major pieces of international legislation as references: the Climate Change Convention, the Biodiversity Convention, and the Montreal Protocol on Ozone. Of these, only the Montreal Protocol is operational with targets and funding. Much remains to be done to bring the other conventions to the same level of implementation, not to mention to tackle the other problems not covered by conventions.

Rio was a major step in achieving these objectives. We can see the beginnings of additional instruments being developed. There was the adoption of the Rio Declaration on Environment and Development. There was the adoption of a framework of principles for a global consensus on forests. There was an agreement to negotiate a desertification convention, and the Global Environment Facility (GEF) was endorsed as an interim funding mechanism for the two Conventions on Climate Change and Biodiversity. And, of course, there was the milestone adoption of Agenda 21 as the framework for global action on the environment and development into the next century. While far from guaranteeing success, or even laying out the global consensus in operational terms, these achievements are milestones that we must take as the starting points for further action if the dreams and the opportunities that seemed so close in Rio are not to disappear from our grasp.

They are milestones along the road that we have traveled together and we must continue to travel together.

One can rightly ask, therefore, what has the World Bank been doing since Rio?

The Bank since Rio: A Fourfold Agenda

Since Rio, and throughout this last year, the World Bank has adopted a fourfold agenda that can be summarized as follows:

1. Assisting our borrowing countries in promoting environmental stewardship
2. Assessing and mitigating any adverse impacts associated with Bank-financed projects
3. Building on the positive synergies between development and the environment
4. Addressing the global environmental challenges.

Promoting Environmental Stewardship

Regarding assisting countries in environmental stewardship, the Bank is helping in the definition of strategies and is providing lending for environmental projects. About \$2 billion were committed last year alone for predominantly environmental projects, bringing the total Bank portfolio of such projects to \$5 billion, up from almost none five years ago. More importantly, the Bank is increasing support to environmental management. This last year we committed \$173 million to support environmental management, bringing our portfolio of environmental management projects and project components financed so far up to about \$500 million. We are also assisting in the expansion and dissemination of knowledge.

But sound environmental stewardship is rooted in sound developmental and environmental strategies, which must be based on properly identifying the right priorities, and these are very much country specific. Is air pollution of a major priority? It depends where. In Mexico City, it certainly is. Look at these stunning statistics: 12,500 deaths per year due to high particulate levels; 11.2 million working days lost; 140,000 children requiring remedial education linked to the lead levels; and 46,000 adults who suffer from hypertension, of whom at least 330 die every year.

So, for Mexico, air pollution is a priority. Thus it is a problem that the Bank is working on with the Mexican authorities, supporting their efforts with a \$280 million loan for dealing with air pollution in Mexico City. But it is not the only priority for Mexico's environmental authorities, and at the last World Bank Annual Meetings held in

September, 1993 in Washington D.C., an important agreement was signed between Mexico and the Bank that provides up to \$1.8 billion in Bank financing for environmental projects over the next three years.

The key point is that environmental priorities will vary from country to country, and the Bank should stand ready to assist each with its particular problems. Beyond air pollution, other forms of pollution could be a major priority in some of the cities of the developing world. There is possibly disposal of toxic wastes in parts of the former Soviet Union. In Niger it could very well be the problem of overgrazing. But whatever it is, the formulation of these strategies, we believe, should be the result of a consultative participatory process in the countries themselves. This is how we hope that the National Environmental Action Plans (NEAPs), which are now being promoted in many countries, will be done.

Assessing and Mitigating Adverse Impacts

The second point of the fourfold agenda is assessing and mitigating adverse impacts where they occur, and that includes environmental and social assessment, as well as economic assessment. The Bank has published much on environmental assessment procedures so I will not go into detail on this point. It is well known and well understood.

Building on "Win-Win" Strategies

Conversely, I would like to dwell on the third point of the fourfold agenda: building synergies between development and the environment. The key is the recognition that proper development helps environmental protection and vice versa. This is the "win-win" strategy. It is, to my mind, the most promising area to focus on. There are two parts to this item of our fourfold agenda: investing in people and promoting the efficient use of resources.

Investing in people is particularly important. Let us recall that it is the poor who suffer the most from environmental degradation, especially women. When drought hits, it is the poor who suffer. Women are responsible for getting water, just as they have to gather fuelwood from farther

and farther afield all the time. The solutions all involve empowering women. This means that investing in people, in human resource development, must pay special attention to girls' education. Girls' education is probably the single most important measure that we can adopt to promote both development and sound environmental policy over time.

Investment in people must also include population programs to recognize the pressure that the global population is putting on all of us, and these must be accompanied by the provision of maternal and infant health care.

The efficient management of resources is the second leg of the win-win strategy. Just how inefficient the current management of resources actually is can be quite striking. Sadly, a large part of this mismanagement is induced by government policy. Energy subsidies in the developing world account for \$230 billion a year. That is four to five times the total volume of Official Development Assistance (ODA) going from the North to the South. That is environmentally unsound, economically unsound, and wasteful of resources that could be going towards other uses.

Likewise, many of the subsidies that exist today are, in fact, for extractive and destructive industries. In the case of logging, for example, average stumpage fees are a fraction of the cost of reforestation. Among African countries sampled in 1988, the best example recouped less than a quarter of the cost of reforestation, while the worst recouped about one percent of the cost. So subsidies were going to private loggers whereas, in fact, the full restitution to the public commons was not taking place.

Addressing Global Challenges

The fourth point of our fourfold agenda is addressing global challenges. We have to recognize that *national activities do have global payoffs* and that this is an area in which much can be done to promote the global agenda from a national sovereignty decisionmaking framework. There are, of course, global activities recognized as such, and it is for these that special instruments like the *Global Environment Facility (GEF)* have a special and crucial role to play.

Among these national activities that have global payoffs is the use of renewable energy sources such as solar or wind and the recycling of waste. All of these are local activities that have a profound global impact.

On the global side, the GEF has been designated as the interim funding mechanism for the Climate Change and Biodiversity Conventions. It is also likely to come into its own as a promising instrument of international cooperation, prefiguring the international cooperation between the North and the South and the intensive collaboration of the different agencies of the UN system. Clearly, the current negotiations for the replenishment of the GEF will be arduous, and many issues remain to sort out, but with goodwill and dedication it is the fervent hope of all concerned that these will be fruitfully concluded in the near future.

However, when talking of global issues, we must go beyond those covered by the GEF or the current conventions. We should also address the *population* issue. I do not think that we can envisage a world population growing at the current rate without serious strains to the links between people and their environment, not to mention problems of carrying capacity in some ecosystems. Yet, whichever scenario we choose—either the base case scenario or the rapid decline scenario—we seem to be destined to have at least ten billion people on the globe, almost twice as many as we now have today, by the end of the next century. And the great bulk of these new billions of people, will be in the developing countries.

Beyond the numbers, there are issues related to population dynamics. In the developing world, we are talking about new household formation. People will be coming into age groups that will be demanding jobs in the marketplace, generating economic activity, and creating more stresses on the environment already affected by the patterns of settlement and activities of a rapidly expanding population. Therefore, coping with the root causes of high fertility becomes absolutely essential. I will say again that the only way that we will have a major impact on these issues is through the empowerment of women at the grassroots.

In parallel to talking about these global population challenges, we have to talk about *consumption*; and if we talk about consumption, we must

address the disparities between the North and the South. It is important to remind ourselves, as the UNDP's 1993 *Human Development Report* did so eloquently in the now-famous "champagne glass" graph, that the richest 20 percent of the world receive about 83 percent of the world's income. The poorest 20 percent of the world receive 1.4 percent. This is a huge disparity, both in consumption patterns and in pollution. For the average of the poorer 80 percent (not just the poorest 20 percent) versus the average of the richest 20 percent, the figures are the following. The average person in the South consumes about 70 percent of the calories, 58 percent of the proteins, one-third of the fat, and about 6 percent of the paper, 9 percent of the steel, and 8 percent of the energy, that the average person in the North consumes.

This means that energy consumption is twelve times as high for each person in the North as for each person in the South. What this argues for is not just sound strategies for people in the South, but certainly for looking again at the consumption patterns in the North. I do not necessarily mean going back to the horse and buggy days. Switzerland, which by no stretch of the imagination is a deprived country, has a per capita water consumption that is about one-fifth of the United States. On energy consumption levels, the difference between Switzerland, or Japan for that matter, and the United States is also about one-half. The per capita consumption of energy in Brazil, China, Costa Rica, or India is a very small fraction of that. The per capita consumption issues must be looked at as well, and these argue for changes in the patterns of the North as much as they argue for sound practices in the South.

If we think in terms of the global commons, and the contribution on the debit side, in terms of *pollution* and the use of the environment as a "sink," contribution in terms of CO₂ emissions, or in terms of global waste production and pollution, then, of course, the disparities are also very large. India's per capita contribution of average annual tons of carbon emitted into the atmosphere is very small compared to Canada or the United States, and this is true of most developing countries, except for the former Soviet Union, where levels are relatively high because of the nature of their industrial activities.

Such disparities would encourage us to think in terms of tradable permits. Low income coun-

tries with a large population could trade permits based on proportional population rights to use environmental services (both to consume and to pollute) with some of the richer countries. While this is not currently on the agenda of international negotiations, there is something there for us to reflect on.

Equipping Ourselves for the Task

To build capacity to deal with this fourfold agenda, we are seeking to equip the Bank better in terms of staffing as well as procedures. But more importantly, we are trying to cooperate with the international community, international agencies, bilateral agencies, governments, NGOs, and academicians, to enhance our understanding of the issues, improve the quality of our work, share our experiences, and enable us collectively to do better for all of us everywhere.

Beyond the Tasks—A Paradigm Shift

But what we are really concerned with is not simply how many dollars have been provided in this last year, but how we understand the shift that is beginning in the way in which we deal with the business of development. In this sense, I would like to go back to *defining Environmentally Sustainable Development (ESD)* for the Bank and for all of us who are working at this task at the World Bank.

We all start, I think, like everyone else, with the Brundtland Commission's definition, which is that sustainable development is development that meets the needs of the present without jeopardizing the ability of future generations to meet their own needs. As the Brundtland Commission recognized, we have a question about the issue of needs. Needs are fairly straightforward when we are talking about the people who live on less than a dollar day and who have no access to clean water. Needs are less clear when we are talking about the household with three cars, four televisions, and two VCRs. These households obviously also have needs, but the extent of what these "needs" comprise is not clear, and the definition of needs is not as sharp and clear as it was in discussing the poorest of the poor.

Second, the issue of technology and social organization becomes important if we are con-

cerned about an operational definition to guide individual investment decisions.

For us at the World Bank, the idea of Environmentally Sustainable Development (ESD) finds its expression in a triangle, which, not by coincidence, is also the logo for the ESD Vice-Presidency.

This triangle recognizes that whatever we are talking about in terms of sustainability has to be economically and financially sustainable in terms of growth, capital maintenance, and efficiency of use of resources and investments.

But it also has to be ecologically sustainable, and here we mean ecosystem integrity; carrying capacity; and protection of species, biodiversity, and natural resources. Ecological sustainability is the domain of the biologist, the physicist, and the chemist, not so much that of the economist and the financier. The units of measurement are different, the constructs are different, and the reasoning is different.

However, equally important is the social side, and here we mean equity, social mobility, social cohesion, participation, empowerment, cultural identity, and institutional development. The social dimension is the domain of the sociologist, the anthropologist, and the political scientist. It is, to my mind, an essential part of the definition of sustainability, because, let me remind you, the neglect of that side leads to institutions that are incapable of responding to the needs of society. In such cases, societies become dysfunctional and are incapable of mediating internal disputes and claims of different social actors. In extreme cases, societies disintegrate, as we have seen in Somalia, in the former Soviet Union, in the former Yugoslavia, and in Zaire. In such circumstances, when societies have neglected that social part of developmental sustainability, there is no possibility of talking about either environmental protection or sound economic development. This social issue is one that I will come back to more than once.

The World Bank is known as an economic institution; therefore an economic outlook is likely to be confronted when addressing the non-economic issues. Here it is important to highlight the limitations of such an approach and to give the non-economic disciplines their due. For even if you look at the same triangle, now with the eyes of the economist, and we reduce the economic

objective to growth and efficiency, the ecological objective to natural resource management, and the social objective to reduction of poverty in terms of some number of people below a poverty line and equity in terms of income distribution—even this reductionist view poses problems. On the link between the economic and social objective lies some of the most controversial parts of current economic policy: targeted interventions, income distribution, employment generation, subsidies. On the economic-ecological link lies some of the most recent, cutting edge work being done by the people who will be addressing the session on environmental assessment, valuation of natural resources, internalization of externalities, and time and discount rates.

It is most appropriate, therefore, that our first concerns in dealing with the ecological-economic link should address national income accounts, time and discount rates, uncertainty and risk, and internalizing externalities.

I emphasize on national income accounts because they have been given an undue attention in many international discussions. They are important, but they are only one measurement of reality, and a fairly faulty one. As they now stand, national income accounts give no value to a forest standing up. If it gets cut down, it contributes to national income accounts. But we at the World Bank, with colleagues elsewhere, have made a significant effort to try to introduce *environmentally adjusted* national income accounts.

Two key studies were made, one for Mexico, one for Papua New Guinea (PNG). The PNG study is particularly relevant in the sense that if we go from a GDP set at a hundred in the conventional way, through various rounds of adjustments, to a net environmentally adjusted domestic product it turns out to be 84. That difference of 16 points is relevant because for four out of the five years for which this calculation was made, local consumption was significantly higher than that 84, which may imply that national natural capital was being depleted and counted as an income stream. It may or may not have been the case, but it clearly calls for more thorough analysis.

Whatever the real story is, I would like to point out that what we have now is inadequate, and that whatever we do, no single number will be sufficient. We may have to look at wealth accounting as well as income accounting. We may have to

look at physical accounting, as Karl-Göran Mäler and others have advocated, stock and flow analysis as well, but we surely cannot capture everything and boil it down to a single number, no matter which methodology will be adopted, and it would be a mistake to try to do so.

As we move “from policy to practice,” we must bring to bear that holistic viewpoint to look at the way of dealing with different issues: water, land, air, species. Take the issue of water. Water has to be recognized both as a basic need and a scarce resource. Water is now looked at in a fragmented way—by agriculturists as irrigation, by people in the municipalities as water supply and sanitation, by environmentalists in terms of water quality and natural resources. This fragmented set of views has led to an inadequate management of water resources and to scarcity of clean water in locations of need as well as to pollution and degradation of natural river systems.

Again, these shortfalls primarily affect the poor, who have no access to clean water. It impacts also on sanitation, both as an input and an output. We need to change this fragmented way of dealing with the problem, to think of water systems holistically, to think of entire river basins such as the Indus River or the Nile, to think about how to manage this scarce resource in an effective way to be able to plant the trees of tomorrow, to efficiently irrigate the crops of tomorrow, and to provide treated water to all so that the next generation will have access to clean water for all their lives.

The Social Dimension: Putting People First

But let me return to that famous triangle, that triangle which is our logo, because I believe that in all of the intense discussions on water or other issues, we do not pay enough attention to the social side. I would like to address the social side today because, for me, the social dimension, putting people first, has to be at the heart and the core of any developmental activity. There is no possibility of dealing with environmental issues without addressing the social dimension.

By social I mean focusing on the well-being and empowerment of people. Take, for example, the issue of *indigenous peoples*. Nineteen hundred and ninety-three was the United Nations International Year of the World’s Indigenous

People. We tend to think of indigenous people as living in harmony with nature, but the fact is that in many countries they tend to be oppressed minorities. They tend to have problems of land tenure, they tend to live in massive poverty, and we must dare to address the aspects of their reality, not just the cultural aspects, important as these are. We must recognize that their culture enriches us all but that at the same time they need to be empowered to live the kind of decent life that we take for granted.

When we talk about social issues, we must, of course, go back to the issue of *the role of women*. No matter how many times we say it, it is not enough because certainly not enough is being done. Women in many parts of the developing world are not receiving adequate education and are being massively discriminated against. Amartya Sen, stunned us all with an essay that he called "More Than 100 Million Women Are Missing!"² By calculating the human cost of discrimination against the girl child, it was found that, in fact, 100 million young girls had died in infancy due to inadequate care vis-a-vis boys.

We have to empower women, both by educating them and by giving them access to assets, credit, and other tools of increasing the returns on their labor as has been done by several organizations such as the Grameen Bank.

Education, again, remains the tool that over time will be the most essential instrument of change. Not surprisingly, we have found that education of girls correlates closely with civil liberties in society. Therefore, the structure of civil liberties will become particularly important in promoting the social side of the triangle.

This brings me to the core of what I have to say about the issues of social development: the issue of *empowerment*. Empowerment is to reach the poor and the marginalized of society: the poor farmers who live on marginal land or small-holder agriculture throughout the world, the unemployed and the dispossessed among the urban poor, the mother and child among the poor. It is to reach all of them and give them the opportunity to take charge of their own futures, not just to have a say about it but to take charge of their own destinies.

Empowerment is not an abstract notion. It means giving access to assets to those who have no assets, and it means providing access to the ser-

vices—credit, extension, training—that increase the returns to the assets held by the poor, starting with their labor.

That this can be done at the level of the poorest of the poor has been effectively and convincingly demonstrated by several important examples, notably, the Grameen Bank of Bangladesh.

The Grameen Bank serves the needs of the poorest of the poor on this planet. The landless rural women of Bangladesh account for the vast bulk (93 percent) of the bank's approximately 1.5 million borrowers, and they are also its owners. The Grameen Bank lends US\$20 million each month and is working in 32,000 of the 68,000 villages in Bangladesh. The bank provides loans averaging \$100 and enjoys a repayment rate averaging 98 percent—far better than most "development banks" lending to entrepreneurs in the developing countries. The success of the Grameen enterprise is a lesson that the most insurmountable obstacles yield to determination. It is a testimonial to what confidence in the empowerment of the weak and the marginalized can achieve.

Not only do the Grameen borrowers repay their loans, they prosper. One follow-up study has shown that most Grameen borrowers take additional loans after repaying their current loans and improve their income levels by about 35 percent a year. More importantly, the Grameen Bank assists its members in finding self-respect and dignity and in becoming agents of development in their immediate communities. Grameen members adopt a 16-point self- and community-improvement program, which appears to be highly effective. Grameen provides additional services to its members, including some insurance for decent burial and exceptional assistance through mutual support in times of personal or family crises. In an area in which most government programs have failed and in which few NGOs have succeeded in expanding the scale of their operations, Grameen, banker to the poorest of the poor, is a signal success deserving recognition and praise.

Some argue that Grameen's operations, or at least its programs for expanding its network, are not viable without a slight subsidy. Whatever the merits of this argument, one can think of few more deserving avenues for spending public and international funds than supporting Grameen-type operations and other such deserving enterprises.

The Civil Society

How do we relate these issues to the problems of governance and developmental performance, which we intuitively feel are all interrelated? The answer is to look at the problems of the civil society, and its key constituent building blocks, the structures of the civic community.

In a landmark study presented in *Making Democracy Work: Civic Traditions in Modern Italy*, Professor Robert D. Putnam of Harvard University and colleagues have made a convincing case that the existence of civic community is not only the precursor and guarantor of good governance but also the key to sustained socioeconomic development.³

Strong civic community is defined as a preponderance of *voluntary horizontal associations*, in contrast to *hierarchical vertical associations*, and the *density* of these voluntary horizontal institutions, throughout the society. A matrix of voluntary horizontal associations is found in prosperous, rapidly developing northern Italy while the less developed, less effective south of Italy is characterized by autocratic vertical institutions.

But which is cause and which is effect? Does the north of Italy have a dense network of horizontal institutions (choral societies, soccer clubs, parent-teacher associations) because it is rich and can afford them? Or is it rich because it has good, responsive government nurtured by long-standing citizen involvement in many such voluntary horizontal institutions? Putnam and his colleagues went back to data from the nineteenth and the beginning of the twentieth centuries, when the socioeconomic structures and levels of development were similar in some northern provinces and some southern provinces but the horizontal and vertical slants of their civic associations were differentiated. They tested the hypotheses as to what best explained the observed socioeconomic structures and civic institutional structures of northern and southern Italy in 1970, when the Italian government abandoned its 100-year-old centralized administration and created twenty virtually identical regional governments, and what would best explain their disparate performance today, twenty years later.

The results of their research are compelling. They indicate that the prevalence of civic com-

munity is a far stronger explanatory variable than the structure of the economy of the regions to predict their institutional performance and socioeconomic development.

It seems clear, therefore, that a strong, dense, horizontally structured civic society of voluntary associations is very likely to promote good governance and nurture sustained socioeconomic performance. Development partners would be well advised to nurture a strong voluntary civic community to promote sustained development over the long term.

What can we do then about this? As development institutions, I think we should support not just development in the broadest sense but *the civil society*.

To promote the civil society, as development institutions, should be willing to promote participation in the operations we finance in the countries where we are engaged in a developmental dialogue with the authorities. Promoting effective participation will promote not only more effective implementation of the operations being financed but also community building among the poor as an instrument of change and as a foundation for the future. This can be done. There are many such community-based organizations or associations that need our support. They are found at the village level, among fishermen's groups, or herders, associations. Sometimes, they are highly organized local development associations, as in the Republic of Yemen, for example. There are endless community possibilities that need to be supported and invigorated.

Governance

In addition, of course, the World Bank as an institution can help in dealing with the framework within which these institutions exist thus raising the overall question of governance. We can promote good governance by promoting transparency, accountability, pluralism, participation, and the rule of law. For between good governance and civic associations, there will be good and responsive institutions. There will be involvement of local communities capable of creating institutions that do not unravel, that do not lead to the loss of that third corner of the triangle, the social dimension.

Toward a New Paradigm

For us, therefore, the issue is not just a matter of nuts and bolts. It is a profound matter of dealing with a paradigm of development. It is a profound matter of recognizing that we should leave behind the dichotomies between development and the environment and think in terms of environmentally sustainable development. This shift is required if there is to be real progress. Progress is always accompanied by paradigm shifts that seem somehow difficult and dangerous at the time that they are envisaged. We need to promote a paradigm shift in the way we think about development, towards thinking holistically about environmentally sustainable development.

We need to do this for the poor and the marginalized of the world. We need to do it for the

women who are carrying the burden of this continuing degradation and discrimination. We need to do it for the future generations for whom we are stewards of this globe, and—dare I say it—we need to do it for Mother Earth herself.

Notes

1. This presentation was supported by a series of slides.

2. Amartya K. Sen, "Women's Survival as a Development Problem" (Comments prepared for the 1700th Stated Meeting of the American Academy of Arts and Sciences, March 8, 1989); Sen, "More Than 100 Million Women Are Missing," *The New York Review of Books* 37 (20) (December 20, 1990): 61-66.

3. Robert D. Putnam (with Robert Leonardi and Raffaella Y. Nanetti), *Making Democracy Work: Civic Traditions in Modern Italy* (Princeton: Princeton University Press, 1993).

Welcoming Remarks

Lewis T. Preston

I have two things to do this evening. The first is to welcome all of you to this conference. Over the last several years, the Bank and almost everybody else has recognized that there can be no development unless it is environmentally sustainable.

This is just not the flavor of the month. The concept of sustainability is integral to everything we are trying to do: poverty reduction, growth, and improving the quality of people's lives.

The Bank's commitment is unequivocal. Lending for environmental purposes is now the fastest growing segment of our operations. And it is a priority concern in all our programs from our new work in the West Bank and Gaza to our more traditional work in Sub-Saharan Africa and South Asia. So we hope this conference can become an annual event. I also hope it can become an important dimension of the Bank's effort to be open, to listen, and to learn. We value your contributions.

My second task tonight is to introduce the conference's keynote speaker, Jacques-Yves Cousteau. I met him for the first time at the Rio conference and like everybody else was captivated by him over a delightful lunch. The phrase "ahead of his time" comes to mind. For more than fifty years, he has been a leading spokesperson for the protection of the global environment and underwater world. Through his numerous books, films, and public appearances, he has been witness, conscience, and catalyst on sustainability issues.

When Ismail Serageldin confessed to me that he was planning this event, he told me he was looking for a keynote speaker who would be recognized the world over for his technical expertise and at the same time would serve as an inspiration to the conference. I said, "Good luck" and told him that finding such a person would not be easy, but he has done it.

The Global Challenge

Jacques-Yves Cousteau

The purpose of my remarks is to stress the positive or negative relationships of the environment today with the principles of market economy, with moral values, with thermodynamics, as well as with biology. What we human beings are all living now, whether we are volunteers or not, is an extraordinary, but exceptionally dangerous, adventure. And we have a very small number of years left to fail or to succeed in providing a sustainable future to our species.

Our life has become an adventure because—as Jean Hamburger, president of the French Academy of Sciences, described so well—after three million years of hazardous existence, “man the victim,” who had no weapons and no protection to survive in very rough natural surrounding and was forced to submit to the harsh laws of the jungle, resented his own precariousness. As soon as he settled in communities and felt safe from all natural dangers, he divorced from nature and decreed his own rules. We wanted to respect individuals. We haughtily refused sickness, premature death, and natural selection that had warranted for 30 million years a quasi-miraculous demographic equilibrium among the innumerable living species. We seek justice, while the story of life was built on the disparity of the chances of each creature.

This breach of contract with natural, proven standards is extremely recent, maybe only 10,000 years old, and was probably at the origin of morals. As Jean Hamburger wrote:

Then, with humans, the spirit blew for the first time—a spirit of revolt against

fundamental biological laws. This rebellion is the essence of man’s destiny; it is the honor of our condition. It gives new meaning to our life, but it is clear that one cannot refuse the norms of life without taking serious risks. The most striking example is the demographic imbalance that we have created: hygiene and medicine, the very expressions of our splendid refusal of our natural, biological situation, have almost tripled the average human life expectancy so that on a planet whose treasures are limited, the population has grown and continues to grow incredibly fast.¹

That explosion is due to the fact that our new set of anti-natural values—generosity, solidarity, pride in our first medical victories over traditional evils—had been enthusiastically applied long before we developed their logical counterpart, birth control. Our lack of synchronism between part and counterpart shows that we have been very slow to understand that our revolutionary new course, replacing harsh natural rules by our own ideals, implied new duties and perils. From victims of nature, we had to become relentless protectors of nature.

We have not yet fully realized that our recent divorce from nature is irreversible. Our ancestors long ago burned the bridges. This implies for modern human beings the overwhelming burden to invent from scratch a behavior that is at the same time biologically acceptable and morally satisfying. Some of these new duties have been

fulfilled already by our democratic world: the abolition of slavery, the Nuremberg Tribunal to judge war criminals, the outcry against racial discrimination, or the founding of the Red Cross. But progress has been made one skirmish at a time without a clear consciousness of the consequences at stake. If we want our precarious endeavor to succeed, we must convince all human beings to participate in our adventure, and we must use urgently, but cautiously, the latest possibilities of science.

Our rejection of the law of the jungle came from our minds, not from our genes. Somehow, in the complex structure of our DNA, is engraved our instinct to submit to the harsh laws and principles that have made the success and diversity of life. The moral laws and principles that we have invented, preferred, and adopted will take a long time to infiltrate our genetic heritage.

We realize now that the subtle trail of our original wildcat nature has been saved, has grown, and finally blossomed in the free market principle, the cornerstone of all our modern economy. The free market economy is by far the most efficient system. The collapse of the Communist world is mainly due to the fact that in the competition between East and West, the liberal economy of the West was much more efficient than the planned economy of the East. However, once the East-West competition is over, a closer look leads to unanswered questions. The triumphant "free economy" has resuscitated natural selection, as merciless in the stock exchange as it is in the jungle, and fierce competition instead of declared mutualism and stimulation.

Market-based economics is primarily concerned with quantifying the flow of goods, services, and money and defines value according to what people are willing to pay for something. This is a receiver-based system of value as contrasted to one that quantifies value according to what was involved in the production of a good or service. If a donor-based value system were used, we would find such things as forests, species, clean water, and education to be of tremendous value. Of course, they *are* of great value even though people are not willing to pay much for them. Clearly, our present economic system of ecological value is flawed.

Economy is described as a circuit. Work and goods, capital and money circulate from enter-

prises to homes so that everyone gets richer. This serves as the principle for all evaluations of economic situations. But economy is *not* a circuit. Non-renewable resources run out while waste piles up. The precious goods vanish while valueless rubbish grows inexorably.

The neoclassical market equilibrium can exist only if the participants are already granted their subsistence, as in a successful agrarian community. But when humans cannot choose between work and leisure, but only between work or starvation, the picture is very different, writes Professor Georgescu-Roegen. In fact, he adds, the real goal of "production" is not the "product;" it is, in fact, an immaterial "fluid," the *joy of living*. And the GNP is nothing else than the "national cost of the joy of living."² We all know that, the earth and its resources being limited, "sustainable" growth is impossible. When, as ecologists, we use the expression "sustainable development," we know that we mean development of quality, not development of quantity. But the neologism lends itself to confusion, and communities in need believe it means that a growing population will someday live like California stars.

Another approach is that, according to the second law of thermodynamics, time and all processes in the real world are irreversible. The reason we still have illusions about "balanced economic circuits" or "balanced market prices" is that, during the past century, gigantic sources of concentrated but exhaustible energy were discovered, and we forget that they are non-renewable. Our type of economy, as our own lives, cannot exist without concentrated energy. Such fatal shortages—I do not want to use the word "entropy" because it is more difficult to do so, that is what it is all about—cannot be cured by manipulating prices. Most of the potential buyers of those raw materials cannot participate because they are not yet born—future generations. Accordingly, today's market prices confirm the dictatorship of present times over the future. A multidisciplinary analysis shows that ecology and economy are difficult to reconcile.

The problem is even more arduous if we include in the picture the *internal* environment of humans. The environment must not be considered as just the surroundings, the theater set on which we conduct our lives. It encompasses our behavior, our moral code, our traditions, our lan-

guage. Even if we have rejected the Darwinian laws, we remain biological creatures and must listen to a number of warnings from nature. Dr. Peter Raven, the famous director of the Missouri Botanical Garden, is one of the most active apostles of biodiversity—the crucial subject of the Biodiversity Convention signed at the Rio “Earth Summit” Conference and later by the USA. “If we simply allow,” says Raven, “vast numbers of organisms to become extinct, without even trying to learn about their properties, we will not only have foregone the chance to preserve them, but we will never know how we might have used them, appreciated them, loved them or done anything else with them.”³

Thus, biodiversity is a major prerequisite for a sound, sustainable environment. When we speak of biodiversity, we mean diversity of species, of ecosystems, but mainly of genetic diversity, within a species, that guarantees the capability of adaptation. The greater the genetic variability the more robust a species. Equally, the greater the number of species composing an ecosystem—I mean a community—the stronger the ecosystem to resist environmental changes. This powerful natural bond between biodiversity of ecosystems and their capacity to endure adversity is a fundamental postulate, and has recently proven to be dramatic. In the USA, the former Soviet Union, and many other countries, ambitious, gigantic farms adopted single species agronomy to improve efficiency, but they harvested famines instead. There are plenty of examples. A few are the monoculture of citrus in Florida in 1984 and in Brazil in 1991, and the monoculture of corn of in the USA in 1970 and in USSR in 1972.

If each species depends on several others, each will easily survive the disappearance of one. Moreover, the greater the number of species, the easier it will be for us to select a variety that will adapt to an environmental disaster, such as a climatic change. In summary, the greater number of species, the stronger the ecosystem.

The theorem of biodiversity applies not only to ecosystems but also to concepts, such as literary, musical, and artistic concepts. The multiplicity and differences of and between cultures are the essential factors in the robustness of our civilization. This is even more important as we have seen how our irreversible divorce from nature has weakened our own future. What we call

“primitive” cultures have been the first to suffer the consequences of the arrogance and the pursuit of hegemony that has motivated history since antiquity.

Today, science has demonstrated that the multiplicity and variety of cultures, whether primitive or sophisticated, constitute the irreplaceable treasure of humankind. But Sumer, Egypt, Mongolia, Greece, Rome, and many other super-states, enraptured by their own might, have laboriously destroyed a few powerful civilizations and crushed hundreds of more modest cultures, thus impoverishing our patrimony forever.

It is commonplace for developing countries to state that modern colonialism has replaced guns with money. It could be said with total plausibility that if cultural hegemony were sought, it is modern media that would replace guns—with the “innocent” help of money. I say “innocent” in spite of the countercurrent character that money acquires when it becomes a source of power and speculation instead of playing the role of irreplaceable tool for exchanges. I also say “innocent” because the economic aspect of cultural colonization is totally irrelevant. We need cultural freedom as we need the air we breathe, a symbol of liberty we refuse to buy. We need cultural diversity as we need gastronomies, unintelligible languages, freedom, and democracy. We need time, not only to produce but also to think, to create, and to enjoy life.

But the protection of cultures goes well beyond a platonic declaration of intentions, well beyond a derisory communication skirmish between Goliath and David symbolizing images against words, the “me” generation against mutualism, competition against stimulation. Whatever marks these ripples have left in history, we now have to make sure that there will be an awakening of global public opinion to save the mixed borders and the flowering profusion of our motley cultural jungle. We have not yet reached such levels of thinking.

In the course of my adventurous life, I have been witness to many cultural shipwrecks. Most of these tragedies resulted from the confrontation of two peoples, two different ways of living, one of them unilaterally declaring its superiority. But the means used as criminal weapons varied greatly.

When my ship “Calypso” arrived in Terra del Fuego in 1972, we investigated the Fuegian

Indians of the island named Onas. There was only one woman left, aged 82. All other Onas had been chased with guns as if they were game. The pretext? Darwin himself had written that the Onas were closer to animals than to men.

In Chile in 1973, we studied the remaining 37 Kawashkiar Indians. Fifteen years later, there were none left. They had been employed as miners and had been unable to adapt. The Niassi, a war-like people, were living on the island of Nias, west of Sumatra. We anchored in the Bay of Lagundi and found colorless citizens of Indonesia: they had kept no memory of their ancestral culture. The elders had erected monuments of stone to leave a trace of their passage so that they would not be forgotten, but one century ago, their chief had been converted to Protestantism and most of their legacy had been eradicated. The missionaries had annihilated the Niassi way of life faster and more completely than centuries of war.

In Brazil, the Yanomami are now persecuted and slaughtered just because gold has been found in their traditional province. The Mentawai from the Indonesian island of Siberut, still proud of their independent way of life, are threatened by a more unexpected and insidious menace, a menace we always considered a blessing—education—which in this case consists of replacing a weak culture by a strong one and which, while it impoverishes our global civilization, instills new blood in a people who would have been eliminated anyway in a few decades.

Finally, the most significant example for the rest of the world is the self-genocide of the Pascuans, a tribe of Polynesians who had settled in 700 A.D. on small Easter Island and proliferated, in 900 years, from 200 people to 70,000 people, succumbing to a total lack of resources due to overpopulation.

These examples of cultural waste teach us a lesson. We have only one way to keep our proud

civilization flourishing: we must protect its diversity. We must refuse to see patrimonies sold off as consumer products.

The goal of civilization is to ensure to all a certain “quality of life” adorned by a fundamental “joy of living.” As democracy implies sharing, one of our priorities is to improve the fate of the least favored people (about three-fifths of the world population). But the individual share of the pie will, to a certain unknown extent, shrink while the population grows.

The riddle is so complex that it cannot be solved by sheer economics nor by ecology, genetics, moral values, thermodynamics, biological nor cultural diversity. More than ever before, the World Bank, the International Monetary Fund, United Nations Development Program, and the UN Commission for Sustainable Development are confronted by such problems as: How should we share our limited environment between humankind needing more and more space (if only to survive) and another indispensable community named wildlife? Questions of that sort underline inevitable dilemmas about the limited but unknown habitability of the sphere we live on.

The carrying capacity of planet Earth varies greatly even if its limits are fixed forever. Its value should be calculated, but we would need an extremely complicated equation with many variables while these variables inter-react according to specific but constantly changing rules. We must not be discouraged by such complexities.

Our hopeless calculations can be simplified by the use of common sense, goodwill, and love.

Notes

1. Jean Hamburger, *L'Aventure humaine (The Human Adventure)*. No citation available.

2. Economist Nicholas Georgescu-Roegen. No citation available.

3. Peter Raven, personal communication.

Implementing Sustainable Development: The Green Belt Movement

Wangari Maathai

The initial idea of the Green Belt Movement was conceived in 1974 in Nairobi, Kenya, during a political campaign for a partner who was seeking to represent Nairobi's Lang'ata constituency in Parliament.

In the course of that political campaign it became obvious to me that constituents were committed to candidates who could dish free funds to them, promise jobs and easy access to the national resources, promise cheaper essential commodities, and generally demonstrate a capacity to give—rather than create an enabling environment for—a better quality of life. The constituents were not thinking of creating jobs for themselves but of being given jobs. However, the only way they could get those jobs would be to sack somebody else! This thinking is encouraged by leaders and constituents alike and makes it possible for many politicians to practice nepotism, tribalism, and corruption. To bribe the voters, leaders turn to misuse of the national resources like allocation of forests areas, wetlands, and catchment areas. That is hardly the way to promote sustainable development and protect the environment.

Environmental education is necessary and should be given to both leaders and citizens. The poorer the people, the more they put their hope in their leaders rather than in themselves. Most of the people from whom votes were being solicited were from sprawling Nairobi slums, where such attitudes are prevalent. Now, twenty years later, voters are still being bribed to vote for candidates who are opportunists and are unlikely to promote democratic principles and practices like

honesty, accountability, transparency, and responsibility. It is leaders with such qualities who are more likely to create an enabling environment that could address the issue of urban poverty and unemployment. But populations change slowly and tend to live for now. In our part of the world they tend to vote for leaders who have encouraged dictatorship. Under such leadership it is difficult to promote protection of the environment.

The Cold War rivalries made it easier for this form of governance to flourish in many parts of the world, especially on the African continent. Therefore, it is important to examine the type of relations and cooperations that should emerge in the post-Cold War period. What type of development will be adopted? It is the right time for the World Bank to address the issue of valuing the environment even as countries pursue development.

To respond to the question of how valuable is the environment, I would like to use the example of the Green Belt Movement. Is the Movement an environment and development organization, or it a political and a subversive movement?

During those days of looking for votes, I developed a personal commitment to those who had assisted my team. I knew that the expected reward for those supporters was jobs. But I also knew that there were no employment opportunities that could satisfy the demand. One day an idea came to mind: Why not create employment for them by planting trees? It took time to develop the activity, but it worked, and the Green Belt Movement eventually was born out of this idea. This was, of

course, not politics but development. The reason it attracted attention is that it addressed the *felt needs* of the participating communities.

The political experience I have described is one of several exposures that eventually converged and gave birth to the Green Belt Movement. Another influence had to do with a seminar that I attended that was organized by members of the National Council of Women of Kenya and at which the speaker described causes of malnutrition, illnesses associated with it, and areas in which the condition was prevalent. We were surprised to hear that the diseases were common in areas that had high financial income from cash crops (coffee, tea, pyrethrum, and dairy products), that is, a comparatively affluent community. In such areas one expected to find no malnutrition and associated illnesses. It turned out that one of the reasons for this poor health was that trees had been cut to make way for this high-potential and income-generating agriculture. There was a fuelwood crisis so many lower-income women used agricultural residues to cook. For this reason families opted for fast-cooking and partly processed foods, all of which were rich in carbohydrates and poor in proteins and vitamins. This link between the availability of fuelwood and the choice of diet made me think about women and the possibility of their planting trees so that they could have adequate energy to cook the right kind of food for their families.

We could have chosen to initiate a campaign to educate women about balanced diets and the different types of foodstuffs that they needed to plant and eat, but the choice of a tree planting activity was a good choice at the right time. We chose an activity that made it possible to get to the root cause of the problem, that is, addressed the issue of energy for the poor in the rural areas. The women needed energy more urgently than knowledge! We immediately started contacting rural women's groups. The response was very encouraging. The activity is the very type needed for the protection of the environment. It coincided with the government's declared policy to promote health and the well-being of all its citizens. It was not politics. It was environmentally sound development. The reason women's groups responded so positively was that tree planting was addressing another felt need: the fuelwood crisis!

The campaign to plant trees in large numbers started in earnest in 1977 during the United Nations Conference on Decertification in Nairobi. During those years the Movement purchased tree seedlings from government tree nurseries and gave them free of charge to women to plant on their farms. This was the arrangement partly because the Movement had no tree nurseries of its own but also because tree seedlings were heavily subsidized by the government. However, there was a problem. First, government tree nurseries were so far away that only people who had cars or could afford to hire transport could benefit from that facility. The poor small-scale farmers could not reach the government tree nurseries and waited until an annual tree planting festival during which time most tree seedlings given out died because they were not attended to even if they were planted.

This situation has since improved because tree nurseries were later decentralized and were moved closer to the people. But in those days, many of those seedlings died before they were even given to the farmers to plant. It was clear that farmers wanted to plant trees only if they had them near them. One of the appealing aspects of the Movement was that it took trees to the people. Any person could walk to the tree nursery and take away a few seedlings at a time convenient to her or him.

With the establishment of community tree nurseries, demand for seedlings rose sharply. Long before the government decentralized its afforestation activities, women groups were encouraged to start small tree nurseries that they could operate on their own. Initially, government foresters assisted the women with basic technical knowledge on tree nursery management. The women were very good at adapting the methods they learned from the foresters. They overcame many obstacles including lack of seeds, water, shelter, soils, animals, and the delicate work of handling minute tree seeds and seedlings.

Ever since then, the movement has grown by leaps and bounds, and the women continue to be the main force behind its success. The planting of trees by women is, of course, not politics but development. The government's policy on reforestation in particular and community development in general is that they should be participatory. Taking tree seedlings to the back-

yards of those who do the planting did the trick, and thousands of farmers (men and women) responded by collecting thousands of seedlings from the tree nurseries. The same response came from schools, which planted trees mostly to create windbreaks, provide shade, and keep dust down. All these people were responding because trees met their felt needs.

For women the initial objectives for planting trees was to get firewood and food (fruits), and to provide building and fencing materials, shade, and authentic beauty (some farmers have remarked how even the birds have come back). Tree planting quickly became an honorable activity for men, women, and children. It was not an activity for the rural poor or just for the women. It was now an honorable activity. Happily, some communities were really hungry for seedlings!

The Movement introduced a procedure that a rural community could follow and ensure not only that trees are planted but also that they are tended and that they survive. Tree seedlings were issued to farmers free of charge. This approach made it possible for any farmer to take as many seedlings as she or he was able to plant and take care of. Many small-scale farmers are peasants who practice subsistence agriculture. They are poor. They could never plant the millions of trees the country needs if they had to pay for them. It is in the common interest of the country to give tree seedlings free of charge and to encourage tree planting even by the poor.

The Movement has become very popular with grassroot participants, especially women. However, men are just as enthusiastic and do not see the activity as a woman's work, even though women provide the initiative and the major force. In time men are able to appreciate the economic value of trees as well as the multiple role trees play in the lives of their families. Again, the Movement meets felt needs.

Although farmers get seedlings free of charge, the women who grow them get paid a token of appreciation of about US\$0.40 per seedling that survives on farmers' land. The counting of the surviving seedlings for payment may take months after the seedlings are issued to farmers. That is little money compared to the work that the women do. It is meant to be an encouragement.

Even then many people have a problem with the payment and argue that women should not

be paid for doing what the foresters should have been doing. Instead, such people argue, women should be encouraged to sell their seedlings to the farmers. Our reaction is that since one is dealing with poor rural people, money should be made available, even by the government, to pay the women for the great work which they do. Women appreciate the funds they get and indeed will abandon the tree nurseries if they are not given even that US\$0.40. It should be recognized as an important incentive. Besides, why do people accept to pay foresters with tax money and object to the comparatively small compensation for women who have done such a comparatively superb job? If there is one group that should be commended for effectively carrying out government's policy on community afforestation it is these women's groups.

During the many years that tree planting has been carried out in the countryside, educational seminars have been conducted for the participants so that they can expand the objectives and the scope of the Movement. In the process many people have understood that the environment is the base upon which all other development depends. They now understand that no progress can be made when the environment is neglected, polluted, degraded, and over-exploited. Many people also have come to appreciate that taking care of the environment is not the responsibility only of the government but of the citizens as well. This awareness is empowering and brings the environment close to the people. Only when this happens do people feel and care for the environment.

Many governments and financial institutions like the World Bank have development policies that are expected to take into account the environmental impact of any project undertaken. But many development experts and planners do not take note of regulations that are intended to protect the environment, and the ordinary people. Profits, expediency, and political and corporate interests have taken priority over the environment. National resources are treated as personal properties by some governments and are exploited and destroyed under the pretense that the country is being developed.

A community whose consciousness about the importance of the environment is high will raise concern when sections of the environment are

threatened. On several occasions the Movement has objected to proposed development projects that were being implemented without any environmental impact assessment. The reaction of the politicians has been to condemn the Movement and accuse it of being political, anti-government, and antidevelopment. Citizens entrust their governments with national resources and expect them to institute laws that protect these resources from any form of abuse. Most, if not all, governments have ministries of environment that formulate policies to guide industries and the people on how to meet felt needs without destroying the environment and natural resources. But if governments lack political will to apply laws, regulations, and agreements to which they have subscribed, only an informed and involved community can stand up for the environment and demand development that is sustainable and that is friendly to the environment. This is the reason that environmentalists spend a lot of time and energy either consulting or confronting their governments to protect the environment and promote environmentally friendly development projects.

From the examples above, it is quite obvious that the Movement is not a political organization. Neither are the participants political merely because of their association and active participation in the planting activities of the Movement. Individual citizens may, of course, decide to participate in the politics of their countries. They may decide to associate themselves with specific political parties. I am, for example, closely associated with the political campaign to introduce and nurture a more democratic governance in my country. Such campaigns have been associated with the Forum for the Restoration for Democracy (FORD), the Middle Ground Group (MGG), and the campaign to end the ongoing politically motivated tribal clashes through a pressure group known as the Tribal Clashes Resettlement Volunteer Service (TCR). All these efforts are trying to ensure that the country does not slide back to dictatorship under which it is impossible to protect the environment or to develop as if people matter. Our agenda is the environment and development without destruction. We know that the environment cannot be adequately protected by dictatorial governments. We believe in a transparent government that is accountable and

responsible to those who elect its members in free and fair elections. Such a government is in a position to assist the current generations to meet their needs of the generations to come.

Environmentalists do not make the economic and the political policies that may protect or adversely affect the local or the global environment. Politicians do. We must stay close to them, and monitor their policies, decisions, and actions. If they do the right things, we should applaud them. If their actions threaten life, we must challenge them and demand that justice be done to the environment. Occasionally, the Movement has played that role but has paid a heavy price for it.

How could international cooperation for environmentally sound development be restructured in the future? It all depends on what the North perceives to be the strategic value of the South to the North. What value is Africa, for example, to the North? What trade-offs are worth considering, and are trade and markets the only reasons Africa should be worth working with? Does Africa have a role in a world that is growing more interdependent and that is advocating for a global development strategy?

During the Cold War era, for example, the North made it possible for Africa to accumulate debts it cannot now pay without sacrificing the lives of millions of its people who now live in debilitating poverty. It was expedient not to push friendly countries to pay the debt because of the superpower rivalries. Now that the Cold War is over, will African states be forced to pay those debts no matter what the price in terms of human sacrifice? Or the price to the environment? How can one speak of development under such circumstances? Which values will motivate the North to consider the debts and the consequences of trying to pay them on schedule or even to pay them at all? Problems like migrations, refugees, the escalating internal conflicts, drugs, and diseases like AIDS can be solved only through global cooperation. Some peoples should not be sacrificed so that others can continue to develop. The environment should be valued as much in poor countries as it is valued in rich countries because the environment is a common resource to all human beings. But at the moment is the part of the world that has the capacity to assist willing to cooperate? Will it take advantage of those who need the coopera-

tion? Will it destroy their environment because their environment is of less value?

Of course, as in the past, the North could be motivated by self-interest, particularly for a source of markets. However, a poor South can hardly be a good market. To be a good market, the South has to improve its economic performance and show a capacity to grow and buy from the North. Even from a simplistic viewpoint this would mean that the North would have to assist the South with its debilitating debt and fluctuating commodity prices.

It would also have to assist the South to develop forms of governance that allow citizens to utilize their creative energies more productively and to improve their earning, and therefore purchasing power. In Africa this would also include support for democratization and the creation of instruments that serve the people with justice and truth.

The Green Belt Movement is an effort to raise people's awareness on the need to protect the environment everywhere. It is an effort to empower people to force that agenda at the social, economic, and political levels. It is an effort to make environmentally sound development the agenda for the coming years. It is based on the belief that only the citizens can save the planet, and therefore they must be mobilized and empowered to take their destinies into their own hands. The enemies of the environment are the enemies of the people. The former have political and economic power. They are doing everything to frustrate that vision. But since we are here at the World Bank discussing environmentally sound development, I am convinced that everything changes in time. In the end, the will of the people will win and save the planet. Everything is possible. There are many positive signs in the world. Sustain hope. I am sure that the Bank will think globally but act locally.

Part Two

From Concepts to Policy: How Valuable Is the Environment?

Optimal versus Sustainable Development

Partha Dasgupta

Summary

Popular writings on the environment do not take economics seriously.¹ Often enough, they do not do so even when written by trained economists. Such writings read as though economic analysis is of no use when so profound and pervasive a feature of our lives as the environment is the topic of discourse. In this paper I show that modern economic analysis has for some while provided us with a language in which to discuss the private and social management of environmental resources. In some cases the prescriptions are sharp and precise; in others, they are outlines, but only because of the deep uncertainties we face about the nature of ecological processes and about our own values, not because we do not have a precise language in which to think them through.

The environment is a gigantic capital asset. For this reason the theory of intertemporal economics is the right place for us to begin. I show that the idea of "sustainable development," as it is typically thought of, is far too loose to be of any use. The sharpest formulation of the idea² suffers from the drawback that it is totally anchored to the present: no net accumulation of the overall capital base is recommended (see Section 1). In short, it is foolishly conservative: if an economy happens to be poor in its resource base today, the formulation condemns it to poverty in perpetuity. In contrast, the theory of "optimal development," developed in the 1960s by the late Tjalling Koopmans, among many others, offers us a flexible, but sufficiently disciplined, ethical framework in which we can frame questions regarding

the management of the environmental resource base. The theory is overarching, and it offers us an account of related, but derived notions, such as "social discount rates" (Section 2), "accounting prices" (Sections 4-6), and "net national product" (Section 4), each of which is a necessary concept for as practical a task as the evaluation of projects and policies. This is what makes the theory operational. I show that "social discount rates" are themselves accounting prices, so are devoid of meaning unless the *numeraire* commodity is specified. Thus, there is no contradiction between those who claim that the *well-beings* of future generations ought not to be discounted and those who argue that future *incomes* ought to be discounted at a positive rate. I also show that income discount rates could well be negative if average income is expected to decline over time (Section 2). Recent simulation models of global warming suggest that nothing substantial needs to be done in the near future about greenhouse emissions.³ This conclusion is odious to environmentalists, who feel that this only proves economic analysis to be incapable of capturing essential features of such global problems. I show that these simulation models assume that average incomes will rise continually, even during the periods when global warming is expected to take its toll. This makes positive discounting of even these distant future incomes a defensible move. If, on the other hand, it were to be assumed that future incomes would decline because of global warming (due to agricultural failures, loss of infrastructure, dislocations of people), then these same simulation studies would recommend the

use of negative discount rates on incomes during the periods of decline. This would amplify future income losses and alter the recommendations.

I show that economic analysis alerts us to the fact that in a market environment there are systematic biases towards an excessive use of environmental resources and that this bias runs even into the pattern of technological discoveries and adaptations (Section 5). In short, the market mechanism is “unfriendly” towards the environment unless it is curbed suitably. The theory calls for a need to estimate “accounting prices” (or “shadow prices”) of environmental goods and services; and it simultaneously instructs us to move to a new concept of national product (net of the depletion and degradation of our natural capital stock) for use in the evaluation of projects and policies. The theory also offers a precise account of how net national product ought to be estimated. In Section 4 I summarize the findings.⁴

Introduction

The World Commission on Environment and Development (Brundtland Commission) popularized the phrase *sustainable development* in connection with the use of environmental resources,⁵ and sustainable continues to be the focal point of much of the writings on the environment. Unfortunately, the emerging literature has on several occasions been developed independently of both intertemporal welfare economics and the theory of optimal development, two subjects that have provided us for over twenty-five years with a language for discussing intergenerational justice. In the event, writings on sustainable development often start from scratch, and some proceed to get things hopelessly wrong.

In this paper I shall argue that “sustainability” offers only a guideline, albeit an important guideline, for social policy in a world with manufactured capital and natural resources (Sections 1-2). Paradoxically, sharper prescriptions are obtainable only if we appeal to something wider, namely, a normative criterion that enables us to identify what we may call *optimal development* (Section 2). However, to operationalize the notion of optimal development requires that we understand the related concepts of accounting prices and net national product. Part of my task here will be to see how these ideas hang together (Sections 3-6).

1. Social Objectives, 1: Sustainable Development

Much attention has been given in recent years to defining sustainable development. One early thought—that whatever else it may imply, it must imply non-negative changes in the stock of natural resources (such as soil and soil quality, ground and surface water and their quality, land biomass, water biomass, and the waste-assimilation capacity of the receiving environments)—is a non-starter—not because it is an undesirable goal, but because it is an impossible goal. However, leaving this aside, there is the weakness that the requirement is imposed as a matter of definition on the determinants of well-being (the means of production of well-being), not on well-being itself. Presumably, the focus of concern should be present and future well-being, and methods of determining how well-being is affected by policy.⁶ History, introspection, and experience with analytical models since the early 1960s tell us that reasonable development paths would involve patterns of resource substitution over time, and also of substitutions among resources and various types of capital stocks, including knowledge and skills.

One immediate question that the notion of sustainability raises is this: What should be sustained? The answer that it is current well-being that should be sustained is not coherent because current well-being is not given from outside but is determined by private and public choice. So the thought occurs that it should be *maximum sustainable well-being*.⁷ However, even though it is coherent, this prescription suffers from the weakness that its acceptance would condemn all future generations to the mercy of today’s productive base: the principle recommends that there should be no net accumulation of the base. This is hard to justify on *a priori* grounds if tiny amounts of net accumulation can improve future living standards greatly.⁸

To be sure, a number of authors writing on sustainable development have recognized that the starting point for questions on intergenerational justice ought to be the distribution of well-being over time. But the thought that, barring exhaustible resources, a just distribution of well-being implies that all capital stocks ought to be

preserved retains an emotional pull. For example, elaborating on the notion of sustainable development, von Amsberg writes:

Under [the] guidelines for intergenerational resource distribution, the endowment of every generation would include the sustainable yield of the earth's natural capital plus the benefits from resource depletion of natural capital if adequate compensation is made to future generations....Owning land would only include the right to harvest the sustainable yield of the land while leaving the capital value intact....

The guidelines for intergenerational resource distribution could be implemented through a sustainability constraint... The purpose of the sustainability constraint is to ensure some minimum level of welfare of future generations and a guarantee that a basic stock of natural capital is passed on to the next generation.⁹

Two constraints? No doubt *some* index of natural capital would have to be preserved if a minimum level of welfare for the future is to be guaranteed. Why then introduce it as an additional constraint? Preservation of the index ought to be derivable from the optimization exercise.

A second weakness of the formulation is this: it offers no ethical argument for imposing either of the side constraints. A more general (and intellectually firmer) approach would be to allow future generations' well-beings to be reflected in a function that is defined over the well-beings of all generations. In other words, the idea is to appeal to an aggregate social well-being function. Such a tactic would enable us also to experiment with different degrees of substitutability between different generations' levels of well-being. The demands on the present generation could well be stiffer in this framework than that it be required merely to ensure that some minimum level of well-being is guaranteed for future generations.¹⁰ This point of view was adopted by the late Tjalling Koopmans in his formulation of the problem of intergenerational justice.

2. Social Objectives, 2: Optimal Development, Discount Rates, and Sustainability

In a remarkable set of contributions, Koopmans conducted a number of thought-experiments on intertemporal choice to see the implications of alternative sets of ethical assumptions in plausible worlds.¹¹ Underlying Koopmans's program of research was the premise that no ethical judgment in such abstract exercises as those involving resource-use should be taken as being decisive. We should instead play off one set of ethical assumptions against another within plausible scenarios, see what their implications are for the distribution of well-being, and then appeal to our varied intuitive senses before arguing policy. For example, he showed that we can have no direct intuition about the validity of discounting future well-beings unless we know something concrete about feasible development paths. As the set of feasible paths in a world with an indefinite future is enormously complicated, the reasonable thing would be to work with alternative discount rates on well-being and see what they imply. Although seemingly innocuous, this suggestion represents a radical break with a philosophical tradition, stretching from Ramsey to Parfit that has argued against discounting future well-beings without first having studied its distributional consequences across generations in plausible worlds.¹² That this tradition is otiose was demonstrated by Mirrlees and Chakravarty, who showed that in plausible economic models, not to discount future well-beings could imply that the present generation be asked to save and invest around 50 percent of gross national product.¹³ This is a stiff requirement when GNP is low.

For simplicity of exposition, let us assume that population size is constant over time (t), and that generation t 's well-being is an increasing function of its level of consumption (C_t), which we denote by $W(C_t)$. We assume time to be continuous. Let Γ_C be the set of feasible consumption paths—from the present to the indefinite future—and let Γ_W be the corresponding set of well-being paths. We take it that there is no uncertainty, and that Γ_W is bounded. Imagine that there is an underlying ethical preference ordering defined over Γ_W . Alternative policies are therefore to be evaluated in terms of this ordering. Koopmans showed that under a plausible set of assumptions, this ordering

can be represented by a numerical function (which we may call aggregate well-being possessing the "utilitarian" form):¹⁴

$$\int_0^{\infty} W(C_t) \exp(-\delta t) dt, \text{ where } \delta > 0. \quad (1)$$

Now (1) may look like classical utilitarianism, but it is not. There is nothing in the Koopmans axioms to force a utilitarian interpretation upon W . Moreover, (1) involves discounting future well-beings at a constant rate ($\delta > 0$). In short, positive discounting of well-being is seen to be an implication of a set of ethical axioms that, at face value at least, would appear to have nothing to do with discounting.

When conducting analytical experiments with alternative assumptions embedded in (1), it makes sense to go beyond the Koopmans axioms and allow for consideration the case where $\delta = 0$. It also makes sense to go beyond the axioms and to consider unbounded well-being functions. In this way we are able to test models to see what all this implies for public policy and the choice of discount rates in social cost-benefit analysis. On the other hand, purposeless generality should be avoided. So we will assume that $W(C)$ is strictly concave, to give shape to the idea that intergenerational equity is valued as an ethical goal.

It is as well to begin by noting that discount rates in use in social cost-benefit analysis are "consumption discount rates." In first-best situations, they equal "income discount rates." (They are also sometimes, misleadingly, called "social discount rates," and are different from market interest rates in second-best situations; see below.) If consumption is expected to grow, then the discount rate used in cost-benefit analysis would be positive even if δ were taken to be zero. This follows from the strict concavity of $W(C)$. To see this recall that, in discrete time the consumption rate of discount at time t is the marginal social rate of indifferent substitution between consumption at times t and $t+1$ minus 1. This means that it is the percentage rate of decline in discounted marginal well-being over the interval $[t, t+1]$. Let ρ_t denote this. Reverting to continuous time and the "utilitarian" form in (1), it is an easy matter to confirm that

$$\rho_t = \rho(C_t) = \delta + \alpha(C_t)[dC_t/dt]/C_t \quad (2)$$

where $\alpha(C_t) > 0$ is the elasticity of marginal well-being at t .¹⁶ Moreover, along a full optimum, the consumption rate of discount equals the productivity of capital (that is, the social rate of return on investment). This is the famous Ramsey Rule.

Iso-elasticity offers a simple, flexible form of $W(\cdot)$. So let us assume that

$$W(C) = -C^{-\alpha}, \text{ where } \alpha \text{ is a positive constant.} \quad (3)$$

In this case the optimality criterion reflected in (1) depends only upon two parameters: α and δ . Obviously, the larger is δ , the lower is the weight awarded to future generations' well-beings relative to that of the present generation. The moral of Mirrlees's computations was that introducing this sort of bias would be a way of countering the advantages to be enjoyed by future generations, should the productivity of capital and technological progress prove to be powerful engines of growth in well-being.¹⁷

Nevertheless, consider the case $\delta = 0$. As an example, let us assume that $\alpha = 2.5$ (a not implausible figure if $W(C)$ were to be based on revealed preferences). If the rate of growth of optimum consumption at t is, say, 2 percent, then $\rho_t = 5\%$. It will be noticed that the larger is α , the more egalitarian is the optimal consumption path. As $\alpha \rightarrow \infty$, the well-being functional represented in (1) resembles more and more the Rawlsian maxi-min principle as applied to the intergenerational distribution of consumption (and thus well-being). This in turn means that, even in productive economies, optimal growth in consumption is slow if α is large. In the limit, as $\alpha \rightarrow \infty$, optimal growth is zero. From equation (2), we can now see why the consumption rate of discount is bounded (and how it manages to equal the productivity of capital) even in these extreme parametric terrains.¹⁸

Social discount rates are percentage rates of change of intertemporal relative shadow prices. It follows that, unless the optimizing economy is in a steady state, social discount rates typically depend upon the *numeraire* that has been adopted.¹⁹ As equation (2) makes clear, the well-being discount rate differs from consumption rates of discount. This is not an obvious point, and it continues to be misunderstood in a good deal of the environmental literature that is critical of social cost-benefit analysis. Modern philosophers writing on the matter make the same mis-

take and conflate well-being and consumption rates of discount. They argue that δ should be zero and then criticize the practice of discounting future flows of consumption in social cost-benefit analysis.²⁰

Although simple, the Koopmans formulation spans a rich variety of ethical considerations. Among other things, it tells us that consumption rates of discount do not reflect primary value judgments: they are derived notions. They are essential when we try to implement optimal policies by means of cost-benefit analysis of projects.

Notice that in equation (3), $W(C)$ is unbounded below. If $\delta = 0$, this ensures that very low consumption rates are penalized by the optimality criterion reflected in (1). On the other hand, if δ were positive, low consumption rates by generations sufficiently far in the future would not be penalized by (1). This means that unless the economy is sufficiently productive, optimal consumption will tend to zero in the very long run. As an illustration of how critical δ can be, Dasgupta and Heal, and Solow showed in a model economy with exhaustible resources that optimal consumption declines to zero in the very long run if $\delta > 0$, but that it increases to infinity if $\delta = 0$.²¹ It is in such examples that notions of sustainable development can offer some cutting power. If by sustainable development we wish to mean that the chosen consumption path should as a minimum never fall short of some stipulated, positive level, then it follows that the value of δ would need to be adjusted downward in a suitable manner to ensure that the optimal consumption path meets with the requirement. This was the substance of Solow's remark that, in the economics of exhaustible resources the choice of δ can be a matter of considerable moment.²²

On the other hand, by sustainable development we could mean something else: that well-being (and, therefore, consumption) must never be allowed to decline. This is a stiffer requirement than the one we have just considered. If δ is less than the productivity of capital, the valuation criterion reflected in (1) ensures that the optimal consumption path will satisfy the requirement. This follows immediately from equation (2) and the Ramsey Rule. We may therefore conclude that the Koopmans program is all-encompassing, and that concepts of "sustainability" are useful in pruning out of consideration those consumption

paths that are ethically indefensible on prima facie grounds. The implications of this framework for social cost-benefit analysis and national income accounting are central to the evaluation and choice of public policies (Sections 4-6).

3. Second-Best Optima, Global Warming, and Risk

Analyzing full optima (that is, first-best allocations) helps fix ideas. In reality, a vast array of forward markets are missing (due to an absence of property rights, transaction costs, or whatever). It is a reason why, typically, market rates of interest ought not to be used in discounting future incomes in the social evaluation of projects and policies.

The phenomenon of global warming offers a good instance of what this can imply. The atmosphere is a global commons *par excellence*, and greenhouse emissions are a byproduct of production and consumption activities. In short, there is market failure. Social cost-benefit analysis needs to be undertaken with these failures in mind. Consider then that a number of simulation studies on the economics of global warming have indicated that the social costs of doing much to counter the phenomenon in the near future would far exceed the benefits because the benefits (for example, avoiding the submergence of fixed capital in low-lying areas, and declines in agricultural outputs) would appear only in the distant future (that is, a hundred years and more).²³ In these studies future costs and benefits, when expressed in terms of income, are discounted at a positive rate over all future periods, even when doing nothing to combat global warming is among the options being considered.

These results, quite rightly, appear as something of a puzzle to the many who imagine that global warming will result eventually in declines and dislocations of incomes, production, and people. They find it odd that "economic logic" has been shown to cast a damper on the idea that anything really drastic needs to be done in the immediate future to counter it. Perhaps then, or so it is on occasion thought, when deliberating environmental matters, we ought to use social rates of discount that are different from those in use in the evaluation of other types of economic activity.

We have seen in the previous section why this would be a wrong thought. On the other hand, using a constant discount rate for the purposes of simulation in the economics of global warming is not sound either. If global warming is expected to lead to declines in (weighted) global consumption over some extended period in the distant future, then the logic underlying formula (2) would say that over this same extended period consumption rates of interest could well be *negative*. If this were so (and it would certainly be so if $\delta = 0$), then from our current viewpoint, future losses due to global warming could well be amplified; they would not be reduced to negligible figures by the relentless application of a constant and positive discount rate. It is then entirely possible that far more aggressive policies than are implied by current simulation models to combat global warming are warranted.

Introducing risk into the theory of optimal development raises additional questions, and avoiding future disasters that could arise from global warming provides another reason why more aggressive current action may be called for. Here lies another weakness of most numerical models of global warming:²⁴ all estimates are point estimates, so the downside of risky situations does not get to play a role. The theory of rational choice under uncertainty (that is, the von Neumann-Morgenstern-Savage theory) instructs us to expand the space of commodities and services by including in their description the event at which they are made available. It tells us that the appropriate generalization of (1) is the expected value of the sums of flows of (possibly discounted) well-being.

Optimal development when future technology is uncertain has been much studied within this framework.²⁵ Risk of extinction of the human race provides an additional reason for discounting future well-beings. If the possibility of extinction is judged to be approximately a Poisson process, then the modification is especially simple: it involves increasing the well-being discount rate by the probability rate of extinction.²⁶

Uncertainty about future possibilities and the fact that economic decisions can have irreversible impacts, together provide us with a reason to value flexibility.²⁷ The underlying idea is that the present generation should choose its policies in a way that helps preserve future generations'

options. Environmentalists have frequently interpreted the idea of sustainable development in this light.

One way of formulating the idea of keeping future options open is to study the structure of Γ_C (which, recall, is the set of feasible consumption paths, from the present to infinity) in terms of the resource and capital base a generation inherits from the past, and to consider only those actions on the part of the generation that, as a minimum, preserve Γ_C . Thus, writing by \underline{K} and \underline{S} the stocks of manufactured capital (including knowledge and skills) and environmental resources, respectively, let $\Gamma_C^t(\underline{K}, \underline{S})$ denote the set of feasible consumption paths defined over $[t, \infty)$. To preserve future generations' options would be to insist that $\Gamma_C^t \subseteq \Gamma_C^{t+1}$ for $t \geq 0$. This idea was suggested by Dasgupta and Heal and subsequently explored by Solow.²⁸

It has two problems. First, but for the simplest of economies (for example, the one-good economy²⁹), $\Gamma_C^t(\underline{K}, \underline{S})$ is so complicated a set that nothing directly can be gleaned about the nature of policies that preserve options. Second, and more importantly, it is an unsatisfactory approach to the notion of intergenerational justice because it pays no heed to the *worth* of options. But worth cannot be measured except in terms of well-being. So we are back full circle to notions of aggregate well-being. To be sure, uncertainties about current stocks (for example, numbers of species), and about future needs, wants, technology, and climate need to be introduced—say, in terms of the expected value of aggregate well-being. But this is only to remind us of a central truth: the worth of keeping future generations' options open should be seen as a derived value. In other words, the worth should be assessed in terms of an overarching notion of aggregate well-being. The theory of option values (see Section 6) is based on this insight.

4. Project Evaluation and the Measurement of Net National Product

There are two ways of assessing changes in aggregate well-being. One would be to measure the value of changes in the constituents of well-being (utility and freedoms), and the other would be to measure the value of the alterations in the commodity determinants of well-being (goods and

services that are inputs in the production of well-being). The former procedure measures the value of alterations in various “outputs” (for example, indices of health, education, and other social indicators), and the latter evaluates the aggregate value of changes in the “inputs” of the production of well-being (namely, real national income). A key theorem in modern resource allocation theory is that, provided certain technical restrictions are met, for any conception of aggregate well-being, and for any set of technological, transaction, information, and ecological constraints, there exists a set of shadow (or accounting) prices of goods and services that can be used in the estimation of real national product.

The index in question has the following property: small investment projects that improve the index are at once those that increase aggregate well-being.³⁰ We may state the matter more generally: provided the set of accounting prices is unaffected, an improvement in the index owing to an alteration in economic activities reflects an increase in aggregate well-being. This is the sense in which real national income measures aggregate well-being. Moreover, the sense persists no matter what is the basis upon which aggregate well-being is founded. In particular, the use of national income in measuring changes in aggregate well-being is *not* restricted to utilitarian ethics.

The theorem should be well-known, but it often goes unrecognized in development economics, and today the use of real national income as an indicator of economic development is held in disrepute. For example, Anand and Ravallion criticize the use of national income in assessing relative well-beings in poor countries on grounds that income is a measure of opulence and not of well-being (nor, as they say, of “capability”).³¹ They assert that using the former for the purposes of measuring the latter constitutes a philosophical error and imply that development planners would have been better placed to make recommendations in poor countries if only they had read their Aristotle. The authors divide national income into personal income and public services, and show that there are a number of countries with a better-than-average personal income per head that display worse-than-average social indicators, such as health and basic education.

But it has long been a tenet of resource allocation theory that public health and basic education

ought not to be a matter of private consumption alone. One reason for this view is that they both display strong externalities and are at once merit goods.³² Another reason is that the credit and savings markets work especially badly for the poor in poor countries. In short, the theory has always informed us that a community’s personal consumption would not tell us much about its health and education statistics. As this is standard fare in public economics, one can but conclude that if the majority of poor countries have a bad record in the provision of public services, it is not due to philosophical error on the part of their leaderships, nor a lack of knowledge of resource allocation theory: it is something else. In any event, reliance on national income as an indicator of aggregate well-being does not reflect any particular brand of ethics. Its justification rests on a technical result in economics and is independent of the ethical stance that is adopted.

To be sure, if real national income is to reflect aggregate well-being, accounting prices should be used. Recall that the accounting price of a resource is the increase in the maximum value of aggregate well-being if a unit more of the resource were made available costlessly. (It is a Lagrange multiplier.) Accounting prices are, therefore, the differences between market prices and optimum taxes and subsidies. This provides us with the sense in which it is important for poor countries to “get their prices right.” Moreover, by real national product for an intertemporal economy, we mean real *net* national product (NNP). The accounting value of the depreciation of fixed capital (and by this we mean both manufactured and natural capital) needs to be deducted if the index of national product is to play the role we are assigning to it here.³³ Thus, NNP, when correctly measured in a closed economy, reads as follows:

$$\begin{aligned}
 \text{NNP} = & \textit{Consumption} \\
 & + \textit{net investment in physical capital} \\
 & + \textit{the value of the net change in human capital} \\
 & + \textit{the value of the net change in the stock} \\
 & \quad \textit{of natural capital} \\
 & - \textit{the value of current environmental damages.}
 \end{aligned}
 \tag{4}$$

We are regarding consumption as the *numeraire* in our measure of NNP. So the “values” referred to in equation (4) are consumption

values, and they are evaluated with the help of shadow prices. Net national product ought ideally to be computed in an intertemporal, optimizing economy. The optimization exercise enables one to estimate accounting prices. These prices can then in principle be used for the purposes of project and policy evaluation even in an economy that is currently far off the optimum.³⁴

An alternative way is to think of public policy as a sequence of reforms. Accounting prices in this framework would be estimated from the *prevailing* structure of production and consumption (and not from the optimum). If the economy has a convex structure, then a sequence of such reforms would in principle take the economy ultimately to the optimum.³⁵ Expression (4) reflects the correct notion of NNP in both frameworks.³⁶

It is useful to note here that the convention of regarding expenditures on public health and education as part of final demand implicitly equates the cost of their provision with the contribution they make to aggregate well-being. This in all probability results in an underestimation in poor countries.³⁷ We should note as well that current defensive expenditure against damages to the flow of environmental amenities ought to be included in the estimation of final demand. Similarly, investment in the stock of environmental defensive capital should be included in NNP.

By "investment," we mean the value of net changes in capital assets, not changes in the value of these assets. This means that anticipated capital gains (or losses) should not be included in NNP. As an example, the value of the *net* decrease in the stock of oil and natural gas (net of new discoveries, that is) ought to be deducted from GNP when NNP is estimated. Answer to the question as to how we should estimate NNP should not be a matter of opinion today: it is a matter of fact.

Current estimates of NNP are biased because depreciation of environmental resources is not deducted from GNP. Stated another way, NNP estimates are biased because a biased set of prices is in use. Prices imputed to environmental resources on site are usually zero. This amounts to regarding the depreciation of environmental capital as zero. But these resources are scarce goods, so we know that their shadow prices are positive. Profits attributed to projects that degrade the environment are therefore higher than the social profits they generate. This means

in turn that wrong sets of projects get chosen—in both the private and public sectors.

The extent of the bias will obviously vary from project to project, and from country to country, but it can be substantial. In their work on the depreciation of natural resources in Costa Rica, Solórzano and others have estimated that in 1989 the depreciation of three resources—forests, soil, and fisheries—amounted to about 10 percent of gross domestic product and over a third of gross capital accumulation.³⁸ Resource-intensive projects look better than they actually are. Installed technologies are usually unfriendly towards the environment.

5. Biases in Technological Adaptation

One can go further: the bias extends to the prior stage of research and development. When environmental resources are underpriced, there is little incentive on anyone's part to develop technologies that economize on their use. The extent of the distortion created by this underpricing will vary from country to country. Poor countries inevitably have to rely on the flow of new knowledge produced in advanced industrial economies. Nevertheless, poor countries need to have the capability for basic research. The structure of shadow prices there is likely to be different from those in advanced industrial countries, most especially for non-traded goods and services. Even when it is publicly available, basic knowledge is not necessarily usable by scientists and technologists, unless they themselves have a feel for basic research. Often enough, ideas developed in foreign lands are merely transplanted to the local economy; whereas they ought, instead, to be modified to suit local ecological conditions before being adopted. This is an occasion in which the use of shadow prices is of help. It creates the right set of incentives both among developers and users of technologies. Adaptation is itself a creative exercise. Unhappily, as matters stand, it is often bypassed. There is loss in this.

There is further loss associated with a different kind of bias: that arising from biased demand. For example, wherever household demands for goods and services in the market reflect in the main male (or for that matter, female) concerns, the direction of technological change would be expected to follow suit. Among poor countries, we would expect technological inventions in farm equipment and

techniques of production to be forthcoming in regions where cultivation is a male activity (there would be a demand for them); we would not observe much in the way of process innovations in threshing, winnowing, the grinding of grain in the home, and in the preparation of food. Thus, cooking in South Asia is a central route to respiratory illnesses among women: women sit hunched over ovens fuelled by cow dung, or wood, or leaves. It is inconceivable that improvements in design are not possible to realize, but entrepreneurs have little incentive to bring about such technological innovations. Household demand for them would be expected to be low.

The argument extends to collective activity in general, and State activity in particular. In poor communities, men typically have the bulk of the political voice. We should then expect public decisions over rural investment and environmental preservation also to be guided by male preferences, not female needs. Over afforestation in the drylands, for example, we should expect women to favor planting for fuelwood and men for fruit trees, because it is the women and children who collect fuelwood, while men control cash income. And fruit can be sold in the market. Such evidence on this as we are aware of is only anecdotal. But as it is confirmed by theory, it is reasonable to imagine that this must quite generally be true.

Such biases in NNP as we have identified here occur in advanced industrial countries as well. So then why do we stress their importance in the context of poor countries? The reason is that poor people in poor countries cannot cope with the same margin of error as people living in rich countries can: a 10 percent drop in the standard of living imposes greater hardship on a poor household than a rich one. Recall, too, that the rural poor are especially dependent upon their local environmental resource base.³⁹ Losses in well-being due to an underpricing of this base are absorbed by them disproportionately. The estimation of accounting prices of environmental resources should now be high on the agenda of research in the economics of poor countries.

6. Environmental Accounting Prices: The Valuation Problem

How we should estimate accounting prices is a complex question, but it is not uniformly com-

plex. There are now standard techniques of evaluation for commodities like irrigation water, fisheries, timber, and agricultural soil.⁴⁰ The same techniques can be used for estimating losses associated with water-logging and overgrazing. They rely on the fact that the environmental resources in question are inputs in the production of tradable goods. As long as the flow of all other inputs in production are held constant, the accounting value of changes in their supply can be estimated directly from the value of the resulting changes in outputs.

For commodities such as firewood and drinking and cooking water, the matter is more complex: they are inputs in household production.⁴¹ This means that we need estimates of household production functions. As an example, transportation costs (in particular energy costs as measured in calories) for women and children would be less were the sources of fuelwood and water not far away and receding. As a first approximation, the value of water or fuelwood resources for household production can be estimated from these energy needs. In some situations (as on occasion with fuelwood), the resource is a substitute for a tradable input (for example, paraffin or kerosene); in others (as with cooking water), it is a complement to tradable inputs (for example, food grain). Such facts allow us to estimate accounting prices of non-marketed goods in terms of the accounting prices of marketed goods.⁴²

The approach outlined above allows us to capture only the known use-value of a resource. Its shadow price may well exceed this. The reason is that additional values may be embodied in a resource stock. One additional value, applicable to living resources, is their intrinsic worth *as* living resources. (It is absurd to suppose that the value of a blue whale is embodied entirely in its flesh and oil, or that the value of the "game" in Kenyan safari parks is simply the present-discounted value of tourists' willingness-to-pay.) The idea of "intrinsic worth" of living things (sometimes called their "existence value") is inherent not only within traditional religious systems of ethics, but also in the modern "utilitarian" tradition. Therefore, the question is not so much whether living things possess intrinsic worth, but, rather, about ways of assessing this worth. It is almost impossible to get a quantitative handle on

intrinsic worth. The right thing to do is to take note of it, keep an eye on it, and call attention to it in public debate if the resource is threatened with extinction.

What is the point of basing shadow prices solely on use-value when we know that resources often possess intrinsic value as well? It is that such estimates provide us with *biased* shadow prices, and this can be useful information. For example, in his classic paper on the optimal rate of harvest of blue whales, Spence took the shadow price of these creatures to be the market value of their flesh, a seemingly absurd and repugnant move.⁴³ But he showed that under a wide range of plausible parametric conditions, it would be most profitable commercially for the international whaling industry to agree on a moratorium until the desired long-run population size were reached, and for the industry to subsequently harvest the creatures at a rate equal to the population's sustainable yield.⁴⁴ In other words, preservation is recommended solely on commercial ground.

But if preservation is justified when the shadow values of blue whales are estimated from their market prices, the recommendation would, obviously, be reinforced if their intrinsic worth were to be added. This was the point of Spence's exercise.

There is another source of value of environmental resources, which is more amenable to quantification. It arises from a combination of two things common to them: uncertainty in their future use-values, and irreversibility in their use. (Genetic material in tropical forests provides a prime example.) The twin presence of uncertainty and irreversibility implies that, even if the aggregate well-being function were neutral to risk, it would not do to estimate the accounting price of an environmental resource solely on the basis of the expected benefit from its future use. Irreversibility in its use implies that preservation of its stock has an additional value—the value of extending society's set of future options. (I discussed this in a wider context in Section 3.) Future options have an additional worth because, with the passage of time, more information is expected to be forthcoming about the resource's use-value. This additional worth is often called an *option value*.⁴⁵ The accounting price of a resource is the sum of its use-value and its option value.

Notes

1. I have gained much from discussions over the years on the subject matter of this paper with Geoffrey M. Heal, Karl Göran-Mäler, and Robert Solow. Some of the material here has been taken from Dasgupta and Mäler, "Poverty, Institutions and the Environmental Resource Base," in J. Behrman and T.N. Srinivasan, eds., *Handbook of Development Economics*, vol. III (Amsterdam: North Holland, 1994).

2. See Partha Dasgupta, "Some Alternative Criteria for Justice between Generations," *Journal of Public Economics* 3 (1974). See also Robert M. Solow, "Intergenerational Equity and Exhaustible Resources," *Review of Economic Studies* (Symposium on the Economics of Exhaustible Resources) 41 (1974).

3. See, for example, W.D. Nordhaus, "To Slow or Not to Slow: The Economics of the Greenhouse Effect" (Department of Economics, Yale University, New Haven, Conn., 1990, Mimeographed).

4. See Partha Dasgupta and Karl Göran-Mäler, "The Environment and Emerging Development Issues," *Proceedings of the Annual World Bank Conference on Development Economics* (Supplement to the *World Bank Economic Review* and the *World Bank Research Observer* (Washington, D.C.: World Bank, 1991). See also Dasgupta and Mäler, "Poverty, Institutions and the Environmental Resource Base."

5. World Commission on Environment and Development, *Our Common Future* (New York: Oxford University Press, 1987).

6. Well-being is a most complex notion and is multi-dimensional. The concept is explored at length in Partha Dasgupta, *An Inquiry into Well-Being and Destitution* (Oxford: Clarendon Press, 1993). Here I shall simplify and think of it as an aggregate, scalar measure. See below.

7. Solow, "Intergenerational Equity and Exhaustible Resources." See also Partha Dasgupta and Geoffrey M. Heal, *Economic Theory and Exhaustible Resources* (Cambridge: Cambridge University Press, 1979).

8. Solow explored this line of thought only because it is a possible interpretation of Rawls's principle of intergenerational justice; Solow was not commending it. See Solow, "Intergenerational Equity and Exhaustible Resources." See also J. Rawls, *A Theory of Justice* (Oxford: Oxford University Press, 1972). But it can be argued that Rawls himself was not prescribing intergenerational maxi-min, but something else. On this, see Dasgupta, "Some Alternative Criteria for Justice between Generations."

9. J. von Amsberg, "Project Evaluation and the Depletion of Natural Capital: An Application of the Sustainability Principle" (Environment Department Working Paper no. 56, World Bank, Washington, D.C., 1993) 15-16.

10. This issue was the focus of Partha Dasgupta and G.M. Heal, "The Optimal Depletion of Exhaustible Resources," *Review of Economic Studies* (Symposium on the Economics of Exhaustible Resources) 41 (1974); and Solow, "Intergenerational Equity and Exhaustible Resources." See Dasgupta and Heal, *Economic Theory and Exhaustible Resources*, chaps. 9-10, for an elaboration.

11. See Tjalling C. Koopmans, "Stationary Ordinal Utility and Impatience," *Econometrica* 28 (1960); Koopmans, "On the Concept of Optimal Economic Growth," *Pontificiae Academiae Scientiarum Scripta Varia* 28 (1965). Reprinted in *The Econometric Approach to Development Planning* (Amsterdam: North Holland, 1966); Koopmans, "Objectives, Constraints and Outcomes in Optimal Growth Models," *Econometrica* 35 (1967); Koopmans, "Representation of Preference Orderings with Independent Components of Consumption," in C.B. McGuire and R. Radner, eds., in *Decision and Organization* (Amsterdam: North Holland, 1972); and Koopmans, "Representation of Preference Orderings over Time," in McGuire and Radner, *Decision and Organization*.

12. See F. Ramsey, "A Mathematical Theory of Saving," *Economic Journal* 38 (1928); and D. Parfit, *Reasons and Persons* (Oxford: Oxford University Press, 1984).

13. See J.A. Mirrlees, "Optimal Growth When Technology Is Changing," *Review of Economic Studies* 34 (1967); and S. Chakravarty, *Capital and Development Planning* (Cambridge, Mass.: MIT Press, 1969).

14. Koopmans, "Stationary Ordinal Utility and Impatience."

15. Koopmans's theorems were proved under the assumption that time is discrete. In Koopmans, "Representation of Preference Orderings with Independent Components of Consumption" and "Representation of Preference Orderings over Time," the ethical axioms are imposed directly on Γ_c , and $W(\cdot)$ is obtained as a numerical representation.

16. See, for example, K.J. Arrow and M. Kurz, *Public Investment, the Rate of Return and Optimal Fiscal Policy* (Baltimore: Johns Hopkins University Press, 1970).

17. J.A. Mirrlees, "Optimum Growth When Technology Is Changing."

18. See Dasgupta and Heal, *Economic Theory and Exhaustible Resources*, chaps. 9-10.

19. Therefore, unless the *numeraire* has been specified, the term "social discount rate" is devoid of meaning.

20. See, for example, Parfit, *Reasons and Persons*; and T. Cowen and D. Parfit, "Against the Social Discount Rate," in P. Laslett and J.S. Fishkin, eds., *Justice between Age Groups and Generations* (New Haven, Conn.: Yale University Press, 1992).

21. See Dasgupta and Heal, "The Optimal Depletion of Exhaustible Resources"; and Solow, "Intergenerational Equity and Exhaustible Resources."

22. R.M. Solow, "The Economics of Resources, or the Resources of Economics," *American Economic Review* (Papers and Proceedings) 64 (1974).

23. See Nordhaus, "To Slow or Not to Slow: The Economics of the Greenhouse Effect."

24. See, for example, Nordhaus, "To Slow or Not to Slow: The Economics of the Greenhouse Effect."

25. See, for example, E.S. Phelps, "The Accumulation of Risky Capital: A Sequential Analysis," *Econometrica* 30 (1962); J.A. Mirrlees, "Optimum Accumulation under Uncertainty" (Faculty of Economics, University of Cambridge, Cambridge, England, 1965, Mimeographed); Mirrlees, "Optimum Accumulation under Uncertainty: The Case of Stationary Returns on Investment," in Jean Drèze,

ed., *Allocation under Uncertainty: Equilibrium and Optimality* (London: Macmillan, 1974); D. Levhari and T.N. Srinivasan, "Optimal Savings under Uncertainty," *Review of Economic Studies* 36 (1969); F.H. Hahn, "Savings and Uncertainty," *Review of Economic Studies* 37 (1970); Dasgupta and Heal, "The Optimal Depletion of Exhaustible Resources"; Partha Dasgupta, Geoffrey M. Heal, and M. Majumdar, "Resource Depletion and Research and Development," in M. Intriligator, *Frontiers of Quantitative Economics*, vol. III (Amsterdam: North Holland, 1977).

26. See, for example, Mirrlees, "Optimal Growth When Technology Is Changing"; Partha Dasgupta, "On the Concept of Optimum Population," *Review of Economic Studies* 36 (1969); Dasgupta, *The Control of Resources* (Oxford: Basil Blackwell, 1982); Dasgupta, "Resource Depletion, Research and Development, and the Social Rate of Discount," in R.C. Lind, ed., *Discounting for Time and Risk in Energy Policy* (Baltimore: Johns Hopkins University Press, 1982).

27. K.J. Arrow and A. Fisher, "Preservation, Uncertainty and Irreversibility," *Quarterly Journal of Economics* 88 (1974); C. Henry, "Investment Decisions under Uncertainty: The Irreversibility Effect," *American Economic Review* 64 (1974).

28. Dasgupta and Heal, *Economic Theory and Exhaustible Resources*, chap. 9. See also R.M. Solow, "Sustainability—An Economist's Perspective" (Department of Economics, Massachusetts Institute of Technology, Cambridge, Mass., 1991).

29. R.M. Solow, "A Contribution to the Theory of Economic Growth," *Quarterly Journal of Economics* 70 (1956).

30. See Dasgupta, *An Inquiry into Well-Being and Destitution*, chaps. 7 and 10. The technical restrictions amount to the requirement that the Kuhn-Tucker Theorem is usable, that is, that both the set of feasible allocations and the ethical ordering reflected by the aggregate well-being function are convex (see Appendix 2). The assumption of convexity is dubious for pollution problems, and we will study the question in Section 14. Nevertheless, in a wide range of circumstances, it is possible to separate out the "non-convex" sector, estimate real national income (or product) for the "convex" sector, and present an estimate of the desired index as a combination of the real product of the convex sector and estimates of stocks and their changes in the non-convex sectors. This is a simple inference from M.L. Weitzman, "Optimal Growth with Scale-Economies in the Creation of Overhead Capital," *Review of Economic Studies* 37 (1970) and R. Portes, "Decentralized Planning Procedures and Centrally Planned Economies," *American Economic Review* (Papers and Proceedings) 61 (1971).

31. S. Anand and M. Ravallion, "Human Development in Poor Countries: On the Role of Private Incomes and Public Services," *Journal of Economic Perspectives* 7 (1993). See also Amartya K. Sen, *Inequality Reexamined*, (Oxford: Clarendon Press, 1992).

32. R. Musgrave, *Theory of Public Finance* (New York: McGraw Hill, 1959).

33. See Dasgupta and Heal, *Economic Theory and Exhaustible Resources*; J. Hartwick, "Natural Resource, National Accounting, and Economic Depreciation," *Journal of Public Economics* 43 (1990); Dasgupta and Mäler, "The

Environment and Emerging Development Issues"; Karl Göran-Mäler, "National Accounting and Environmental Resources," *Journal of Environmental Economics and Resources* 1 (1991); and Ernst Lutz, ed., *Toward Improved Accounting for the Environment* (Washington, D.C.: World Bank, 1993).

34. See, for example, I.M.D. Little and J.A. Mirrlees, *Project Appraisal and Planning for Developing Countries* (London: Heinemann, 1974); and Lyn Squire and Herman van der Tak, *Economic Analysis of Projects* (Baltimore: Johns Hopkins University Press, 1975).

35. See, for example, Partha Dasgupta, S. Marglin, and Amartya K. Sen, *Guidelines for Project Evaluation* (New York: United Nations, 1972); and E. Ahmad and N. Stern, *The Theory and Practice of Tax Reform for Developing Countries* (Cambridge: Cambridge University, 1990).

36. For a simplified exposition of the connection between these two modes of analysis (reforms and optimization), see Dasgupta, *The Control of Resources*, chap. 5.

37. If education is regarded as a merit good, and not merely as instrumental in raising productivity, then its accounting price would be that much higher.

38. R. Solórzano and others, *Accounts Overdue: Natural Resource Depreciation in Costa Rica* (Washington, D.C.: World Resources Institute, 1991).

39. See, for example, Dasgupta and Mäler, "The Environment and Emerging Development Issues."

40. See, for example, for irrigation water G. Brown and C.B. McGuire, "A Socially Optimal Pricing Policy for a Public Water Agency," *Water Resources Research* 3 (1967); for fisheries C.W. Clark, *Mathematical Bioeconomics: The Optimal Management of Renewable Resources* (New York: John Wiley, 1976), R. Cooper, "An Economist's View of the Oceans," *Journal of World Trade Law* 9 (1977), and Dasgupta, *The Control of Resources*; for soil fertility W. Magrath and P. Arens, "The Costs of Soil

Erosion in Java: A Natural Resource Accounting Approach" (Environment Department Working Paper no. 18, World Bank, Washington, D.C., 1989); and Robert C. Repetto and others, *Wasting Assets: Natural Resources and the National Income Accounts* (Washington, D.C.: World Resources Institute, 1989); for forestry Ken Newcombe, "An Economic Justification of Rural Afforestation: The Case of Ethiopia" (Energy Department Paper no. 16, World Bank, Washington, D.C., 1984), and Dennis Anderson, *Economics of Afforestation: A Case Study in Africa*, Occasional Paper no. 1 (Baltimore: Johns Hopkins University Press for the World Bank, 1987); and for the latter three R. Solórzano and others, *Accounts Overdue: Natural Resource Depreciation in Costa Rica*.

41. The classic on household production is G. Becker, *A Treatise on the Family* (Cambridge, Mass.: Harvard University Press, 1981).

42. See Karl Göran-Mäler, *Environmental Economics: A Theoretical Enquiry* (Baltimore: Johns Hopkins University Press, 1974) and "Welfare Economics and the Environment," in A.V. Kneese and J.L. Sweeney, eds., *Handbook of Natural Resource and Energy Economics*, vol. 1 (Amsterdam: North Holland, 1985).

43. A.M. Spence, "Blue Whales and Optimal Control Theory," in H. Gottinger, ed., *Systems Approaches and Environmental Problems* (Gottingen: Vandenhoeck and Ruprecht, 1974).

44. During the moratorium the whale population grows at the fastest possible rate. In Spence's numerical computations, the commercially most profitable duration of the moratorium was found to be ten to fifteen years.

45. See Arrow and Fisher, "Preservation, Uncertainty and Irreversibility"; and Henry, "Investment Decisions under Uncertainty: The Irreversibility Effect."

Valuing the Environment: Past Practice, Future Prospect

David W. Pearce

What Does It Mean to “Value the Environment”?

Strictly speaking, there is no activity that can rightly be called “valuing the environment.” What economists do is to seek measures of individuals’ preferences for environmental improvement or conservation, or individuals’ loss of well-being because of environmental degradation or from losing an environmental asset. They find those measures in the concepts of expressed or revealed “willingness to pay” (WTP) and “willingness to accept compensation” (WTAC). They then make certain assumptions about our ability to aggregate these individual valuations. The shorthand for this activity—“valuing the environment”—is convenient, but misleading to many. It implies that there is only one source of value—human preferences. Utilitarianism is only one of a number of value systems, and we all know that its practical counterpart—benefit cost analysis as practiced in modern project appraisal—suffers from various ethical drawbacks.¹ The aggregation assumption also has its own problems, notably that of “interpersonal comparisons of utility.”²

But while benefit-cost analysis has problems, so do alternative paradigms for making social choice. Indeed, some of them appear fundamentally unsuited to the practical, real world choices that have to be made. In the context of this conference, those choices relate to the conflict between the conservation of environmental assets and traditional patterns of economic development: clearance of tropical forest for agriculture,

for example, versus forest conservation. If environmental assets have inviolable “intrinsic rights,” then much economic development is morally unsound. If the rights of the people whose livelihoods are subsequently put at stake are allowed, then we have a conflict of rights and no clear decision rule that enables us to choose the “right” course of action. Both of those positions would be applauded by some philosophers and many environmentalists, but they do not add up, I suggest, to a constructive view of social choice in the context of economic development, however suited they are to armchair philosophizing.

Why “Value the Environment”? The Consequences of Asymmetry

The previous brief discussion establishes the main reason for “valuing the environment”: choices have to be made; hence there is a need to compare the net social gains of one policy option with that of another. If we accept the WTP/WTAC indicators as our measuring rods, money becomes the convenient unit of account.³ If there were markets in all gains and losses, the economist’s task would be relatively simple. The value of marketed outputs and inputs could be compared for each option, and that with the highest net gain would be “socially preferred.”⁴ But the pervasive problem with environment is that so many environmental assets are not marketed—there are no values to compare with those from economic development. Pursuing the tropical forest example, what *actually* gets compared is the net return from agriculture, livestock, or

timber with the market value of a conserved forest, which is zero or close to zero. Not surprisingly, clearance and logging win the day. There is an asymmetry of valuation. The “economic playing field” is biased against the conservation option because, if there are economic values in conservation, they have no market, or only an incomplete market.

This is the link between economic valuation and sustainable development. *However* sustainable development is defined,⁵ the “bottom line” is not debatable: the environment needs to be higher on the development agenda if there is to be sustainable development.⁶ That much follows from the simple observation that environmental services invariably do go unvalued, so that paths of development based on the asymmetry of values noted above must, of necessity, be economically inefficient. We need only the observation of missing or incomplete markets to reach this conclusion.

The inefficiency arising from asymmetric valuation occurs at all levels. At the project level, the computation of net social benefits is distorted unless environmental impacts are properly valued. At the sectoral level, we have no mechanism for comparing sectoral priorities unless we have some idea of relative net social gains from sectoral investment and change. And at the national level, we will continue to be tempted to use GNP as an indicator of national well-being until we have an acceptable measure of gross national product (GNP) modified for the depreciation of environmental assets—some sort of “green national income.” The valuation issue is therefore pervasive to the *way* we encourage economic development, and this justifies the attention being paid to it.

Valuation in Practice: Developing Countries’ Experience

Most, but not all, of our experience in economic valuation is in the rich world of the Organisation for Economic Co-operation and Development (OECD) countries. To some extent this is not surprising. Not only did the idea of “efficiency in government” arise first in the developed world,⁷ giving rise to a whole set of procedures for dealing with non-market products such as defence, health, education and environment, but the conflict between environment and economic devel-

opment was more likely to arise in high income contexts. This historical experience has tended to reinforce the assumption that environment is an “income elastic” commodity, something we worry about only when basic needs have been met and we move into a high consumption phase of development. To some extent, therefore, the asymmetry of valuation reflects human preferences—there are no markets in environmental commodities because there is no demand for those commodities. Once the demand emerges, the markets get created. And the demand is more likely to arise when things get bad than when they appear to be satisfactory. The Climate Change and Biodiversity Conventions, The Montreal Protocol, the Global Environment Facility, the various attempts to get our oceans cleaned up—can all be seen as examples of markets emerging in response to crisis.

One of the features of the sustainable development debate has been a questioning of this income elasticity assumption. For the poor, the environment is an integral part of development until such times as technological substitutes can be provided. This is true of fuelwood and fodder, other forest products, water supply, water quality, soil and soil nutrients. There is a direct dependence of livelihoods on natural resources in their unprocessed state. Clean air may be something we can wait for until it can be afforded. Clean water and biomass energy are not.

There is a second dimension of the sustainable development debate that is highly relevant to the valuation issue, namely North-South transfers. The Brundtland Commission,⁸ the Rio Conventions and Agenda 21 have focused a lot of attention on the issue of both the scale and nature of the transfers between rich and poor countries. Leaving aside some of the rather silly estimates of required transfers that circulated at the Rio Earth Summit, there is an important issue of how these transfers can be determined. They can be thought of as comprising two components: an equity component based on what the North ought to transfer to the South for developmental reasons, and a self-interested component based on the transfers necessary to secure the North’s own collective benefit from conservation and environmental improvement in the South. In the former case we need to uncover the South’s own “local” WTP for environmental improvement. In the latter case

we need to elicit the North's WTP for the South's environment. We provide examples of each of these.

To date, the most successful applications of economic valuation techniques in the developing world have been in the context of water supply, sanitation, and forest functions. The available case studies have been summarized in Pearce and Whittington.⁹ A few examples are given here. Extensive further detail is available for water and forests¹⁰ and for natural habitats and biodiversity.¹¹

Local Values: Water and Sanitation

The first cases concern the value of water supply and sanitation. Traditionally, water supply investments have been evaluated by rules of thumb related to assumed willingness-to-pay for basic services. Since the service is usually supplied to the poor, the assumption has been that only the most basic provision—public taps and hand pumps—is warranted. No one is willing to pay for better, more elaborate services. This “basic needs” philosophy would be satisfactory if the resulting public supplies were reliable. However, perhaps one in four public supply systems are not working at any one point of time, while use rates of those that do work are low—only one-third of people connected to public supply systems in Côte d'Ivoire and Kenya actually use them. Yet the benefits of such systems, in terms of public health and time saving, are clearly substantial. Households' true willingness to pay is, therefore, worth estimating.

The World Bank's program of work on economic valuation of water supply has adopted basically two approaches to deriving economic values: *dichotomous choice* and *contingent valuation*.

With dichotomous choice one can observe how people choose between alternative means of water supply involving different allocations of time. In Ukundu, Kenya, villagers could choose between water from vendors who visit the house, water sold at “kiosks” in the village, and water from the well.¹² In terms of *collection time*, relative to use of the well, house delivery saves the most collection time and collecting from kiosks the least amount of time. In terms of *expenditure*, household vending costs the most, then kiosk water, with well water being the cheapest. By

looking at actual choices, the trade-off between money and time can be determined. Time saving is one of the benefits of water supply improvement. In this case, if water quality is invariant among sources, time savings will generally define total benefits. The Ukundu study found that users of vendors and kiosks were revealing high WTP for time savings, of the order of 8 percent of incomes.

A study in Brazil used the contingent valuation approach, which essentially involves asking people either directly what they are willing to pay, or less directly what their choice would be if they were faced with certain prices for the service in question.¹³ The question took the form, “If you are required to pay X, would you connect to the new supply or use an alternative supply?” Three different areas were surveyed, some with improved services available to which households might or might not be connected, and some without. In the “without” cases some had services planned with an announced tariff; others expected a service but did not know of what kind or what the tariff would be. From the survey the probabilities of being connected were estimated, and these were found to behave as predicted. The higher the price and the greater the distance to the source, the less likely was connection. WTP estimates were also obtained from the questionnaires. The results provide not just an estimate of the average WTP, but also indicate how households would respond to higher prices, an important consideration if revenue-raising is a concern. Maximum WTP for a yard tap was around 2.5 times the prevailing tariff and some 2.3 percent of family income. Some “strategic bias”—deliberate under-reporting of WTP—was probably present so that true WTP was probably higher than this. Equity considerations could be taken care of by providing relatively highly priced services to the better off and using revenues to cross subsidize the needs of the poor for free public taps.

Fewer than 300 million people lived in developing country urban areas in 1950. Today the figure is over 1,300 million. By 2000 it will be 1.9 billion. By the year 2000 there will be 200 cities with populations over 1 million, 150 of which will be in developing countries. The cost of the necessary infrastructure for this urban development is enormous. As with water supply generally, sanitation systems tend to be primitive for the poor,

and subsidized systems of the less primitive schemes tend to benefit the middle and upper income classes. As with water, willingness-to-pay is generally *assumed* rather than estimated. Charges above 3 percent of household incomes are thought not to be affordable.

In Kumasi, Ghana, WTP for sanitation was estimated through a contingent valuation approach. The options were water closets with a piped sewage system and ventilated pit latrines ("KVIPs"). The latter represent a far cheaper option for sanitation than connecting sewers and installing water closets. Households varied according to the systems already in place. Some had water connections and could therefore be asked their WTP for a water closet and a KVIP. Households with water closets could be asked how much they would be WTP for a connection to the sewer, and so on. KVIPs can operate without water connections. The results showed that households without water closets were WTP roughly the same sum for a WC or a KVIP. In terms of WTP for KVIPs, households with bucket latrines bid the lowest price; those using public latrines bid significantly higher prices (around 30-35 percent more), reflecting the inconvenience and lack of privacy of the public systems. Overall mean bids of around \$1.50 per month compare to average existing expenditures of about \$0.50 per month. Comparing WTP with the costs of provision of KVIPs and WCs, WTP was found to be *less* than costs of supply. Given that sanitation systems yield extensive external benefits in the form of public health, a subsidy would probably be justified (the benefits of improved health were not estimated). The study showed that the required subsidy for a WC system for Kumasi would amount to some \$60 million. The required overall subsidy for the KVIP system would amount to some \$4 million.¹⁴

Local and Global Values: Forest Conservation

Korup National Park lies in Southwest Province, Cameroon. It contains Africa's oldest rainforest, over 60 million years old, with high species endemism. There are over 1000 species of plant, and 1300 animal species including 119 mammals and 15 primates. Of the total listed species, 60 occur nowhere else, and 170 are listed as endangered. Continued land-use changes are putting substantial pressure on the rainforest. The

Worldwide Fund for Nature (WWF) initiated a program of conservation, centered on a management area of 126,000 hectares plus a surrounding buffer zone of 300,000 hectares. A similar program was initiated for Oban National Park just across the border in Nigeria.

Economic valuation of the rainforest's benefits was carried out to assist with the process of raising development aid funds to conserve the area.¹⁵ Benefits of conservation were then compared to the costs of the conservation project plus the foregone timber revenues. While the framework for analysis was the total economic value concept, existence and option values were not directly estimated. The procedure involved estimating direct and indirect use values to Cameroon and then seeing what the existence and option value *would have to be* to justify the project. Since it was thought that the non-use values would reside mainly with people outside Cameroon, the focus of attention for non-use values was on seeing what international transfers might be needed. The results are shown in box 1 below.

Box 1. The Korup Project

Benefits and costs to Cameroon
(Present values, million CFA, 1989 prices)
(Discount rate = 8%)

Costs of conservation project

Resource costs	- 4475
Foregone forest benefits	
timber	- 353
forest products	- 223
	- 5051

Benefits of conservation project

<i>Direct use benefits</i>	
Use of forest products	+ 354
Tourism	+ 680

Indirect use benefits

Protection of fisheries	+ 1770
Flood control	+ 265
Soil productivity	+ 130
	+ 3199

Net benefits to Cameroon	- 1852
Economic rate of return (ERR)	6.2%

Net benefits to Cameroon if the discount rate is 6%	+ 319
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From the standpoint of Cameroon, the project appears not be worthwhile because there is a negative net present value of some 1852 million CFA at 8 percent discount rate, although there is a modest positive net present value if the discount rate is lowered to 6 percent. But the analysis covers only some of the components of total economic value. What of existence and option values? These were not estimated directly. Instead, the issue becomes one of asking whether the rest of the world would be willing to pay 1852 million CFA (in present value terms) to Cameroon to reflect these option and existence values. One way of testing this is to look at existing conservation transfers through debt-for-nature swaps. Translated into a per hectare basis, the required transfer for Cameroon is just over 1000 ECUs per km². Debt-for-nature swaps have implied various valuations ranging from as low as 15 ECUs per km² (Bolivia) to around 1600 ECUs per km² (Costa Rica). Given the high species endemism and diversity of Korup, values of 1000 ECUs or more would seem justified. The conservation of Korup forest becomes justified in economic terms provided this transfer actually takes place.

The resource costs are based on budgets and plans in the Korup National Park Master Plan, net of compensation payments (which are internal transfers) and other costs regarded as being not attributable to the conservation project. The foregone forest benefits include timber from potential commercial logging (the 353 million CFA) and some foregone traditional uses of the forest, mainly hunting, which would be forbidden within a designated national park, and which cannot be offset by diverting activity elsewhere (the 223 million CFA). This proscription of traditional uses affects some 800 villagers within the national park boundaries. In the long run, however, other residents, mainly some 12,000 people on the periphery, will be able to continue their traditional use of the forest, which they would not be able to do if deforestation continued. Thus, while one group loses benefits, another, larger group gains (the 354 million CFA). The tourism figure is conjectural and is based on an eventual 1000 visitors annually by the year 2000 and their expected expenditure adjusted for the shadow wage rate. The fisheries item is important. Rainfall in the forest feeds several rivers that feed into large mangrove areas rich in fish. The mangroves prosper

on the basis of freshwater inundation in high water periods and saltwater in low water periods. If the forest were to disappear, peak flows from the forest would increase, bringing added sediment and less salinity. Basically, the mangrove swamps would no longer function as the habitat for the rich fish species that make up both the on- and offshore fisheries. Since the link between the rainforest and the offshore fishery is less established than the link to the inshore fishery, only damage to the onshore fishery was estimated. This was valued at the market value of fish and, as a check, at the income derived from the fishery.

The flood alleviation benefits were calculated by looking at the expected value of the income losses that would accrue if there were a flood. The soil fertility benefits were based on a broad brush assessment that, if the forest disappeared, cash crop yields would decline by 10 percent.

The implicit minimum requirement for an international transfer (the "rainforest supply price") was estimated by taking the present value of net costs (the 1852 million CFA) and dividing by the present value of the hectare that could be identified as being protected by the conservation project—some 500,000 "hectare years." This produces the value of 3600 CFA per hectare per year, or some 1060 ECUs/km².

Notable omissions from the study are twofold: no attempt was made to assess the value of the forest to local people over and above its use value; and no attempt was made to estimate the net contribution to CO₂ emissions from deforestation. Both omissions are likely to reduce the net present value deficit shown in the table. However, only the former will lower the rainforest supply price because CO₂ benefits are likely to attract a negligible if not zero willingness to pay on the part of Cameroon citizens. The CO₂ benefits will, however, make it *more* likely that the rest of the world will pay for rainforest conservation (that is, it affects the rainforest demand price). How relevant the CO₂ benefits can be is illustrated below.

Global Missing Markets

The final example of valuation raises an interesting issue relating to the North's willingness to pay for environmental improvement in the South. Economists are used to speaking of "market

failure" as a major factor in explaining environmental degradation, along with misdirected interventions by governments themselves.¹⁶ Market failure relates to the inability of markets to account for the social costs of economic activity: the upstream polluter, for example, does not pay for downstream pollution unless forced to do so by regulation or some form of pollution taxation.

But market failure is not just a local phenomenon. Many environmental assets have global economic value. This is most pronounced and least understood for biological diversity, but extends to global climatic change. Pursuing our tropical forest example once more, all forests store carbon so that, if cleared for agriculture, there will be a release of carbon dioxide that will contribute to the accelerated greenhouse effect and hence global warming. To derive a value for the "carbon credit" that should be ascribed to a tropical forest, we need to know (a) the net carbon released when forests are converted to other uses, and (b) the economic value of one ton of carbon released to the atmosphere.

Carbon will be released at different rates according to the method of clearance and subsequent land use. With burning there will be an immediate release of CO₂ into the atmosphere, and some of the remaining carbon will be locked in ash and charcoal that is resistant to decay. The slash not converted by fire into CO₂ or charcoal and ash decays over time, releasing most of its carbon to the atmosphere within ten to twenty years. Studies of tropical forests indicate that significant amounts of cleared vegetation become lumber, slash, charcoal and ash. The proportion differs for closed and open forests; the smaller stature and drier climate of open forests result in the combustion of higher proportion of the vegetation.

If tropical forested land is converted to pasture or permanent agriculture, the amount of carbon stored in secondary vegetation is equivalent to the carbon content of the biomass of crops planted, or the grass grown on the pasture. If a secondary forest is allowed to grow, then carbon will accumulate, and maximum biomass density is attained after a relatively short time.

Box 2 illustrates the net carbon storage effects of land use conversion from tropical forests and closed primary, closed secondary, or open forests to shifting cultivation, permanent agriculture, or pasture. The negative figures represent emissions of carbon; for example, conversion from closed primary forest to shifting agriculture results in a net loss of 194 tC/ha. The greatest loss of carbon involves change of land use from primary closed forest to permanent agriculture. These figures represent the permanent change that will occur in carbon storage as a result of the various land use conversions.

The data suggest that, allowing for the carbon fixed by subsequent land uses, carbon released from deforestation of secondary and primary tropical forest is of the order of 100-200 tons of carbon per hectare.

The carbon released from burning tropical forests contributes to global warming, and we now have, leaving aside catastrophic events, several estimates of the minimum economic damage done by global warming. Recent work by Fankhauser suggests a "central" value of \$20 of damage for every ton of carbon released.¹⁷ Applying this figure to the data in box 2, we can conclude that converting an open forest to agriculture or pasture would result in global warming damage of, say, \$600-1000 per hectare; conversion of closed secondary forest would

Box 2. Changes in forest land use and carbon release
(tC/ha)

	<i>Original C</i>	<i>Shifting agriculture</i>	<i>Permanent agriculture</i>	<i>Pasture</i>
Original C		79	63	63
Closed primary	283	-204	-220	-220
Closed secondary	194	-106	-152	-122
Open forest	115	-36	-52	-52

Note: Shifting agriculture represents carbon in biomass and soils in second year of shifting cultivation cycle.

Source: David W. Pearce and K. Brown, "The Economic Value of Carbon Storage in Tropical Forests," in S. Weiss, ed., *The Economics of Project Appraisal and the Environment* (London: Edward Elgar, 1993).

cause damage of \$2000-3000 per hectare; and conversion of primary forest to agriculture would give rise to damage of about \$4000-4400 per hectare. Note that these estimates allow for carbon fixation in the subsequent land use.

How do these estimates relate to the development benefits of land use conversion? We can illustrate with respect to the Amazon region of Brazil. Schneider reports upper bound values of \$300 per hectare for land in the Paragominas area of Para, and a range of only \$15 to \$150 for land in Rondonia.¹⁸ If we take a "carbon credit" value of \$2000, the figures suggest carbon credit values are at least 7 times and could be over 100 times the price of land in Rondonia. These "carbon credits" also compare favorably with the value of forest land for timber in, for example, Indonesia, where estimates are \$2000-2500 per hectare. These figures suggest the scope for a global bargain. The land is worth \$300 per hectare to the forest colonist but several times this to the world at large. If the North can transfer a sum of money greater than \$300, say, but less than the damage cost from global warming, there are mutual gains to be obtained.

Note that if the transfers did take place at, say, \$500 per hectare, the cost per ton carbon reduced is of the order of \$5 tC (\$500/100 tC/ha). These unit costs compare favorably with those to be achieved by carbon emission reduction policies through fossil fuel conversion. Avoiding deforestation becomes a legitimate and potentially important means of reducing global warming rates.

Valuation and the National Accounts

Significant effort has gone into both the theoretical and practical problems of adjusting measures of GNP to reflect environmental concerns.¹⁹ The basic idea is that "true" or "sustainable" income is that flow of income that leaves the capital stock of the economy intact. Intuitively, we can no more sustain an economy by mining its capital stock than a businessperson can survive by depleting his or her own capital. The link to the concept of sustainable development is obvious: no development path can be sustained beyond the short run if it involves running down national assets. But assets in this context have to be construed far more broadly: they include the conventional human-made (or "reproducible") capital assets

such as roads and schools; human capital in the form of the stock of knowledge, skills, and capabilities; and environmental assets. Just as we measure *net* national income (NNP or NDP) as GNP less depreciation on the human-made capital stock, so we need to make adjustments for any depreciation (or enhancement) of environmental capital. At its very simplest, then, we would expect to see a modified GNP figure obeying a formula such as:

$$gNNP = GNP - \delta Km - \delta Kn$$

where g signifies "green" or "adjusted" net national product; δKm is depreciation on human-made capital assets; and δKn is depreciation on natural capital.

Annex 1 shows how such a formula might be expanded to cover non-renewable resources, renewable resources, and pollution damage.

Unfortunately, the experts are not in agreement as to how a $gNNP$ measure should be estimated. The competing methodologies are summarized in the identities below. The names of prominent authors are linked to the different approaches, but it should be stressed that there is a wide spectrum of opinion among them. Note that the last one relates to *wealth* rather than income, and at least one country (Canada) is pursuing the idea of modified wealth accounting. Wealth accounting has obvious links to a measure of sustainable development if a condition for sustainable development is taken to be *at least* a constant stock of all assets.²⁰

$$gGDP = GDP + ES +/ - ED_1 - IR \quad (1)$$

$$gNDP = NDP + RDIS - RDEP - ED_2 \quad (2)$$

$$NW = NEA + TAm + TAn \quad (3)$$

where:

- $gGDP$ = "Green" gross domestic product
- ES = The value of environmental services
- ED_1 = Environmental damages that are deducted according to one school of thought and added according to another, depending on how GDP is measured
- IR = Invested resource rents
- $gNDP$ = "Green" net domestic product

<i>RDIS</i>	= The value of resource discoveries
<i>RDEP</i>	= The value of resource depreciation
<i>ED₂</i>	= Environmental damage that in this case is deducted from net product
<i>DE</i>	= Defensive expenditures
<i>NW</i>	= National wealth
<i>NFA</i>	= Net financial assets
<i>TAm</i>	= Human-made tangible assets
<i>TAn</i>	= "Natural" tangible assets

Further detail is given in Hamilton and others.²¹

The underlying policy perspective is that because decisionmakers are influenced by measures of GNP, it is essential to have a modified measure of GNP – green GNP (*g*GNP) so that those decisionmakers receive the right signals about the "true" progress of the economy. However, countries that have experimented with adjusted income measures, including those that eschew adjusted *monetary* measures in favor of conventional GNP allied to sets of *physical* resource accounts ("satellite accounting"), reveal very different motives for wanting a modified set of accounts. A survey by Hamilton and others shows that a few seek to develop "sustainability indicators" (Canada); several seek to improve their macroeconomic planning capabilities to trace out the implications of economic decisions, and not surprisingly this is the focus in those countries with a strong macro-planning background (Finland, Norway, Sweden); and some have clearly followed a trend without any particular "philosophy" in mind.²²

The other, perhaps more controversial, observation is that the extent to which modified income accounting alters *behavior* has yet to be tested. Unquestionably, it has led to a number of insights, especially in underlining the extent to which countries, both developing, for example, Philippines²³ and developed, for example, the United Kingdom²⁴ have failed to re-invest rents from the exploitation of resources. Given the Hartwick-Solow rule on re-investing rents for sustainable consumption, we can truly say that certain countries have been, and are, living off capital assets of a relatively short-lived nature. There is also the whole "consciousness raising" aspect of modified income accounting. How far it will feed into changes in political behavior is very likely to depend on (a) further resolving the disputes between the experts as to the "right" way to modify the accounts and (b) finding short-cut

measures that avoid the often high cost of detailed exercises.

Valuation: Where Next?

What can we learn from this quick *tour d'horizon* of the valuation issue? There are several propositions we can make:

- The moral debate about the underlying ethics of economic valuation will continue. This reflects the wider debate about neoclassical welfare economics generally, of which environmental valuation is one part.
- The number of valuation exercises has increased rapidly and shows no sign of abating.
- Valuation is essential if we are even to approach the correction of distorted development paths based on the asymmetry of values for the environment and for "development." Valuation is not inimical to development. It is a corrective against wrong and unsustainable development.
- The experience to date with valuation in the developing world shows us that it can be very successful in eliciting the social value of basic needs such as water and sanitation. This enables such values to enter into project appraisal in place of "rules of thumb" that have been used hitherto.
- Since developing country valuation exercises so far have been confined mainly to water and sanitation, we have little idea as yet about the sectoral priorities that would emerge if we compared such investments with other investments. Hazardous a guess, it seems likely that *local* valuation exercises will:
 - a. Reinforce the view that what we might term "*environmental basic needs investments*"—water, biomass, sanitation—have very high social rates of return
 - b. Raise the profile of water pollution control investments due to the strong link between water pollution and human health
 - c. Reveal high rates of return to soil erosion control and nutrient investment.
- As far as the *global* values of tropical forests and other "biodiversity havens" are concerned, those who pin their hopes on the global value of genetic materials through biotechnology or pharmaceuticals are very probably backing low value opportunities.²⁵

Far greater potential exists in terms of the values of carbon storage and use and non-use values for diverse systems. We know a good deal about carbon values, but next to nothing about global biodiversity values. The latter are the greatest challenge to the “economic valuers.” Global “missing markets” do a lot to explain the skewed development paths of resource-rich countries, and hence the loss of so much of the world’s environmental assets.

- Perversely, while we are making efforts to value environmental benefits and damages, we very often have little idea about the opportunity costs of *conserving* environmental assets. That is, we know very little about the development “benefits” that accrue from land

conversion, the main source of environmental loss. There is a high likelihood that a very high percentage of land conversions are carried out for zero or negative net gains: the resulting incomes barely compensate labor, leaving nothing as the gain in rent. If the development gain is zero, or near zero, then it requires little by way of positive economic value for environmental services to justify conservation.

- Finally, valuation is an integral part of most modified national accounting systems. Getting the analytical exercises into the *real* political arena, where we can observe behavioral change, will require some resolution of the existing methodological debate and the development of rapid appraisal techniques.

Annex An Approach to Modified Income Accounting

This annex is based mainly on Hartwick.²⁶

Conventional GNP is defined as

$$\text{GNP} = \text{NNP} + \delta Km \quad (1)$$

where δKm is depreciation on human-made capital. We need to extend this to allow for natural capital Kn and for pollution damage. Take natural capital first. Above is extended to

$$\text{GNP} = \text{NNP} + \delta Km + \delta Kn \quad (2)$$

Hence

$$\text{NNP} = \text{GNP} - \delta Km - \delta Kn \quad (3)$$

How is δKn measured?

For *non-renewable resources*, Hartwick shows that for each kind of natural capital (Kn_i), it is given by:

$$\delta Kn_i = [P_i - MC_i][Q_i - N_i] \quad (4)$$

where P_i is the shadow price of the resource (= market price in a competitive economy)

MC_i is the marginal cost of extraction

$P_i - MC_i$ is then the user cost or royalty on the resource.

Q_i is output of the resource (its "draw down")

N_i is new discoveries.

So, the first extension gives:

$$\text{NNP} = \text{GNP} - \delta Km - \sum_i [P_i - MC_i][Q_i - N_i] \quad (5)$$

where subscript i refers to non-renewable resources.

If $N_i > Q_i$, NNP grows relative to the conventional definition. Otherwise it is less. (Note: the way in which new discoveries are treated here is open to dispute.)

For *renewable resources* (subscript j), the principle is the same, but we now have to allow for the natural growth rate of the resource $g(X_j)$ and its harvest rate H_j . The net growth [$g(X_j) - H_j$] is then valued at the royalty $P_j - MC_j$.

This second extension now produces:

$$\text{NNP} = \text{GNP} - \delta Km - \sum_i [P_i - MC_i][Q_i - N_i] + \sum_j [P_j - MC_j][g(X_j) - H_j] \quad (6)$$

Note that if the harvest rate exceeds the growth rate, the last bracketed expression is negative and NNP falls.

For *pollution damage*, let D_k be the flow of pollution of type k in physical units; P_k is the shadow price of pollution damage (estimated, for example, by contingent valuation), and MC_k is the marginal cost of pollution abatement. There are *two* effects of pollution: one on households—the disutility of pollution—and this will equal the flow of pollution multiplied by the shadow price of pollution, that is, $P_k \cdot D_k$; and the other, on production—and this will equal $MC_k \cdot D_k$. The *sum* of these two impacts is then:

$$(P_k + MC_k) \cdot D_k$$

and this needs to be *deducted* from GNP to get to NNP. Thus, if $D_k > 0$ there is more pollution and a positive value of damage $P_k \cdot D_k$ to householders and this should be deducted from GNP. Hence $\text{NNP} < \text{GNP}$. If pollution damage *falls*, that is, $D_k < 0$. Both P and MC are positive, so the expression $(P_k + MC_k) \cdot D_k$ is *negative*, and since it is being deducted from GNP, the effect is to *add* to NNP. $\text{NNP} > \text{GNP}$.

So the final expression for NNP is:

$$\text{NNP} = \text{GNP} - \delta Km - \sum_i [P_i - MC_i][Q_i - N_i] + \sum_j [P_j - MC_j][g(X_j) - H_j] - \sum_k [P_k + MC_k]D_k \quad (7)$$

Notes

1. For a recent statement, see D. Hausman, *The Inexact and Separate Science of Economics* (Cambridge: Cambridge University Press, 1992).

2. J. Elster and J. Roemer, *Interpersonal Comparisons of Well-Being* (Cambridge: Cambridge University Press, 1991).

3. This is quite different from saying that compensation, for example, should always be thought of in terms of cash. Other goods and replacement assets may be more appropriate, but they can be related back to money in the resulting calculus.

4. The aggregation problem arises again. There will be gainers and losers under each option. Benefit-cost analysis proceeds on the assumption that gainers do not *actually* have to compensate losers—"hypothetical compensation." But if losers are not compensated, they are actually worse off, which has obvious implications for distributive justice.

5. John Pezzey, *Sustainable Development Concepts: An Economic Analysis*. Environment Paper no. 2 (Washington D.C.: World Bank, 1992); David W. Pearce, *Economic Values and the Natural World* (London: Earthscan Publications, 1993).

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16. David W. Pearce and Jeremy J. Warford, *World without End: Economics, Environment, and Sustainable Development* (New York and Oxford: Oxford University Press, 1993); Robert C. Repetto, *World Enough and Time: Successful Strategies for Resource Management* (New Haven: Yale University Press, 1986).

17. S. Fankhauser, "Evaluating the Social Costs of CO₂ Emissions" (CSERGE Working Paper, Centre for Social and Economic Research on the Global Environment, University College London and University of East Anglia, 1993).

18. R. Schneider, "The Potential for Trade with the Amazon in Greenhouse Gas Reduction" (LATEN Dissemination Note no. 2, Environment Division, Latin America Technical Department, World Bank, Washington D.C., 1993).

19. Yusef J. Ahmad, Salah El Serafy, and Ernst Lutz, *Environmental Accounting for Sustainable Development* (Washington, D.C.: World Bank, 1989); Ernst Lutz, ed., *Toward Improved Accounting for the Environment* (Washington, D.C.: World Bank, 1993).

20. Robert M. Solow, "On the Intergenerational Allocation of Natural Resources," *Scandinavian Journal of Economics* 88 (1) 1986.

21. K. Hamilton, David W. Pearce, G. Atkinson, A. Gomez-Lobo, and C. Young, "The Policy Implications of Natural Resource and Environmental Accounting." (Report to the Environment Department, World Bank. Centre for Social and Economic Research on the Global Environment, University College London, 1993).

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24. David W. Pearce, ed., *Blueprint 3: Measuring Sustainable Development* (London: Earthscan Publications, 1993).

25. Pearce and Moran, *The Economic Value of Biological Diversity*.

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Discussant Remarks

Anne Harrison

There is agreement that what we want to do with accounting measures is to change the conventional way in which we measure production so that we take appropriate account of environmental issues. But there is very little agreement over the whole range of issues of *how* we do it. I would like to talk about some of the issues that have come up in these two papers, point to the areas on which I think there is fairly general agreement or agreement is well on the way, but highlight some areas where agreement is further away.

What Are Economic and Environmental Assets?

This statement appears in David Pearce's paper: "'True' or 'sustainable' income is that flow of income which leaves *the value* of the capital stock of the economy intact" [addition in italics mine]. It is not enough to say that sustainable income is the flow of income that leaves the capital stock intact. We are talking about the value of the capital stock. Among humanmade assets we continually substitute one sort of capital asset for another, and we have to raise the possibility that we can do the same with environmental assets. Clearly, we do not mean that to maintain capital stock intact, petrol in the ground has to stay in the ground. We have to think in terms of *substitutability*, a major area to which we have to pay attention.

Next, I want to talk about what we mean by capital assets. It is clear that economic assets are "good things," but not all good things become economic assets. We have to be careful in speci-

fying what we mean by an economic asset. Those of us who have been involved with the revision of the System of National Accounts (SNA) spent some time fighting for a definition and ended up with the following:

An economic asset is an entity over which ownership rights are enforced by institutional units, individually or collectively, and from which economic benefits are derived by its owner(s) by holding or using it over a period of time.

You may have some reservations about it initially, but if you can come up with a better and more satisfying definition, many people would be very glad to hear it. Working from this basis, we then decided that we need to think about the level of wealth of an economy, and we need to work out a taxonomy for it.

Table 1 lists different types of assets, starting with financial assets and liabilities. For non-financial assets, we tend to differentiate between produced and non-produced. They are not quite the same as the difference between manmade and natural assets that are referred to in the Pearce and Dasgupta papers because some natural assets that are cultivated are included within standard measures of production. It is only those that are not cultivated in that sense that we treat as non-produced.

But even within the second list of the non-produced assets, not all of them are necessarily included in conventional accounts. We include only those that are drawn into the production

process: sub-soil assets that are being exploited are included whereas those that remain economically nonviable at the moment are excluded. Thus, we can make an additional list of environmental assets that are currently excluded from the SNA, which will have the same basic headings as those above but which are not yet drawn into the production process.

Clearly, it is possible to extend the sort of analysis that we are used to doing in national accounts to include these items. One of the characteristics of those that are listed above the dotted line is that ownership can and is established over these, and on the whole we can find prices that represent them. Over the first set below the dotted line, ownership could be established, and probably some sort of valuation could be placed on them.

But there remain some items, such as the oceans and people, for which it is rather difficult to do either of these things. On the whole, within the national accounts we do not yet regard people as being economic assets. People obviously have worth. They are often economically productive, but they are not, thankfully, generally bought and sold in the marketplace with skills that can be transferred from one person to another.

Table 1. Assets constituting wealth in a wide sense

Financial assets/liabilities	
Non-financial assets	
Produced assets	
"Man-made"	
Cultivated	
Non-produced assets	
Land	Drawn into
Subsoil assets	production process
Non-cultivated biological resources	
Water resources	
Land	Not/not yet drawn into
Subsoil assets	production process
Biological resources	
Water resources	
Air	
Oceans	
People	

Table 2. Possible relations between GNP and NNP

GNP
$NNP = GNP - \delta K_p$
(1) $g\ GNP = GNP$
$g\ NNP = g\ GNP - \delta K_p - \delta K_n$
(2) $g\ GNP = GNP + \delta K_n$
$g\ NNP = g\ GNP - \delta K_p - \delta K_n$
(3) $g\ GNP = GNP - \delta K_n$
$g\ NNP = g\ GNP - \delta K_p$

So these are the lists of assets that we can consider, and it is the list above the dotted line, and possibly including the first set below the dotted line, that we wish to consider preserving or of which we wish to consider preserving the value when we make estimates for gross national product and net national product.

Towards the end of his paper, David Pearce has a couple of equations showing the alternatives to accounting and showing variations. Another way of looking at it is shown in table 2.

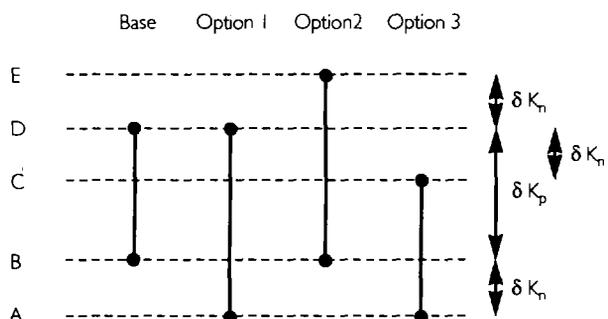
At the top is what we generally include in national accounts: a measure of gross national product and then a measure of net national product that takes out the consumption of fixed capital on produced assets. Next, we have three variations put forward by different people in slightly different circumstances.

The first one is the most simplistic: we leave gross product unaltered, but for net product we take off consumption or depreciation not only for produced assets but also for non-produced assets. The second alternative is to say that we should *not* leave gross product unaltered. We need to make an addition to the gross product as well as make the two deductions to reach net product. The third option is that we still change gross product, but by making a deduction, not an addition.

It may be easier to look at these variations as shown in figure 1.

In the base case, the bulb at the top is gross product; the bulb at the bottom is net product. Option 1 leaves the gross product unchanged but depresses net product. Option 2 leaves net product unchanged but increases gross product, but the difference between the two is the same, as in Option 1 (that is, $AD = BE$). Option 3

Figure 1 Schema of Table 2



depresses gross product but leaves net product where it is under Option 1. In the base case and Option 3, the difference between gross and net product is only δK_p ; in both Option 1 and Option 2, it is $\delta K_p + \delta K_n$.

To a large extent there is agreement on the differences between gross and net measures. There is less agreement about which one we keep constant, if either. Figure 1 is one way in which I would characterize the remaining discussion about how we should alter GDP, if at all.

The Adjustment for Depletion of Natural Capital

There are three elements to an adjustment for consumption of natural capital: depletion for nonrenewable resources, depletion for renewable resources; and degradation. The two formulae in table 3 come from David Pearce's paper. The first one shows the difference between the quantity extracted of a nonrenewable resource less the discovery, and we multiply it by a price that is the difference between its market price and the marginal cost of extracting it. It is, in effect, therefore, the value of the petrol in the ground if we take $P-MC$ as a measure of its unit value.

I would argue and a number of other people would argue that in that equation it is not appropriate to have N for the new discoveries. If we suddenly win a million dollars in a lottery, would we really regard that as being our income in this year? It is true that we could spend it and still be as well off at the end of the year as we were at the beginning, but it is not a very prudent way of proceeding. We would not typically assume that it was income. Similarly, if we have an earthquake as there was in India this morning, and there is a massive loss of capital stock, we would not normally take that capital loss off the income for India this year. Within depreciation, we generally

Table 3. Pearce's equations for depletion of natural resources

Depletion of non-renewable resources

$$(1) \delta K_n = (P - MC)(Q - N)$$

Depletion of renewable resources

$$(2) \delta K_n = (P - MC)(g(X) - M)$$

Key: δK_n = Depletion
 P = Price
 MC = Marginal cost
 Q = Quantity extracted
 N = New discoveries
 $g(X)$ = Natural growth
 M = Offtake

talk about normal losses. We deal with exceptional losses separately.

Therefore, if exceptional losses do not come out of depreciation for produced assets, then in parallel the discoveries should probably not be knocked off the depreciation for the non-produced assets. So on the whole, in the first equation my inclination would be to take out the term N .

I have little problem with the second equation although I think in practice for many renewable resources, the marginal cost of extraction is probably not so relevant in the equation. We can usually simply take the market price times the difference between the growth during the year and the offtake.

The real problem comes with the third adjustment—for degradation. This is an area about which a great deal of discussion continues and little consensus has yet emerged. Let me try to illustrate some of the problems with a notional example that does not initially have to do with the environment. Suppose we think about a manufacturer of cigarettes, and we say that it costs 100 to make the cigarettes. The immediate costs are 45, leaving value-added of 55. Households consume the cigarettes, spending 100 on them, and because they are not good for their health, they also have to spend another 20 in putting good the damages that they incur to their health. These figures appear in the first column of table 4.

The logic that says that the pollution costs should be borne by the producer means that we would change the numbers as follows (see column 2): output is still 100, but the costs have increased from 45 to 65 because the producer will pay for the health costs. His or her value-added goes down, and households still have to spend only 100 because they now get free health care provided courtesy of the tobacco manufacturer!

This does not seem to me to be likely. In the real world the tobacco manufacturer would increase the cost of his/her product to cover the extra costs, as in column 3: output would go up

Table 4. "Environmentally adjusted" account for cigarette production and consumption

Output	100	100	120
Intermediate consumption	45	65	65
Value-added	55	35	55
Household consumption of cigarettes	100	100	120
health	20		

to 120, his costs would stay at 65, but his value-added would revert to where it was originally, and households would go back to spending 120 because the cost of the cigarettes have gone up.

This case is oversimplified because some consumers would be put off by the increase in the price of cigarettes and a new supply/demand equilibrium would be reached, say at 110 instead of 120. Basically, the process of including prices that were not included before changes the whole picture. We cannot simply move things from one bit of the equation to another and assume everything stays the same. When we want to take pollution costs into account, we end up in a modeling situation in which we have to worry about elasticity of demand for all products in the production cycle affected by the new costs. It is not just as simple as saying we will knock something off GDP, perhaps on two sides, once on the demand and once on the supply side, to get to what we want.

National Accounts, the Environment, and What Else?

This is one of the problems that I have with the proposal for how to deal with the consumption of non-produced assets. I have problems, too, about consistency. Why do we take a system and change the valuation for part of it rather than have a whole new system in which we use a different set of valuation rules all the way through?

If we think that we need to do certain things for environmental goods, why do we not do them

for others? If we think that it is appropriate to take externalities into account for environmental goods, why do we not do so for cigarettes, for confectionery if it is bad for teeth, for fast cars which also kill people? Why stop at the purely environmental issues?

If we want to measure the cost of fetching water in terms of the energy expended and the time taken, why do we not do that for other types of production? For subsistence agriculture, we typically value the value of rice or maize grown by its price if it were sold, but we could measure it the same way that we would do for water, so why don't we?

I would like to end by making a reference to the measure of GDP as welfare. Most national accountants fight very hard against the idea that GDP is a measure of welfare. It might be a measure of welfare. It certainly is not the only measure of welfare. There are serious problems in trying to find a single number to tell us everything we want to know about an economy. The report produced by UNICEF last week called *The Progress of Nations* compares and contrasts very good measures of welfare for many countries with their GNP and shows that there is an almost complete lack of correlation.¹

Note

1. UNICEF, *The Progress of Nations* (New York: UNICEF House, 1994).

Discussant Remarks

Dhira Phantumvanit

Environmental valuation rarely has been employed in the developing world. This empirical tool has been used in Thailand. There has been, for example, a study of the willingness-to-pay of users in the central park in Bangkok, Lumpini Park. The national Global Climate Change response strategy also makes use of this tool, and a 1993 World Bank report, *Thailand: Managing Environmental Impacts in a High-Growth Economy*, attempts to assess the health costs of various forms of urban environmental problems to set priorities for remedial action. But these are isolated cases.

Thus, when the debate turns to the ethics and techniques of environmental valuation, one of the first issues that springs to my mind concerns the limited application of these techniques to the developing world.

If we consider the basis of willingness-to-pay, perhaps this will give us some idea of the problems of the ethics of implementation. Understanding the position of those valuing the environment provides an insight into the difficulties of application of this economic tool. The value placed on environmental quality is likely to be different between the rich and the poor, the educated and the uneducated. The “upside-down U” curve is often cited in this regard. We should not expect the poor to be as enthusiastic about paying for environmental quality as the rich, particularly when the issues concerned are very distant from their day-to-day lives, as, for example, global warming.

There are also differences between groups in their estimation of option values. Those in abject poverty are far less likely to take into considera-

tion the long-term implications of resource use than are those who are more economically stable.

Practical problems in applying economic tools to environmental valuation in the developing world also have limited their use. In particular, there is a lack of basic data linking environmental quality with health and with the performance of the national economy, let alone data on biodiversity or assessments of spiritual values on the environment. Thailand recently tried to devise a strategy for tackling water pollution in the Chao Phraya River, which runs through Bangkok, but the lack of data linking water quality and the health of nearby residents made it difficult to estimate the economic benefits from investing in sewage treatment systems, not to mention the valuation of aesthetic values associated with such an investment scheme.

Global Climatic Change

Regarding opportunities in the application of valuation techniques for global issues, for example, global climatic change, I agree that these may be very useful tools in the move towards more sustainable development. *However, they should be used in association with policy measures that ensure that the poor in the developing world do not lose out. If the North is willing-to-pay the South to conserve their forests to serve as carbon sinks, there are bound to be problems in distributing financial compensation fairly.*

For example, we recently completed a response strategy for the Government of Thailand based on “no regrets” policy. Actions proposed

include energy conservation and expanding reforestation in addition to the economic and social policies of the government. In adopting a "no regrets" approach, it is possible to circumvent the problems of estimating the likely impacts of global climate change in Thailand. Nonetheless, there is a need for economic valuation as a step towards setting priorities in policy implementation. The role of reforestation and energy conservation in tackling global climatic change at the national and international level is a particularly interesting area of study.

Our study in Thailand indicates that the magnitude of carbon reduction by reforestation is large, compared with other alternatives. Fuel switching from high to low carbon content fuels plus demand-side management on power use and better efficiency in transportation can reduce CO₂ emissions by 10 to 12 percent. On the other hand the conservation of forest resources can reduce CO₂ emissions by about 20 percent. The average net cost per ton of carbon sequestered in Thailand is between US\$4-8, a figure that is much lower than the environmental damage of US\$20, as suggested by Frankhauser.¹ And the latter does not include the economic value of biodiversity that a policy of forest conservation would save.

Nonetheless, the use of fossil fuels is damaging to the environment in other ways and is likely to increase throughout the developing world unless alternative sources of energy can be found to support moves towards economic development.

In the debate surrounding the means to tackle global climatic change, there has been a justifiable emphasis on finding the most cost-effective way to reduce CO₂ emissions. There has also been consideration of the size of the countries, the amount of greenhouse gases emitted, and the fragility of the recipient countries. The point I should like to raise is that there has perhaps been too little consideration of the growing ability of people in various countries, including some developing countries, to appreciate option values in setting forestry and energy policies. Hence, countries with good economic track records will be in a position to generate additional domestic

resources to complement external inputs. This is something that new avenues of environmental financing, such as the Global Environment Facility, should not disregard.

National Accounting

David Pearce has outlined some of the problems with national accounting as practiced and suggests methods to produce a green measure of national product. One fundamental problem that I can foresee comes simply from the difficulties in assessing the "credits" and "debits" in the national account. How do we value the extinction of a species of animal? We can hardly balance this "debit" with increases in the numbers of another species.

Finally, let us turn to green national accounting in the developing world. I am often asked to comment on the relevance of environmental national accounting to Thailand. My standard response is that it remains very much a spectator sport for developing countries. I cannot foresee our national governments adopting these techniques until they have been seen to be tried, tested, and standardized in the Organisation of Economic Co-operation and Development (OECD) countries first. Developing world governments are particularly concerned that such assessments of our national accounts will produce a lower per capita GNP estimate. This may change the economic rating of the country and hence the position of donor organizations and foreign investors.

Novel ideas are always welcome, but, in my experience, novel means to manage the environment often remain of more interest to the arm-chair philosophers whom Professor Pearce mentions than they are translated into practice. The challenge is to develop these tools so that they can be applied throughout the world within the constraints of a real-world setting.

Note

1. Frankhauser citation not available.

Discussant Remarks

Robert C. Repetto

If the accounting framework that the World Bank and other development agencies use to construct their economic analyses leaves out important categories of benefits and costs, or counts as benefits what are actually costs, it is almost inevitable that those analyses will lead the Bank and other agencies to wrong decisions. The accounting framework is seriously deficient, and there is ample evidence that in the past this has contributed to faulty decisions.

The Bank's main mission is to raise incomes in developing countries, especially the incomes of the poor. But the accounting framework measures income incorrectly, failing to distinguish between the yield on productive natural assets and the consumption or depletion of the assets themselves. Even though poor households in developing countries are disproportionately dependent on natural resources, most of which are rapidly deteriorating in productivity, the accounting framework in use today fails to treat natural resources as productive capital and fails to record the loss of this natural capital as disinvestment or capital consumption.

The World Bank has done a great deal in recent years to strengthen its environmental assessment of projects and to seek out projects that contribute to economic and environmental goals. Nonetheless, it is not surprising that in past years, using this faulty analytical framework, the World Bank and other multilateral development banks have financed projects that did little more than facilitate the stripping of natural assets. At least one multilateral development bank (MDB) has financed forestry projects that sharpened the

blades of the sawmills in the absence of any sustainable timber management. There have been fisheries projects that provided the equipment to deplete fish populations more rapidly. There have been agricultural projects that accelerated the depletion of soils and groundwater.

Bank economists, such as Jerry Warford, have written years ago on the need to apply a user cost to projects that deplete natural capital.¹ However, a recent review by von Amsberg notes that many project appraisals either do not include a user cost for resource depletion where one is needed or assign a zero default value for natural capital.² Obviously, this situation should change. The appropriate decision criterion for project evaluation consistent with good welfare economics, which Partha Dasgupta's paper plainly sets forth, includes the cost (or benefit) of net changes in the stock of natural resources.

The effects of a faulty accounting framework are not limited to individual project appraisal. They can also be found in sectoral activities. For example, the World Bank is an important supporter of agricultural research through the Consultative Group on International Agricultural Research (CGIAR) network and a major lender for agricultural modernization. However, although the CGIAR is now paying much more attention to issues of sustainability in agriculture, the criterion that CGIAR researchers have been using to judge whether a potential technological innovation in agriculture represents an improvement has not included a user cost for natural resource depletion or the loss of natural capital. Recent research has shown that when these costs

are factored in, less intensive but resource-conserving production systems, which have been slighted by the agricultural research establishment, actually have higher potential returns.

The effects of a faulty accounting framework also distort macroeconomic analysis and policy. Stabilization programs supported by the International Monetary Fund are designed to prevent an excessive accumulation of internal and external debt, that is, an unsustainable rise in national liabilities. They are explicitly based on the assumption that the productive capital stock is fixed in the short-run. In other words, they are designed to stabilize one-half of the national balance sheet, the liabilities side, paying little attention to the other half, the asset side.

However, the level of indebtedness a country can sustain is closely tied to the level of its productive assets. Recent studies have shown that in several countries that went into so-called debt crisis in the 1980s, the loss of productive natural resource assets had been proceeding at a higher rate than the increase in external indebtedness. The loss of natural resource assets reduced potential income and exports with which the debt could have been serviced. Yet, this fact was completely overlooked because, while financial statistics monitored changes in debt position, the macroeconomic accounting framework gave no indication of the depletion or loss of natural resource assets.³ Moreover, in at least one country case study, research has shown that policies designed to reduce the rate of accumulation of debt had the unintended—and unexamined—consequence of accelerating the loss of natural resource assets.⁴

These examples proceed from project to sector to national level. I have emphasized the pitfalls to which a faulty accounting framework can lead. I could just as easily give examples of the beneficial uses and insights that corrected accounts have provided. Both kinds of experience indicate that an investment of World Bank resources to generate and apply better accounting frameworks, accounts that assign appropriate values to natural capital, is fundamental to the mission of sustainable development.

In the Environment Department and in Ismail Serageldin's new vice-presidency, and indeed throughout the Bank, there are people who have supported efforts to put appropriate values on

the environment. John Dixon, Andrew Steer, Herman Daly, David Wheeler, John O'Connor, and others have spearheaded these efforts. Much more could be done. The World Bank has the largest and most capable group of development economists and related professionals in the world. It has the largest financial resources of any development agency. It has the best access to data and information of any development agency. It is in a position to take a leadership role and to make a major contribution to progress in this area.

Relative to these capabilities, the Bank so far has done little. It has spent a great deal of time on reviews of methodology. However, the methodological framework was established years ago, by the likes of Dasgupta, Heal, Weitzman, Solow, Samuelson, Mäler, and Hartwick. There are no fundamental methodological problems. The principles of asset valuation are well understood. The issues are largely those of adapting those principles to the needs of specific applications, availability of data, and institutional capabilities. The UN's System of National Accounts (SNA) already includes national balance sheets in which land, subsoil minerals, forests, fisheries and other natural resources are included. The SNA guidelines for valuing such assets have been accepted for decades. The principles of asset valuation adopted in those balance sheet accounts are equally applicable to the income, product, and investment accounts.

The Bank has also supported three rather quick and dirty country case studies based on readily available statistical information, at a cost of roughly \$50,000 each. In fact, developing countries are out in front of the Bank at this point. Efforts are already underway in more than a dozen developing countries to construct natural resource accounts. A recent conference hosted by the Organization of American States (OAS) for agencies responsible for constructing national accounts in all countries in the Western Hemisphere demonstrated strong interest in natural resource accounting. Participants in that OAS conference formulated a proposal for cooperation among Western Hemisphere countries in training, technical assistance, and information exchange. Developing countries already see the need and are making efforts to change, and they are asking for the Bank's support and assistance. I respectfully urge that the Bank join

with the UN and other multilateral agencies to provide that support.

Notes

1. Jeremy J. Warford and David Pearce, *World without End* (New York: Oxford University Press, 1993).
2. J. von Amsberg, "Project Evaluation and the Depletion of Natural Capital: An Application of the

Sustainability Principle" (Environment Department Working Paper no. 56, World Bank, Washington, D.C., 1993).

3. Wilfredo Cruz and Robert C. Repetto, *Accounts Overdue: Natural Resource Depreciation in Costa Rica* (Washington, D.C.: World Resources Institute, 1991).

4. Wilfredo Cruz and Robert C. Repetto, *The Environmental Effects of Stabilization and Structural Adjustment Programs: The Philippines Case* (Washington, D.C.: World Resources Institute, 1992).

Discussant Remarks

Andrew Steer

It is good to follow Bob Repetto, especially when he is giving the World Bank advice. We are doing much more than you suggest, Bob, but even so, we should be doing more. I have just three comments on what we have heard this afternoon.

First, how valuable is the concept of sustainability in theory and in practice? Partha Dasgupta argues that while the concept of “sustainable” development is useful in motivating enthusiasm for the environment, it has no useful meaning in theory—and hence, presumably none in practice. He takes the economist’s stance: if we do the intertemporal optimization right, and use the right shadow prices, the correct policies will simply fall out of the analysis. This approach will serve us much better than simply assigning “sustainability” rules, which inevitably will be arbitrary.

When my good friend Herman Daly read that, he was very troubled because he saw a serious threat to real world policymaking from theoretical economics. In the real world, it is not possible to do the careful intertemporal optimization calculations, using correct shadow prices. And it is because of this, presumably, that David Pearce *would* support supplementary sustainability conditions. Elsewhere, David has argued that a concern for the long-term environment calls not for an adjustment of discount rates, but it may (for precautionary reasons) call for the imposition of special constraints to ensure that future generations’ welfare is protected. Thus, for example, to be on the safe side, we may choose to require that the value of natural capital does not decline below today’s level. This would provide some broad assurance that the welfare accruing to

tomorrow’s generations from the natural capital stock not be less than that enjoyed by today’s generation. Partha Dasgupta would argue that such a constraint is quite arbitrary and may lead to sub-optimal intertemporal welfare. Hence the title of his paper. But which of the two of these distinguished economists is correct? David, are you making progress on applying the sustainability constraints in practice? Partha, do you agree that in the real world, we need some (albeit arbitrary) rules of thumb to give some assurance that tomorrow’s citizens can lead the good life?

Second, we economists need to know our own limits. There are some things that we cannot put money value on with any accuracy. Often, values imputed to the environment by human beings stem from deeply held spiritual and cultural roots. Contingent valuation can shed light on those values, but the empirical problems associated with such techniques are well known.

For many environmental assets, these non-measurable values may be the most important of all. This need not be a problem as long as we adopt a sensible attitude towards the estimation of economic values, that is, that such estimates are only partial. The job of the economist is to do as good a job as possible in estimating those values that can be measured, and this should be respected by all as one important input to the decisionmaking process, but not the only one. Decisions need to be informed not only by such calculations but also by the expressed views of people through open discussion and the political process. This point explains why sound environmental policymaking can operate only in an

atmosphere of participation and democracy—a point that Ismail Serageldin made.

In practice, unfortunately, economists tend to condescend to policymakers when decisions are made on “non-economic” grounds, and environmentalists tend to harshly criticize economists whose valuation exercises suggest that, on economic grounds, the costs of protection outweigh the benefits.

Calculations of the economic costs and benefits of averting global warming illustrate these points. When economists have attempted to calculate the economic costs of global warming—as in William Cline’s excellent book, *The Economics of Global Warming*¹—the justification for strong action today is marginal at best. Such calculations should not lead economists necessarily to oppose action. Nor should they lead environmentalists to exaggerate numbers or argue for artificially low discount rates so as to bias the results in their favor. The real reason we should do something about global warming is not that it is going to affect the economics of our lives 200 years from now. Rather, it relates to the much deeper spiritual and moral reasons associated with the fact that you and I do not want to hand on to our children’s children a world that is very different from the one we inherited. While, in principle, such values could be captured by economists’ tools, in practice, they cannot with accuracy. For more on this, and on choosing discount rates, I recommend an interesting debate in *Finance & Development* between Nancy Birdsall and myself, on one side, and William Cline on the other. The articles are entitled, “Act Now on Global Warming—But Don’t Cook the Books” and “Give Greenhouse Abatement a Fair Chance.”²

Third, I would like to raise the issue of national accounting for the environment. The World Bank has been very heavily involved in this whole process with our colleagues at the United Nations Statistical Office (UNSTAT). We have formed a small unit in the Environment Department at the Bank to advance this debate and to provide technical assistance when requested. We have just completed a book, edited

by Ernst Lutz, which presents the findings of three case studies—Mexico, Papua New Guinea, and Thailand.³

I have some sympathy for Dhira Phantumvanit when he says that national environmental accounting is still a spectator sport. Institutions like the World Bank, the Government of Thailand, or Dhira’s institute have to decide how to allocate their scarce resources. How much to allocate to adjusting the national accounts will depend on the circumstances. On the one hand, it is important that we not go overboard on this issue, and pre-empt too much of the scarce resources of environmental and statistical agencies. (A report we have just completed documents how six different methodologies have been recommended to the authorities in Indonesia, causing all kinds of confusion.⁴) Similarly, we do not want to get too arcane in the methodology when the quality of the basic data remains unacceptably poor. On the other hand, however, it is important that we not get overwhelmed by the difficulties involved. Short-cut measures need to be devised for situations in which data are weak, and many more resources need to be allocated to improving the quality of basic data.

Above all, given the large number of options, the choice of indicators and the types of adjustment to the national accounts need to be driven by policy-relevant questions of importance to development practitioners.

Notes

1. William R. Cline, *The Economics of Global Warming* (Washington, D.C.: Institute for International Economics, 1992).

2. Nancy Birdsall and Andrew Steer, “Act Now on Global Warming—But Don’t Cook the Books”; and William R. Cline, “Give Greenhouse Abatement a Fair Chance,” *Finance & Development* 30 (1) March 1993: 3-8.

3. Ernst Lutz, ed., *Toward Improved Accounting for the Environment*, An UNSTAT-World Bank Symposium (Washington, D.C.: World Bank, 1993). A paper describing the findings and recommending strategies for the future is Appendix 1 of this volume.

4. Internal World Bank report.

Floor Discussion

In addition to the panelists' responding to the discussants' remarks, the process was opened up to enable the audience to express their concerns and ask questions. Their questions included (1) whether the World Bank will engage the world's spiritual traditions in the value decisions and moral questions inherent in valuation of the environment, and (2) the economic implications of including or not including disabled persons in development, and the issue of participation.

Panelists' Responses

Partha Dasgupta: Anne Harrison raised a number of questions. First, should accidental discoveries be included in measures of NNP? The answer is, if the likelihood of such discoveries is uninfluenced by policy, that is, if the discoveries are totally serendipitous, then "no." More accurately, it is a matter of indifference whether or not we include them in the estimates. The reason is that, at the margin, policy choice will be unaffected by the prospects of accidental discoveries because the latter are, by hypothesis, uninfluenced by policy!

On the other hand, discoveries are not a matter of luck. They also involve expenditures of resources, that is, research and development. In other words the likelihood of new discoveries is influenced by R&D expenditure. Given this fact, discoveries should be included.

Anne's second point concerned the taxation of motor cars on account of their causing accidents. So do alcohol and tobacco cause "accidents," and we do tax them. There are two points about such goods. Governments may wish to tax activities

because of the external damages they cause, for example, motor driving, which causes congestion on the roads, or because they are bad for us, for example, not wearing a helmet when riding a bike. I do not think there is any conceptual difficulty in distinguishing these two cases. The concept of "merit goods" would cover the desirability of taxing activities because there are intrinsic harms in engaging in them.

Anne's third point was that GNP is not a measure of human well-being. I do not know anyone who thinks it is. It is net national product, or NNP, *when properly measured*, that is an index of well-being. NNP measures well-being in the following sense: small policy changes that would increase NNP simultaneously would increase the level of well-being. Contrariwise, policy changes that would decrease NNP would simultaneously reduce well-being.

In saying this, I hope it is realized that NNP is not independent of our notion of human well-being. The valuation of goods and services is dependent on the latter. In short, NNP is based on shadow prices, not market prices (unless the two sets of prices coincide). Thus, there is no contradiction between what I am saying here and the claim that is increasingly made that there are countries with high GNP per head and low life expectancy at birth and countries with low GNP and high life expectancy at birth. The consumption of services such as primary health care is known to possess strong externalities. Public economics has for long made it clear that on their own markets will not produce an adequate amount of this kind of good. NNP, when correctly

measured, uses shadow prices for all goods and services. For this reason NNP would be expected to be congruent with human well-being, which includes life expectancy at birth as a component.

This brings me to the point that David Pearce and I tried to make earlier. Estimating NNP is as much an art as a science. We understand the principles quite well now. How many corrections we choose to make to market prices is not something that theory can tell us.

Regarding the notion of sustainability, I still find it lacking conceptual sharpness. I do not think it has helped us understand matters. Consider, for example, the thought that *some* index of capital ought to be preserved to sustain consumption. Along a sustainable path some capital stocks will, presumably, get reduced, for example, coal stocks; while others will improve, for example, water equality, hopefully. In short, there will be a changing mix of capital assets along the chosen sustainable path. Thus, to create the index of capital that, by implication, must be preserved, we will need shadow prices, or some surrogate of shadow prices. Where will we get these shadow prices? Plainly, we will need a valuation criterion to obtain them. Thus, we are back to the notion of optimal policies, and the prior question of the distribution of well-being across generations.

The final question that was raised concerning the need to look after disabled people is immensely important. I would like to add that a great deal of the "disability" to which the questioner alluded is experienced by widows and girl-children in poor countries.

David Pearce: In his discussion Andrew Steer asked if had I modified my views on discounting and sustainability. The answer is no because if one reads carefully what we said, what I was arguing then and am arguing now is that we have an obligation to conserve what we would call critical natural capital, which is really the life support functions of the world in which we live. Thus, I would acknowledge the existence of substitution between forms of capital up to a point, and I would acknowledge the role of valuation. I hope I came across as both acknowledging it and advocating it.

Sustainability is not the only criterion for making choices about intergenerational transfers. Nonetheless, it is an important concept, and per-

haps people tend to overlook that we have already acknowledged that it is an important concept. Regarding our international agreements, people tend to rush straight to the articles of agreement and overlook the preamble. It is worth reminding ourselves that in the framework Convention for Climate Change we adopted a sustainability principle. In the Biodiversity Convention, we adopted a sustainability principle. In Europe we are negotiating a new acid rain protocol. That protocol speaks of eventually achieving critical loads of acid deposition, and a critical load is a zero damage load. It is a sustainability principle. If we look at the preambles to the conventions and if we look at Agenda 21 and at the legislation coming from the European Community, they speak of the precautionary principle, which is by and large a principle of sustainability.

I am glad that valuation and participation were raised because they are perhaps something we have overlooked: the process of eliciting people's preferences is also a process of participation. I have been working for a few months with the social analysts in the Bank on the resettlement issue. It is intriguing to find that rarely does anybody ask the resettled, What are you willing to accept? How do you value your assets? These are things that perhaps the valuation exercise has to show.

Here we also have a potential collaboration among the disciplines of which Ismail spoke at the beginning. For far too long, economists have neglected what sociologists and anthropologists have to say.

Ismail Serageldin: We have had a very lively debate. I would like to end with two observations. First, the question is valid that much of what we have been discussing does involve questions of moral and spiritual decisionmaking and commitment to the welfare of others—of the unborn, of future generations. Andrew Steer rightly reminded us that many of these choices are not going to be strictly economic choices anyway.

But perhaps what we need to carry from this discussion is that we need to move further; not wait for the perfect answer to all the questions, but move in steps. Much of what exists in current national income accounting is by convention and is not necessarily correct, but it is something that we have adopted and we use it knowing full well

its limitations. In this sense, on some things such as use costs, we should be using something other than zero value, rather than spending our time arguing about exactly what it should be. These are immediate steps we should all be taking.

I would also like to emphasize that it has not been the position of the World Bank to argue that GNP per capita is the sole measure. This view of the Bank seems to be perpetuated in the press, but it certainly runs counter to the slew of indicators that are published every year in the *World Development Report*. Every WDR contains 50 to 60 pages of statistics including the single page of basic statistics. We have never said that we would reduce

everything to a single measure. Obviously, no doctor would say that he or she could diagnose everything about a patient simply by measuring the patient's temperature and knowing whether the person is running a high fever.

This does not mean that we should throw away all the thermometers. There are still values in knowing whether people are running fevers or not, but we also need to know a lot more, and this is very much what the World Bank and all of us are trying to do. Every one of the speakers and discussants on this panel has contributed much to what we should be doing in the months and years ahead.

Part Three

**From Policy to Practice:
Managing Water**

Introduction

Emil Salim

The Rio Summit in June 1993 reminded us that there will be an increase in demand for fresh water for drinking, sanitation, irrigation, industry, urban development, hydropower generation, fisheries, transportation, recreation, and, in general, the healthy functioning of nature. There will be an ever increasing competing pressure for water throughout the years to come.

Meanwhile, the supply of fresh water, both on the surface and in the ground, is declining caused by deforestation, loss of water catchment area, and global climate change, which is already affecting parts of China. The quality of fresh water is also negatively affected by salt water

intrusion into estuaries and coastal aquifers; and water pollution caused by agriculture and industry, sewage, dams, and river diversion schemes.

With the projected increase of demand, which will be met by reduced flow of water combined with an increased rate of contamination and pollution, it is clear that many countries are facing a serious problem regarding fresh water supply. Such a situation calls for a water resource management framework and policy with the following major points:

- Increasing water use efficiency
- Enhancing the capacity of nature to catch water
- Eliminating water pollution.

The World Bank's New Water Resources Management Policy

Michel J. Petit

Water is critical for human survival. That is why governments in most countries see, and have always seen, an imperative need to become involved in its overall management. This has been true as far back as Hammurabi's Water Code in ancient Mesopotamia. Yet in most of the developing world, water resources are not being used efficiently and sustainably. Moreover, given the environmental sensitivity of river and underground water systems and the multiple demands from domestic consumers, industrial users, and farmers, the management of water resources is complex and difficult.

Countries are now faced with increasing difficulties in meeting the demand for inexpensive, clean, and reliable water supplies. A new approach is called for—one that recognizes that water is both a basic need and a scarce economic resource. The time to adopt it is now because the long gestation time of water investments and policies is such that what we do now will affect the next generation. This new approach is set out in the World Bank's water resources policy, which was approved by the Board of Directors in May 1993.¹ This policy seeks to balance two fundamental considerations:

- The need for a holistic management approach that gives due weight to longer term factors and to protecting the ecosystems
- The advantages of relying more on markets and pricing to improve the allocation of water among competing users.

I would like to highlight the key concerns that have guided the preparation of this policy paper,

but let me first mention some salient facts that provide its context.

The World Bank and Water Resources

From its early days the World Bank has had a very active assistance program for water resources management. By the end of 1991 the Bank had lent over US\$34 billion for water projects, over half of which was for irrigation. Present lending plans envisage a continued active involvement in water resources management: US\$18.3 billion are projected to be lent for water resource investments by the Bank during 1993-98.

Water Use and Future Demand

Human use of water has increased more than 35-fold over the past three centuries. Recently, water withdrawals have been increasing 4 to 8 percent per year, with the bulk of the demand arising in the developing world. Sixty-nine percent is used for agriculture, 23 percent for industry, and 8 percent for domestic uses. In Asia and Africa over 85 percent of the water is used for agriculture. Average consumption rates vary widely with per capita consumption in North and Central America being over twice that of Europe, three times that of Asia, and seven times that of Africa.

With the world's population growing from 5 billion now to at least 8 billion by 2025, and assuming steadily rising living standards, the demand for water will increase dramatically. Feeding these

populations alone will place huge new demands on the world's irrigated agriculture.

Food Production

One-third of the total world's food production comes from irrigated land. Since 1950 the irrigated area has grown by 2.5 times—a key factor in allowing food production to keep up with the growth in food demand. It is noteworthy that over the past twenty-five years, the expansion of irrigation has accounted for over one-half the increase in global food production. However, it is becoming increasingly difficult to sustain this expansion. The costs of new irrigation infrastructure are rising rapidly, and there are growing environmental concerns about large projects and the over-exploitation of groundwater. Consequently, new irrigated areas are not likely to be the major source of new food supplies. Rather, the focus must be on more efficient use of water in existing irrigation systems. This challenge is particularly acute in countries where some of the water currently used for irrigation will need to be reallocated to other uses.

Domestic and Industrial Uses

With regard to domestic needs, about 1 billion people in developing countries do not have access to potable water, particularly the rural poor, and 1.7 billion have inadequate sanitation facilities. As a result, waterborne diseases impose a huge burden on many countries. Unsafe water is implicated in the deaths of more than 3 million people and causes about 900 million episodes of illness each year. A safe water supply is literally a life and death issue.

Improving access to water and sanitation also makes good economic sense. For example, in just the first ten weeks of the 1991 cholera epidemic in Peru, losses from reduced agricultural exports and tourism were estimated at \$1 billion—more than three times the amount that the country had invested in water supply and sanitation services in the 1980s. With the fast growth of population and rapid urbanization in developing countries, domestic and industrial water demand are expected to rise sharply. However, both domestic and industrial users in urban areas are already

facing steeply rising costs of new supplies—sometimes twice or three times previous costs.

Environmental Water Requirements

Besides supplying water to domestic, industrial, and agricultural users, countries are increasingly faced with major environmental problems related to the management of water resources. For example, fisheries and wetlands depend on continuous river flows of reasonable quality and are threatened by growing extraction.

Moreover, in many places ground water resources are seriously at risk from over-exploitation and contamination by urban and agricultural pollutants and salt water intrusion. In the case of fossil groundwater, greater attention needs to be given to possible future uses for these resources now before they become exhausted. There are cases where non-renewable groundwater that could be an important source of water for future domestic or industrial use is being pumped to irrigate low-valued crops.

Improved Management

All of these considerations lead us to the irrefutable conclusion that water resources must be better managed. Current practices are not sustainable from either an economic or an environmental perspective. In many countries, water is grossly misallocated, with low-valued uses consuming a significant share of the resource while high-value uses face shortages. Inefficiencies abound. For example, unaccounted-for water amounts to 58 percent of the water delivered in Manila's water supply systems and about 40 percent of the water delivered in most Latin American cities, compared to only 8 percent in Singapore. Some of the losses are due to poor design and management while others arise from the low price charged for water. For example, a recent review of World Bank-financed projects showed that the effective price charged for water was only about 35 percent of the average cost of supply, and, for irrigation water, the effective prices cover an even smaller share of average costs.

Let me summarize the weakness of current practices:

- Fragmented water resources management leading to wasteful investments and uncoordinated management
- Excessive reliance on over-extended governmental agencies lacking the proper incentive structure and leading to poor service quality
- Underpricing of water and lack of cost recovery, resulting in excessive and wasteful water use, misallocation, and inviable water service entities
- Inadequate delivery of water and sewage services to the poor
- Over-centralization of the delivery of water services and the lack of stakeholder, community, and private-sector involvement, yielding a vicious cycle of unreliable service, low willingness to pay, and a further decline in capacity to provide service
- The neglect of water quality, health and environmental concerns leading to environmental degradation, poor water quality, and human suffering.

The World Bank's New Policy

The Bank's new approach was developed with inputs from outside organizations, such as the United Nations Development Programme (UNDP), the Food and Agriculture Organization of the United Nations (FAO), the World Health Organization (WHO), and the United Nations Environment Programme (UNEP), as well as intensive consultation with the nongovernmental organizations (NGOs) from both developed and developing countries. It also reflects the main principles recommended in Agenda 21 during the Rio Earth Summit.

At the core of the new policy is the adoption of a comprehensive management framework that calls for water to be treated as an economic good with multiple potential uses. It recommends a more decentralized system of service delivery, greater reliance on pricing, and fuller participation of water users in the management of water supply systems. It encourages countries to develop national water strategies with coherent and consistent policies and regulations across sectors. Let me briefly underline the main features of the Bank's new approach:

- Assisting countries in the development of a comprehensive analytical framework for

water resources, management that is suitable for a country's needs, resources, and capabilities. Such a framework will allow the incorporation of cross-sectoral and environmental considerations in the design of investments and policies by recognizing the interactions between the various elements of a river basin's ecosystem.

- Supporting reforms placing greater emphasis on incentives for efficiency and financial accountability by promoting financially autonomous water entities, privatization, and community ownership. This would entail increased reliance on pricing as a management device that reflects scarcity and encourages efficient utilization of the resource.
- Helping governments in establishing a strong legal and regulatory framework for dealing with the pricing, monopoly organizations, environmental protection, and other aspects of water management that are not adequately handled by unrestrained market forces.
- Supporting governments' efforts to decentralize water service delivery responsibilities to local governments and to transfer some of these functions to the private sector, to financially autonomous entities, and to community organizations, such as water user associations.
- Enhancing the capacity of governments, staff, and related institutions at the central and local levels to manage water resources through support for training in various aspects of water management.
- Prescribing and encouraging the participation of beneficiaries and affected parties in planning, designing, implementation, and management of water activities.
- Assisting governments in taking an active role in protecting, enhancing, and restoring water quality and water dependent ecosystems, and in abating water pollution. The Bank will increase its support to governments' efforts to improve and expand sanitation and wastewater collection and treatment.
- Prompting and supporting greater priority to the provision of adequate water and sanitation services for the poor, thus helping to stop the spread of disease in crowded low-income areas.

- Supporting research, development of low-cost options, and adaptation of technologies for irrigation distribution, water supply and sanitation, flood control, pollution monitoring, and waste treatment.

Future Financial Needs

The financial requirements to meet future demands for irrigation, hydropower, and water supply and sanitation investments in developing countries are estimated to be US\$600-700 billion over the next decade. The Bank will be able to finance only a small share of this. Part of the capital will have to come from water users themselves. This reality implies that the stronger emphasis on cost recovery and private sector involvement promoted in the policy paper will be absolutely necessary if countries are to meet their domestic water and food supply needs in the next century.

Implementation

This is an ambitious agenda. In most countries its implementation will be gradual, dealing first with priority issues, which differ from country to country. Programs must be tailored to the institutional capacity of the country. In many cases, capacity will need to be enhanced, and this takes time. Implementation of the policy paper's recommendations within the Bank will take time, too, as staff skills must be upgraded, skills mixes adjusted, and procedures developed and improved. Nonetheless, the process has already started, and the new water policy paper provides overall guidance for our trip on the long road ahead.

Note

1. World Bank, *Water Resources Management: A World Bank Policy Paper* (Washington, D.C.: World Bank, 1993).

Managing Water: The French Model

Ivan Chéret

This paper, which was commissioned by the World Bank, describes the system of water management used in France, drawing particular attention to its specific and original aspects. The aim is not to provide an exhaustive description of the system, which is necessarily complex at both legal and institutional levels, but to facilitate a clear understanding of it by concentrating on its underlying logic and the original options and mechanisms that have been developed in France.

The paper begins with a description of how the French water management system has changed over half a century and then highlights two original aspects:

1. The management of water resources, in particular the institutional and planning aspects
2. The management of urban water supply and sewage services by, in particular, bringing in private operators.

Water in France

Each year France receives some 450 billion cubic meters of rainwater, of which 250 billion m³ evaporate quickly or are absorbed by plants. The other 200 billion m³ feed aquifers, rivers, streams, and lakes. Half of this volume is technically and economically usable. About 30 billion m³ is abstracted, with about half of this amount used for cooling thermal power plants.

In an average year, overall precipitation is of the order of 800 mm, while in a dry year it may be as low as 600 mm. Water shortages can be much more serious in some areas than others, as shown by the droughts of 1976, 1982, and 1989,

which successively affected the western and southern parts of France.

Water is a very important economic and social commodity in France: environment-related expenditure concerning water is estimated at about \$10 billion a year, with over half of this amount being spent on pollution control. About 150,000 people are permanently employed in water-related jobs in France.

Administrative Organization of France

France covers an area of 549,000 km² and has a population of 55 million. The population density is of the order of 100 inhabitants per km². The smallest administrative unit is the *Commune* (of which there are about 36,500), followed by the *Départements* (95), and the *Régions* (22).

Each *Commune*, from the largest (Paris) to the smallest (about ten inhabitants), elects a local council and a mayor to take care of its administrative functions. The mayor and his or her local council decide what facilities will be provided in the *Commune*, particularly with regard to water supply and sewage services, and are responsible for levying the taxes to finance them. The same laws apply to large cities as to small *Communes* because theoretically they assume the same responsibilities.

Each *Département* in France elects a council that has the power to grant financial aid to the *Communes*, particularly for drinking water and sewage services. The *Région* has essentially a planning role and is administered by a regional council. The boundaries of *Départements* and

Régions were fixed in accordance with human factors and do not necessarily take into account the courses of rivers and streams, nor their catchment areas. Thus, the administrative division of the country into *Départements* and *Régions* is not always adapted to a sound consideration of water resources management problems.

Evolution of Water Policy in the Post-World War II Era

Until the post-war years, the demand for water remained well within the capacity of resources that were available locally or were easily obtainable, even if conflicts between users did arise in some places. The allocation of water to a particular use—urban, industrial, agricultural, or inland waterways—was generally made without noticeably prejudicing the other uses. This situation with virtually no competition promoted a *user-based management system*. Even so, this did not in any way hinder the development of water resources in France. It was essentially during the period between the two world wars that the major dam and irrigation projects were constructed.

Institutional Aspects

The Compagnie Nationale du Rhône, created in the 1930s before the Tennessee Valley Authority, paved the way with regard to the multipurpose development of a major river.

The responsibilities for water resources were at that time divided among:

- Ministry of Agriculture for rural water supplies (irrigation, water supply, and sewage for rural communities)
- Ministry of Public Works for shipping and flood protection
- Ministry of Industry for industrial and power requirements
- Ministry of the Interior, administrative supervisor of the *Communes*
- Ministry of Health for aspects relating to hygiene
- Ministry of Finance for questions of finance.

Legal Aspects

French legislation in matters pertaining to water distribution and use has for many years been

based on a variety of texts that nonetheless have the same dual aim of fair distribution and, more recently, a certain minimum quality. Until 1964, water rights were dominated by the *Code Civil* of 1804 and, above all, by the law of 1898. According to this law, the State made a distinction between rivers and streams in the public domain and those not in the public domain, and had the powers strictly required for operating inland waterways and avoiding abuse of water. This law of 1898 also recognized the right of a landowner—whether private or public—to use (but not to own) the water that the land receives and the ground water in the subsoil.

Thus, landowners could use rainwater falling on their land, as well as spring water, within the limits of their requirements. Those occupying land bordering rivers that were neither navigable nor floatable, that is, not publicly owned, could use the water within certain limits. As for groundwater, it was considered an “accessory” of the land, and the owner was free to use it within certain depth limits, defined by local regulations.

It is also important to mention the law of 1917 on “hazardous establishments,” the first of its kind in the developed countries. The aim of this law was to control the harmful effects and pollution caused by industrial activities.

The Need for Change: The 1964 Act

In the post-war years, France experienced considerable demographic and economic growth (the GNP in constant francs tripled between 1949 and 1969), resulting in a substantial increase in the demand for water and, a considerable rise in all kinds of pollution.

Around this time France, which had always been a rural nation, experienced the phenomenon of urban concentration that Germany and Great Britain had experienced several decades earlier. Urban water requirements thus quickly increased, resulting in corresponding growth in domestic pollution. At the same time, the industrial revival of the country accentuated the pressure on water resources and considerably increased the pollution of the natural environment. In addition, irrigation needs grew as extensive areas outside the traditionally irrigated zones of the south became equipped with irrigation facilities. Finally, this period saw the completion

of the hydropower development program—with a significant impact on river regimes—and the commissioning of thermal power plants, which are particularly large consumers of water.

Very quickly, a number of water shortages and pollution problems appeared—resulting from constant, uncontrolled use of water resources and the various types of pollution, especially urban and industrial, affecting the quality of surface water and groundwater. Local conflicts became more common. Gradually, a greater awareness of the limits and vulnerability of water resources developed among the public, local officials, and the more “sensitive” user groups, such as fishermen’s associations.

Public authorities were therefore confronted with conflicts among users, whether the problems were quantitative, in particular the amounts used in times of drought; or qualitative, especially the industrial pollutant and toxic outfalls in rivers. These user conflicts then developed into conflicts among administrative bodies, often leading to complex and difficult situations.

This increasing number of difficult situations gave rise to the reassessment that began in 1958 and resulted in the Water Act of 1964. A Water Commission was set up in 1959, a sort of “think-tank” comprising the various parties involved in water management. This commission outlined a number of general principles, which at the time were quite innovative even if today they may appear somewhat commonplace:

- In the same *hydrographic* basin, and even more so in the same sub-basin, there is increasing *interdependence* among users who abstract water in the same natural environment. A strong feeling of *solidarity* must be developed between users to encourage each one to minimize pollutant outfalls.
- Rational water management is possible only if it is recognized that water has an *economic value*, a notion that has been underlined as a result of competition among uses. Similarly, pollution has a real economic impact.
- *The water resources* of a given basin (groundwater and surface water) must be considered as a single resource, and, as such, long-term planning of water development and protection is required, taking into account the needs of all users and the impact of all abstractions and outfalls in the basin as a whole.

It was therefore necessary to change from a userbased water management system to an integrated or holistic approach.

To prepare a new water policy based on these principles and instituted by legislation, a Permanent Secretariat for the Study of Water Problems was set up in 1960. Its work resulted in the drafting of a bill at the end of 1963 concerning water distribution and pollution control. The bill was finally adopted at the end of 1964.

At this stage, it is well to remember the important political and administrative changes that France was undergoing during this period and that made it possible to envisage such profound reforms in water management. While the entire economy was centralized in the hands of the State after the Second World War, there was a gradual emergence and growth in the financial autonomy of local and regional authorities (the *Régions* were created in 1963). We should also take into account the economic forces existing at that period, not only the more traditional groups, such as the farmers, but also the industrial and town lobbies. The reform of the water management system owed its success in large part to its ability to adapt to the economic, administrative, and political circumstances.

The law of December 16, 1964 has profoundly modified water policy strategy in France:

- It established legislation and regulations for pollution control, introduced the notion of quality objectives, and set timetables, placing the emphasis on solidarity among users with regard to these objectives.
- It increased the policing and supervisory powers of the State as well as the means for settling disputes and introduced the notion of the *catchment area* for dealing with water problems.
- It introduced an *economic dimension* to identify the financial resources necessary for the investments that have to be made, particularly through the creation of the Basin Committees (*Comités de Bassin*) and the Water Boards (*Agences Financières de Bassins*).

Thus, the foundation for water management in France was established and put into concrete form. The system is underpinned by three principles of equal importance: *regulation*, *incentives*, and *dialogue*. Effective implementation of the law has since involved two main aspects:

1. Development of government action with respect to antipollution measures
2. Introduction of economic means of intervention through the Water Boards.

The establishment of the Water Boards was followed in 1971 by the creation of a Ministry of the Environment, which prepares water policy, sets regulations, and organizes planning. The Ministry of the Environment supervises the Water Boards, which in 1990 became known as the *Agences de l'Eau*.

Regular Updating: The 1992 Act

Since 1968, when the law came into force, considerable improvements have been made in every area of water management in France, but none of the basic principles of the 1964 Act have been called into question. However, a certain number of new factors have appeared during this period:

- Recurring drought lasting several years
- New types of pollution, in particular related to farming practices
- Insufficient development in the field of wastewater treatment (cleansing rate of the order of 40 percent in 1989)
- Inadequate consideration of the problem of stormwater.

In view of these factors it was necessary to renew and upgrade existing facilities, particularly since France has had to meet requirements stemming from European directives on water management in force since 1975. Preparation of the 1992 Act began in 1984. The Act aimed at:

- Remedying the inadequacies and disparity of existing legislation and eliminating obsolete clauses
- Improving the effectiveness of water policing
- Expressing the uniqueness of the water domain (oceans, surface water, groundwater) in the form of appropriate legislation and regulations
- Facilitating the role of local authorities in water management affairs
- Promoting balanced management of water and aquatic environments.

Among the most innovative aspects of the Act of January 3, 1992, the following are worthy of mention:

- Recognition of water as part of the nation's heritage
- Setting up a unified legal system

- Introduction of an original system of planning
- Upgrading the powers of the *Communes*, particularly with respect to sewage services
- Increasing consultation with elected representatives and water users, and openness towards the general public.

All these measures are in line both with past practices and current European and world trends.

Water Resource Management

Modern water management practices in France were introduced by the 1964 Act and improved and adapted over the years, specifically by the 1992 Act. *Water is now considered as part of the common heritage; its management is based on an integrated and balanced approach that aims at both satisfying users and preserving the natural environment.*

The present French system involves every level of the administrative machine—State, *Régions*, *Départements*, *Communes*; the users; the elected representatives; at the basin level, the Basin Committees (*Comités de Bassin*); and the mainstays of the organization: the Water Boards (*Agences de l'Eau*).

This section describes the institutional structure of water management in France, the recently introduced management planning tools, and, because of their importance and originality, the Water Boards.

Institutional Structure

Central level (State). The trend over recent years has been to group the scattered bodies with responsibilities in the field of water management within the Ministry of the Environment or its agencies. A *Water Directorate (Direction de l'Eau)* was set up in 1992 within the Ministry of the Environment to strengthen the role of the State in the area of water management, to exercise more effective supervision and coordination of the Water Boards, and to provide fresh impetus for the decentralized external services.

In preparing its water management policy, initiating and monitoring water use regulations, and planning organization, the Water Directorate receives guidance from:

1. The *Mission Interministérielle de l'Eau* (Interministerial Water Commission), which represents thirteen ministries

2. The *Comité National de l'Eau* (National Water Committee), which consists of representatives of the different categories of water users, river basin authorities, and the government, and expresses opinions on national water management policy.

In 1992 the Ministry of the Environment set up decentralized external services known as *Directions Régionales de l'Environnement*, or *DIREN* (Regional Environmental Directorates). The role of these services in water management is described later. The Ministry of the Environment calls on the external services of other ministries—Agriculture, Public Works, Health, Industry—for assistance, particularly in its policing role.

Hydrographic basin level. The fundamental concept introduced by the 1964 law was the creation of an inseparable tandem covering the major river basins: the *Comité de Bassin*, an authentic river basin “water parliament,” which defines the water policy in the basin; and its “government,” the *Agence de Bassin*, which implements the policy defined by the *Comité de Bassin*.

The 1964 Act resulted in the division of France into six hydrographic basins or, more exactly, groups of basins, a division that was formalized in 1966 by decrees relating to the Basin Committees and Water Boards. The six basins correspond to the following:

1. The country's four main catchment areas (Garonne, Loire, Rhône, and Seine), to which secondary basins were attached
2. Two specific border basins, in the north and northeast of the country, in areas of dense population and intense industrial activity.

The limits of these basins correspond to the watersheds and are generally not the same as the administrative limits. The main characteristics (area and population) of these basins are shown in table 1.

Each basin has its Basin Committee, which defines water management policy for the basin.

Table 1

River basin	Area (km ²)	Population (1990)
Adour-Garonne	115,000	5,700,000 -
Artois-Picardie	20,000	4,600,000
Loire-Bretagne	156,000	11,500,000
Rhin-Meuse	31,300	4,100,000
Rhône-Méditerranée-Corse	129,000	12,400,000
Seine-Normandie	97,000	17,700,000

These committees facilitate dialogue and solidarity among members. The composition of the Basin Committee is fixed by ministerial order and comprises three groups:

1. Users, qualified local dignitaries, and representatives of socio-professional groups, making up the largest group (40 to 45 percent of seats)
2. Representatives of the different authorities (*Régions, Départements, Communes*) (accounting for 36 to 38 percent of seats)
3. Representatives of the State (19 to 23 percent of seats).

The total number of committee members varies between 61 and 114, depending on the basin. This organization, which deliberately limits the influence of the State, reflects the desire to promote the role and responsibility of the different actors—users and elected representatives—in each basin and to encourage them to reach agreement. The Basin Committee, which generally meets twice a year, is systematically consulted and must give its approval on *fees (redevances) and the basis for their calculation*. These are presented by the Water board along with its *action program*.

The Basin Committee's executing agency is the Water Board, an administrative public body that comes under the responsibility of the State in two fields. In technical matters it answers to the Ministry of the Environment (Water Directorate) while in financial matters it is responsible to the Ministry of Finance. Each Water Board has a Board of Directors comprising twenty-six members who are generally appointed or elected for six-year terms:

- Eight representatives of the *State* for each ministry concerned by water problems
 - Eight representatives of the different *user* categories elected by the representatives of this same category on the Basin Committee
 - Eight representatives of the *regional authorities (Communes, Départements, Régions)* elected in the same way
 - One representative (elected) of the personnel of the Water Board
 - The Chairman of the Board of Directors, appointed by decree for three years.
- The Water Board directors are appointed by order of the Ministry of the Environment. *The Water Boards are the key elements in the organizational structure established to manage French water*

resources. The tasks and resources of the Water Boards, and the results they have achieved, are analyzed in the third part of this section.

Under the 1992 Act, at the basin level the Prefect of the *Région* where the Basin Committee has its main offices is assigned the role of *Coordinating Prefect for the Basin (Préfet Coordonnateur de Bassin)*. He or she implements and coordinates State policy with respect to the policing and management of water resources and ensures that the actions of the State are coherent. The Prefect is assisted by the *regional Environmental Directorate*, which thus acts as Basin Delegate. The Coordinating Prefect therefore has an essential role in providing impetus in water management matters. This is clearly seen in planning, for it is he or she who takes the initiative in preparing the Water Management and Development Master Plan for the basin.

Regional level. The *Région* is responsible for regional planning. Consequently, it plays an essential role in implementing water policy by integrating the development of water resources in regional development plans. The *Régions* are represented on the Basin Committees and on the Water Boards. The *Régions* can allocate subsidies for studies and works related to water management. Most of their operations are carried out within the context of contracts with the State.

At the regional level, State intervention in water affairs is through the *Préfet de Région*, who coordinates the decentralized services of the State in implementing measures that go beyond the limits of the *Département*. In this role he or she is assisted by the services of the regional Environmental Directorate (*DIREN*) and, for industrial problems, the Regional Directorate for Industry, Research and Environment (*DRIRE*).

It should be remembered, however, that the *Préfet de Région* where the Basin Committee has its head offices plays a particularly important role in coordinating and implementing State policy. He or she also ensures the unity and coherency of decentralized State actions in the *Régions* and *Départements* concerned by the basin.

Département level. The State is represented by a *Préfet de Département*, whose powers were significantly strengthened by the 1992 Act. Indeed, the recognition of water as part of the nation's

common heritage and the fact that its protection has been declared as being in the general interest, with an improved range of administrative sanctions to match, have considerably increased the legal basis for the actions and powers of the *Préfets de Département*. Furthermore, like the *Préfets de Région* coordinating the basin, the *Préfets de Département* are invested with local "crisis powers" in the event of accidents, drought, floods, or shortages.

The *Département* is the basic administrative level for State intervention in the policing and management of water resources and aquatic environments and in preparing and following up planning documents. The *Département* offices of the ministries concerned (Public Works, Agriculture, Inland Waterways, Industry, Health) come under the authority of the *Préfet*.

Increasing domestic pollution has resulted in almost every *Département* setting up Technical Assistance Services (*SATESE*) to provide help for the operators of sewage works. The financing of these services is generally shared by the *Département* council and the Water Board. The technical assistance services cover three main areas:

1. Preparing reports on the operation of sewage treatment works, and provision of assistance as needed
2. Monitoring structures to ensure that health standards are met
3. Collecting data with a view to awarding purification bonuses, as explained later.

The State subsidizes the *Départements* for works related to water supply and sewage systems. These funds are drawn from the financial resources of the National Fund for the Development of Water Supply Systems (*FNDAE*). This fund receives some money from a surtax on water consumption, but gets its primary funding from a tax on the *PMU* (national tote betting system).

Gradually, especially since the decentralization legislation of 1983, the *Départements* have supplemented and subsequently taken over the role of the State. The present participation of *Départements* in the water and sewage investments of the *Communes* (in the form of subsidies) accounts for 15 to 25 percent of total investment, depending on the size of the *Communes*.

Commune level. For more than a century, the *Communes* benefitted from the provisions of the

Codes des Communes, which gave them responsibility for the water supply and sewage services. The law of 1992 defines in greater detail the obligations and financial resources of the *Communes* with respect to sewage. These provisions enable them to meet the deadlines fixed for respecting European directives, especially the European Communities (EC) Directive of May 1991, which stipulates that community sewage systems must be completed over the entire territory by December 31, 2005.

With regard to the management of water supply and sewage services, the *Communes* have a monopoly that can be exercised directly by the *Communes* or groups of *Communes* (local utilities responsible for serving about 25 percent of the population in France), or by delegation to a private operator.

This possibility of delegating the management of water and sewage services has been written into the local community law (*Code des Communes*) for more than a century and constitutes an original aspect that is specifically French. For this reason it is the subject of a special section.

Through the preparation of Water Management and Development Plans, local authorities now have an important role to play in resource planning. It should be remembered that they are represented on the Basin Committees and consequently on the Boards of Directors of the Water Boards.

Planning Tools

An original system of planning the development and management of water resources was institutionalized by law in 1992. This law lays down the procedures to be followed concerning the policing and management of water resources at two geographical levels: the entire hydrographic basin and the individual hydrographic unit (river or aquifer).

The *Water Resources Development and Management Master Plan (SDAGE)* thus determines, for a basin or group of basins, policy orientations for sound water resource management. Taking into account the main programs put forward by the public authorities, it defines, in a general manner, the objectives concerning water quantity and quality as well as the development works to be carried out to reach these objectives. It defines the

perimeter of the sub-basins corresponding to the hydrographic units.

The *SDAGEs* are prepared by the Basin Committee at the initiative of the *Préfet de Région* for the basin, and cover a period of five years. Users and locally elected representatives are thus involved in the preparation of the Master Plans through the Basin Committee. The preparation of the Master Plan also brings together the representatives of the *Région* and *Département*.

After the Master Plan has been adopted by the Basin Committee, it has to be approved by the administrative authority, thus underlining a certain preeminence of the State in water management matters. Then the Master Plan is made available to the public.

The *SDAGEs* also ensure the coherency of the *Water Resources Development and Management Plans (SAGEs)*. The latter are drawn up for the sub-basins corresponding to hydrographic units or aquifer systems, or for a group of sub-basins, and define the general objectives for the use, development, and quantitative and qualitative protection of surface and ground water resources and aquatic ecosystems, as well as the preservation of wetlands.

The preparation, revision, and monitoring of a *SAGE* are the responsibility of a special commission. The commission consists of representatives of the local community, accounting for about half the members; representatives of users, owners, riverside dwellers, professional organizations, and associations, accounting for about one-quarter of the members; and representatives of the State and its public bodies, including the Water Boards, who account for the other quarter of the group. From its composition, it is clear that this commission aims to involve all the parties concerned by water management as much as possible at the local level, by structuring it around the local community.

The draft *SAGE* is made available to the public for two months to obtain their opinions and observations. After any necessary modifications have been made, the *SAGE* is submitted to the authorities concerned and the Basin Committee for their opinions, then approved by the administrative authority. Subsequently, the Plan is made available to the public.

To make it easier to meet the objectives of the *SAGE*, the law provides for the possibility of

establishing a public body (*Communauté Locale de l'Eau/Local Water Community*), which will act as the owner for public works, structures, and installations executed in pursuance of the objectives of the SAGE.

This hierarchy in the planning process (*SDAGE/SAGE*) is to a large extent inspired by urban planning procedures (urban planning and development master plans/land use plans). As with urban planning, it is a relatively complex procedure supervised by the State but involving considerable participation from the different parties concerned, in both its preparation and its implementation.

Water Boards

When they were set up in 1967/1968, the Water Boards (*Agences Financières de Bassins*, now known as *Agences de l'Eau*) were assigned a dual role:

- A main role in taking part in the financing of general works in the basin
- A subsidiary role involving water-related research studies.

This second role, although not of great importance compared with the first, is nevertheless not negligible. Each Water Board operates rainfall and flow-gauging networks and data bases, which provide them with detailed knowledge of the basin. The Water Boards conduct individual and joint studies and research projects in certain fields related to their activities, such as nitrate and pesticide pollution, rain water management, and accidental pollution. The results are published and distributed to interested agencies and individuals. The Water Board also provides assistance and expertise, particularly with regard to the training of water management personnel.

However, the main role of the Water Boards is still to provide *financial incentives*. The Water Board is neither owner nor contractor of works implemented for improving and preserving water resource. Its involvement in such cases is purely financial.

The general community must learn that it is unacceptable to waste or pollute water. It is not sufficient simply to promote awareness of this precious heritage. The public must be made to see the advantages of not wasting or polluting water—or at least causing less pollution. To achieve this, there must be incentives. The Water

Boards use two *economic instruments* to combat wastage and pollution:

1. On one hand, the fees (*redevances*) paid by water users and polluters according to the volume of water used or the pollution caused. This is the principle of "*the user/polluter pays.*"
2. On the other hand, *financial assistance* ("*aides*"): money collected in fees is reinjected in water-related economic channels to help the public or private sector save and purify water by investing in water conservation and antipollution techniques and equipment. This is the principle of "*those who protect water receive help.*"

Action programs. Financial actions implemented by the Water Boards (collection of fees and distribution of financial aid) are carried out within their pluri-annual (generally five-year) action programs, which are presented by the Water Boards to their Basin Committees. The decree governing the creation of the Water Boards specifies that the amount of the fees levied by a Water Board is fixed according to the various expenses that the Water Board will have to meet within the context of the pluri-annual action program, and is approved by the Prime Minister upon recommendation by the Interministerial Water Commission. The action program, which thus legitimizes the fees, is the basic instrument that determines both their nature and their amount.

The action programs must necessarily be in keeping with the socioeconomic options taken at the national level, particularly with regard to general water policy. In terms of volume, the action program has no limits other than the level of fees. These are voted by the Basin Committees of which nearly two-thirds of the members are water users and thus subject to the fees. There is thus a form of self-regulation in the process of drawing up the programs.

The action program of each Water Board comprises three sections:

1. Analysis of the problems existing in the basin, hence the value of information provided by the gauging networks and data bases
2. List or type of operations to be carried out, assessment of their cost accompanied by an estimate of the assistance that the Water Board expects to provide

3. Fee system to ensure the program's financial equilibrium.

The types of action covered by the program may vary considerably from one Water Board to another, depending on their characteristics and priorities. These actions generally concern:

- Development, planning, and protection of water resources, through financial assistance for operations such as the protection of water catchment areas, the development and maintenance of rivers, and water demand control, or structures of general interest such as regulation dams
- Water pollution control, regardless of origin, particularly by providing assistance for the construction, extension, or refurbishment of sewage works and sewage networks, but also through help to improve industrial processes with a view to reducing pollution
- Improvement and security of drinking water supplies, for example through financial assistance to establish special treatment procedures and install interconnection systems in areas in which the water supply is particularly vulnerable.

The action program does not generally identify each individual operation that may benefit from financial assistance but identifies the types of operations and structures that are eligible, the level of financial assistance (percentage of the cost of the operation) from the Water Board for each category, and the nature of the assistance (grant, interest-free loan, loan), depending on the legal status of the beneficiary, whether public (associations, public corporations, State) or private (industry in particular).

Water fees. Under French law, Water Boards are authorized to collect fees from public or private persons who contribute to the deterioration of water quality, who abstract water from the water resources, or who modify the water regime in part or all of the basin. In such cases, these are "active" or "responsibility" fees.

Another type of fee may also be collected from public or private persons benefiting directly or indirectly from works or structures completed with assistance from the Water Boards. Such fees are known as "passive" or "beneficiary" fees.

Anyone who pollutes, abstracts, or consumes water is subject to the fee. This includes essentially:

- Towns and urban centers that abstract and consume large amounts of water and produce pollutant loads
- Industries that, in general, abstract and consume little water but cause many different types of pollution
- Farmers, who abstract a lot of water during certain periods and cause widespread pollution of rivers and groundwater
- Inland waterways
- The French Electricity Board (EDF), which abstracts and consumes large quantities of water.

The Water Boards distinguish two types of fees: the "pollution" fee, related to discharges into the natural environment, and the "resource" fee, related to abstraction and consumption.

"Pollution" fee and purification bonus. Pollution fees are based on the volume of pollutant load discharged into the natural environment. For domestic pollution, the fee is based on the total population. Each inhabitant contributes to the cost by means of a surtax on the price of water, which is then transferred by the water utility to the Water Board. For nondomestic pollution, the amount of pollution is either measured or estimated in terms of a lump sum on the basis of the activity concerned.

The above fees are *gross fees* and correspond to the gross pollutant load before any purification treatment. When, as is most frequently the case, waste treatment plants have been installed, the community or industry is awarded a purification bonus, which is deducted from the gross fee levied to obtain the *net fee*.

The amount of pollution fees is fixed by each Water Board to balance its antipollution program. The rates are adjusted geographically according to the quality priorities and objectives defined by the Basin Committee.

In 1987 gross pollution fees amounted to about US\$350 million (for all Boards), or 60 percent of the total revenue of the Boards, while purification bonuses accounted for US\$75 million, or 15 percent of total Water Board expenditures.

"Resource" fees. These fees are used to cover part of the program for *quantitative water management*, that is, to finance storage reservoirs, water distribution systems, and irrigation structures.

The resource fee is a combination of two fees:

1. The fee for "water abstraction or modification of the water regime," the amount of which is determined according to the volume of water abstracted, measured, or estimated
2. The "consumption" fee, determined by a coefficient—depending on water usage—applied to the net consumption. This coefficient is, for example, 0.20 for water distribution and 0.70 for sprinkler irrigation.

Like the "pollution" fee, the "resource fee" for the water supply system is collected as a surtax on the price of water, which is then transferred by the water utility to the Water Board.

Resource fee rates vary considerably, depending on, for example, whether they apply to groundwater or surface water, whether the requirements in the area are high or low, or whether abstractions are regular throughout the year or concentrated in the dry period.

In 1987 resource fees collected by the Water Boards amounted to US\$85 million, or one-quarter of the amount collected in pollution fees.

Water Board budget. For the sixth five-year program (1992-1996), the total budget of the Water Boards amounts to about US\$7.5 billion (1991 prices), distributed as shown in table 2.

The Water Boards' total budget for the sixth five-year program is nearly twice as much as the budget of the fifth five-year program (1987-1991). The total cost of works subsidized by the Water Boards will increase as shown in table 3 (1991 prices).

This reflects the considerable efforts being made to reduce all types of pollution, whether domestic, industrial, or agricultural.

Management of Municipal Water Supply and Sewage Services

The *Code des Communes* stipulates that water distribution is an industrial and commercial public

Table 2

Revenue	Expenditures
Water Board fees	Financial assistance
Pollution fees: 68%	Grants: 40%
Resources fees: 14%	Loans: 25%
	Purification bonuses: 12%
Loan repayments: 18%	Operation: 9%
	Research, development, and gauging networks: 14%

service in the *Communes*. The same is true of waste water disposal and treatment. The *Communes* have the exclusive power to grant the right to use public land within their boundaries. Since this right is granted to only one operator for water supply and/or sewage, these services are *de facto* monopolies.

For many years, neighboring *Communes* and clusters of *Communes* have tried to settle their infrastructure problems by creating joint bodies such as intercommunal associations, urban communities, and districts, to which they have delegated their powers, in particular concerning water supply and sewage services. The result is that there are over 4,600 intercommunal services throughout France. Water supply and sewage services in the community are under the technical, administrative, and financial supervision of the State (Ministry of the Interior) while the Ministry of Health is responsible for monitoring the quality of water that is distributed.

Under French law, communities have the power to create and manage water distribution and sewage services provided to the public. This is known as *direct management*, and concerned about 25 percent of the French population in 1992 (as opposed to 70 percent in 1945). Communities also have the legal right, when they feel it necessary, to delegate all or part of their task to a private operator. This is known as "*delegated*" management, and may be implemented in a wide variety of ways: management contract, lease contract, concession contract, or any combination of these.

A local community may use a private operator for various technical or financial reasons, but such action often results from:

- The increasing complexity of water supply and sewage tasks: increasingly refined treatment

Table 3

	Total costs (US\$ millions)	
	5th 5-year program	6th 5-year program
Urban and rural sewage	4,100	7,700
Industrial pollution control	1,100	1,900
Improvement of agricultural practices	—	600
Water supply	1,700	2,700
Water resource development	700	1,100
Environment	200	400
Total	7,800	14,400
Amount of financial assistance provided by Water Boards	N.A.	6,200

processes in response to the deteriorating quality of raw water; sophisticated purification processes required to meet increasingly higher standards concerning wastewater; management of an increasing number of consumers

- The problems encountered by the community in generating sufficient funds to ensure maintenance and replacement of equipment and to finance the development of water and sewage systems.

Nevertheless, the *Communes* always have control over the management method selected without outside interference, in particular from the administrative supervisor.

Different Management Systems

Under *direct management*, the community is responsible for the creation, development, and management of its water supply and sewage services. The community creates the necessary structures and renews them as required, with work performed by its own personnel. It fixes the rates and is responsible for its own expenditures and revenue. This direct management by the community, without outside assistance—*integrated management* in EC terminology—is conventional and will not be discussed here.

Delegated management, whatever form it may take, involves delegating management to a private operator. However, in every case, the community retains ownership of the structures and equipment. In France delegation concerns only the management of water supply and/or sewage services and does not involve the transfer of structures and equipment, even when they are financed by the private operator. In certain countries, for example, the British Water Authorities, the involvement of the private sector is accompanied by a transfer of assets. In such cases, *privatization* can be said to be virtually definitive, but this term cannot be applied to the French situation, in which delegation of management responsibilities is reviewed periodically.

Delegated management can generally be divided into two types, depending on whether the possible operating deficit is borne by the community or by the private operator.

When management of water supply and sewage services is not provided at the risk of the private operator but at the risk of the community, it may be one of two kinds:

1. "*Gérance*," in which the operator ensures the operation of the services only, for which it receives a lump sum payment
2. "*Régie intéressé*," in which the operator is also involved in determining the tariffs and receives, in addition to remuneration, a sum that correlates to the service management results.

These formulae gradually have been replaced by contractor-type contracts in which the operator takes full responsibility for proper use of facilities and accepts the financial operating risks for a fixed price within the framework of a long-term contract. Two such contracts may be identified:

1. Lease contract (*affermage*), the most widespread form of delegated management in France. The operator (*fermier*) is responsible for managing the service while the community is responsible for building new structures, including related financing.
2. Concession contract. The operator (the concession-holder) is responsible not just for managing the service at his or her own risk but also for financing and building structures.

Lease and concession contracts. These two types of delegation represent the great majority of contracts involving delegated management in France, and constitute one of the most original aspects of French water management.

For both lease and concession operations, the government prepares model or typical specifications sheets that provide a framework for drawing up the contracts. Each community wishing to lease or grant a concession for its water supply or sewage services adapts such specifications to its own characteristics and needs. Thus, new types of contracts have started to make their appearance, for example, "hybrid" contracts that fall between a lease and a concession. Some leases may include small concessions, in which the operator is no longer solely responsible for the building of structures. However, the legality of delegated management contracts is in the end checked by the government, in this case by the *Préfets de Départements*.

The initial contracts for the delegation of management are generally awarded following a call for tender, on the basis of specifications prepared by the local community in accordance with their specific needs. When the contract reaches the

expiration date, its extension, with modifications to take into account new conditions, is generally renegotiated with the current operator.

A leasing contract generally lasts for twelve years, a relatively short period, which explains the popularity of this type of contract. A concession lasts between twenty and thirty years. The length of this type of contract allows the concession holder to cover initial investment costs without having to resort to excessive tariffs. The contract may be terminated by the community in the event of a particularly serious offense by the operator. This, however, is extremely rare.

An important aspect of the change from direct management to delegated management concerns the integration into the new system of community personnel, often somewhat numerous in relation to real needs. The integration of all or some of the personnel, and their status in the new structure, may constitute an important criterion in selecting the operator. These considerations concerning community personnel are then specified in the contract.

Contracts also specify which works, within the area covered by the lease or concession, are the responsibility of the collectivity and which are the responsibility of the operator (new works, renewal, maintenance, repairs to main structures). They also give details of responsibilities with regard to connections and water meters.

Regarding pollutant outfalls in the natural environment and quality of distributed water, the contracts refer to the regulations in force. In this area, both leaseholders and concession holders come under the control of the Ministry of Health.

Finally, tariffs are determined in the contracts. Tariffs generally include a fixed part (subscription) and a part that is proportional to consumption (binomial tariff). The tariff is established on the basis of the forecast operating statement, which is submitted by the operator in support of his or her bid and takes into consideration the foreseeable changes in income and expenditure over the duration of the contract. This document, which is noncontractual, facilitates contract negotiations. The contracts also include inflation-indexed water tariff revision clauses. Revision of water rates takes into account, in particular, the changes in salaries and social charges as well as the cost of energy and chemicals.

The Price of Water in France

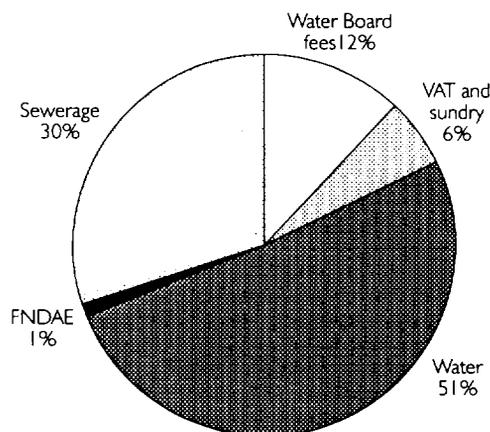
France has approximately 13,000 water supply services and as many sewage services. There are therefore at least 13,000 different prices for water. Recent surveys revealed differences in average prices between regions of 20 to 50 percent, with an extreme ratio of 1:20 between the lowest and highest prices observed (approximately US\$0.17 to 3.40).

The most important reasons for such price differences are:

- Presence or absence (rural *Communes*) of sewage works, the cost of which is reflected in water bills
- Quality and proximity of available water resources
- Population served (economies of scale)
- Impact of recovering investment costs for works, which can vary considerably across *Régions*
- Cost of maintaining structures and equipment, in other words, the quality of facilities.

Generally, a water bill in France is made up as shown in figure 1.

Figure 1



The following examples illustrate the wide range of water rates in urban areas in France (prices given in US\$ per cubic meter, including sewage and taxes):

Aix-en-Provence (1992)	1.07
Bordeaux (1992)	2.68
Calais (1992)	1.61
Creil (1993)	2.70
Grenoble (1992)	1.79
Lyon (1992)	2.50
Paris (1993)	1.79

Table 4In US\$/m³, excluding taxes

Community	Current price			Future price		
	Water	Sewage	Total	Water	Sewage	Total
Rural commune	0.36	0.00	0.36	2.55	1.50	4.05
Small town	0.89	0.74	1.63	1.89	1.54	3.43
Average town	1.34	0.79	2.13	1.50	1.14	2.64
Intercommunal association	2.14	1.25	3.39	2.21	1.66	3.87

Rouen (1992)	1.96
Saint-Etienne (1993)	2.45
Soissons (1993)	2.53
Versailles (1992)	1.96

1. A small, under-equipped rural *Commune*
2. A small town with insufficient sewage
3. An average-sized town
4. An intercommunal association equipped with standard facilities.

The considerable investments that will have to be made in the coming years, particularly to comply with European Community directives on sewage, will also significantly affect the price of water by the turn of the century.

A simulation study was carried out using four types of fictitious cases:

The results of this simulation are presented in table 4.

Increases will be greatest where current prices are the lowest and thus will help reduce the price differences that have been observed until now.

Discussant Remarks: Poland

Janusz Kindler

Poland covers an area of 312,000 km² and has a population of approximately 38 million in comparison to France, which covers 549,000 km² and has a population of 55 million. Poland's population density is thus in the order of 123 inhabitants per km² while France averages 100 inhabitants per km². About 62 percent of Poland's population live in cities and towns: 43 cities have over 100,000 inhabitants. Administratively the country is divided into 49 *voivodships*, whose role is comparable to that of French *départements*—regional representation of national government. Each *voivodship* is divided into municipalities (*gminas*) which since 1990, as was the case before the Second World War, are locally elected self-governing bodies.

Unlike France, which is divided into six well-defined river basins, Poland is divided into only two major basins: the Vistula (about two-third of the country's area) and the Odra. These two rivers drain to the Baltic Sea. The average freshwater availability in France is 3,420 m³ per capita compared to only 1,730 m³ per capita in Poland. Indeed, Poland is one of the most water-scarce countries of Europe. This is well illustrated by the fact that the average runoff from all of Poland is about the same as the runoff from the Rhone River Basin in France, which is one-third the size. At the same time, water use per \$1,000 of gross national product in Poland is about 2.5 times higher than in France, which is an indication of Poland's great potential for water conservation and demand management. The combination of scarce water resources, their extensive use, and insufficient wastewater treatment capacities

cause water pollution in Poland to be generally much higher than in France.

Since early 1990, dramatic political, economic, and institutional changes in Poland have affected every aspect of life, including water resources management. Central planning by the state has been almost completely abandoned, and there is a strong movement toward decentralization and privatization. The institutional system is undergoing significant change, leading to a strongly increased role for local self-governing authorities. Responsibility for municipal water supply, water treatment, and ownership of the infrastructure is being transferred to municipalities. In this respect, the situation is similar to France, where the *communes* are responsible for the development and management of its water supply and sewage services.

Poland's state subsidies for water resources management and protection are generally ending and being replaced by subsidies or loans from environmental and water funds. Varied approaches to project financing are promoted, including enhanced local sources of revenue from taxes and user charges, user taxes on potentially polluting substances, and private investments that supplement traditional public-sector and budgetary resources. In spite of these efforts, local resources remain limited, at least in the short term. Drafting new legislation (including new Water Law) as well as enforcement of new regulatory arrangements is difficult in this period of political, economic, and social transition.

According to the 1974 Water Law, the Ministry of Environmental Protection, Natural Resources

and Forestry (MEPNRF) is responsible for water policy throughout Poland. This responsibility includes long-term strategic planning, water quality and effluent standard setting, and pricing policy. At the regional level, water resources are managed by the *voivodship* agencies of the ministry. These offices issue water withdrawal and wastewater discharge permits; they also collect all water and wastewater fees and charges. These funds remain partially at the disposal of the *voivodship*; a portion, however, is transferred to the National Fund for Environmental Protection and Water Management.

Regional agencies of MEPNRF operate within the administrative boundaries of individual *voivodships*. However, as a result, even relatively small river basins are often under the authority of several *voivodships*. Frequent conflicts of interest have been observed between water users and administrative bodies, often leading to complex and difficult situations, especially in the frequently recurring dry years. As with France prior to 1964, the need for a change towards river basin management was gradually acknowledged in Poland. In 1989 establishment of river basin authorities and introduction of the "polluter pays" principle was officially endorsed by all concerned.

In 1990 close collaboration was established between France and Poland in natural resources management and environmental protection. At the MEPNRF in Warsaw, the Bureau de Coopération franco-polonaise dans le domaine de l'environnement (BCFPDE) was set up, focusing primarily on water resources management. About a year later, a mixed group of Polish and French specialists drafted a new Water Law providing for the establishment of Regional Water Authorities and Regional Water Councils. They are named "Regional" to reflect the fact that their boundaries follow hydrographic regions (sub-basins) of the only two major basins in Poland—of the Vistula and Odra Rivers. Except for some modifications reflecting specific Polish conditions, the functions and responsibilities of these institutions are quite similar to those of their French counterparts, namely, Water Boards and Basin Committees.

Under the proposed law the Regional Water Authorities would be responsible for collection of water withdrawal and wastewater disposal

charges. Thus, the current practice of collecting these charges will be modified; this function is to be transferred from the *voivodship* agencies of MEPNRF to the new Regional Water Authorities. In addition, the Authorities would monitor use of both surface and groundwater water resources in the region, develop and operate water management information systems, prepare multi-annual action programs, initiate research and exploratory work, and develop guidelines, such as water allocation principles and limits on wastewater disposal for integrated water use in their regions. The guidelines will have to be coordinated among the Regional Authorities for the entire Vistula and Odra basins. The guidelines also are to be used in issuing water withdrawal and wastewater discharge permits, which process remains in the hands of the MEPNRF *voivodship* agencies. Since each of these agencies operates in some part of the river basin only, the water use guidelines will be the main instrument for integrating and coordinating effort across each basin.

The Regional Water Committees, composed of the representatives of state government (national and *voivodship*), local self-governing authorities, and water users, are charged with water policymaking in the basin. Each committee is responsible for the approval of action programs developed by the Board; development of investment priorities and basin-wide financial policy (distribution of funds collected by the Regional Water Authorities and setting up pricing policy for water withdrawal and wastewater disposal); and the overall supervision of the activities of Regional Water Authorities.

Although the legislative process concerning the new Water Law has not been completed, in 1991 seven Regional Water Authorities Basin were established. Three are in the catchment basin of the Odra River and four in the Vistula River basin. Their boundaries follow the hydrography of the country, but, unfortunately, until the passage of new Water Law, they cannot perform their main function of collecting water and wastewater charges. Thus, for the time being they are responsible primarily for the preparatory work to introduce a new basin-oriented system of water resources management. With the assistance of BCFPDE and the French International Office for Water, over thirty Polish specialists from the Regional Water Authorities and the MEPNRF

participated in the extensive hands-on training program in France. At the French *Agences de l'Eau*, each course participant was given the opportunity to take part in day-to-day activities of his or her French counterpart. These contacts led to direct twinning arrangements between some Polish Regional Water Authorities and French Water Boards.

In 1993, without waiting for the new Water Law, Poland initiated the process of setting up Regional Water Councils. Most of the Councils are now established, and after the first few meetings, it is already obvious that these basin-wide "water parliaments" are beginning to play an extremely important role in the country. They provide unique fora for discussion of a number of difficult issues, and, importantly, they give all parties concerned a sense of ownership and participation.

At present, the adoption of the new Water Law is the most pressing issue. Regional Water Administrations are working well, but they cannot play their proper role until the new Water Law gives them power to collect water and wastewater fees and charges. Unfortunately, the legislative

process is going quite slowly. However, it is hoped that by early 1994 the new Water Law will be operational and the new Regional Water Authorities will quickly prove their value to the country.

To conclude, the French experience in the area of water management does apply to Poland. The shift to basin management and planning is recognized throughout Poland as a logical and necessary step. However, development of full working relationships between the administrative structure of *voivodships* and the new Regional Water Authorities and Councils is an intricate process that has just begun. While supporting the concept of basin management, *voivodships* nevertheless are losing part of their authority over water finances to pay for local operations (although *voivodships* are represented on the Regional Water Councils).

It has to be recognized that France took several decades to decentralize and refine its water management system. A blueprint can not be transferred to any other country and be expected to work immediately. The principles are correct, but the devil is in the details.

Discussant Remarks: Brazil

Roberto Messias Franco

France's experience does apply to Brazil. For the last ten years I have been managing environmental control agencies in Brazil at the state and federal levels. In my experience the most important environmental problems are water quality and water quantity. How do we manage water in a country like Brazil? Let me show you, first, how we adapted the French experience to the Brazilian case.

Brazil is the largest country in South America with 8.5 million square kilometers. It is a federation of 26 states and the federal district. The capital, Brasilia, is in the center. Some of the states are very large. The state of Amazonas has 1.5 million square kilometers. Brazil is 17 times the size of France.

If we look at the principal hydrographic basins in Brazil, 20 percent of the fresh water of the earth comes from the Amazon Basin. How can we manage a basin that is so large and so complex? The important French experience on water resources management is one of the most creative we can find today and prescribes recommendations that are similar to the World Bank's new approach to water resources management policy.

Participation

Participation is a very precise concept. It is very easy to say that people must participate, but how do we do it? When we turn to practice, our day-to-day mission, it is very difficult to facilitate people's participation because those participating in water resources management have many different interests.

Decentralization

A strong legal and regulatory framework, incentives for efficiency, incorporation of environmental considerations, and use long-term factors are components of decentralization. Implementation of all of this, as it is happening in France, is certainly possible for Brazil and other countries, but it is not easy.

Comparing the historical evolution of water resources management in France and Brazil, we can find legal and institutional coincidences that occur in different periods of the histories of both countries. Ivan Cheret's excellent paper says that in France the first, or primary, water management law dates from 1878. This law distinguished between public and private domain and recognized the right of the landowners to use the water.

Brazil passed what we call the Code of Waters, or Law of Waters, in 1934. It has the same definitions that we find in the first French law but focused on hydropower. As many as five decades ago, in the mid-1930s, Brazilian authorities already believed that we should have an important hydropower policy for the development of the country.

Another idea that we can see in both the Brazilian and the French history of water resources management is France's creation in 1930 of a *Compagnie Nationale du Rhône*, a national company for the multipurpose development of a major river. This company was created before the Tennessee Valley Authority (TVA) in America.

In 1956 Brazil also created an entity to coordinate the development of the São Francisco River Valley, today called the *Compania de Desenvolvi-*

mento do Vale do São Francisco—the São Francisco Development Company. Other countries also created companies through the regional development using water together with other natural resources that were found in their areas.

Later, as described in the Chéret paper, France legislated the New Water Act. How did France come to its present legislation and institutional arrangement? As a response to the phenomena of urban concentration and economic growth that arose between 1949 and 1969, which increased the pollution and number of hydropower and thermal power plants, in 1959 France set up the Water Commission with the participation of the various parties involved and outlined the principles for the Water Act of 1964.

Judging from the Chéret paper, 1964 is a very important date in the history of water resources management because in 1964 French law introduced the notion of *quality objectives*, a notion that still seems to be absent in many nations' legislation.

The Water Committees and the Water Boards seem to me the most important point of this French management system. The Water Committees and Water Boards include the participation of users, states, and local authorities. The French law of 1964 often seems to use regulations, incentives, and dialogue as principles for water management. These seem to me absolutely correct, but I do not know how to apply them. It is not easy to apply dialogue when the question of power is involved: the division and concentration of power.

In 1992, the French system arrived at a new Water Law, with the explicit recognition of water as part of the nation's heritage, but based on the same principles as the 1964 Act.

We had in Brazil during all of those years a democratic evolution of the French system of water management. At almost the same time urban concentration and new industries came to Brazil. This kind of development that came to France after the second World War came in Brazil after 1955 or 1956, especially from 1970 to 1980. Politically, the situation in Brazil was quite different. We were under a military dictatorship with a concentration of political power at the central level, and important financial resources were used in hydropower plants—Furnas, Itaipu, Tucuruí, Sobradinho, and many others, especially in the São Francisco River Basin and in the

rivers of the southern region—which comprise the Parana-La Plata Basin. Many of those hydropower plants were generating more than 1 million kilowatts. That means they are enormous dams with enormous environmental impacts that were not measured at that time. When those dams and plants were built, there was almost no environmental control in Brazil.

From 1970 to 1980, water supply and sewage services also were centralized with incentives to every one of the Brazilian states to create water and sanitation companies. Therefore, one of the important experiences we had at the local or municipal level was the management of the water resources, especially with regard to sanitation. There was a very important foundation of the Ministry of Health, a special Health Service, which was a kind of central authority that advised every municipality how to manage water and sanitation. This experience has been changed by the new experience of delegating the centralized public management of water resources to the states' water and sanitation companies.

Thus, whereas in Brazil we had a period of centralization, now we come to a new idea, a new era, a new period: how to decentralize again, how to give back authority to the local institutions, how to build up the states' capacity to manage their water resources.

Presently, in 1993, the National Congress is discussing a new law creating the National Policy for Water Resources. This proposal would divide Brazil into three large hydrographic regions. Brazil is such a large country that, again, we would have to put together many basins in each hydrographic region. The Amazon River Basin in the north of the country is the principal one. The second region would be the eastern region, where the São Francisco is the principal river and the only one that flows directly to the Atlantic Ocean. The third region would be the area of the Parana River, which flows southward, entering the Atlantic Ocean between Buenos Aires and Montevideo.

But in the Congress there is much resistance to this proposal legislation. The wealthy are a problem. In addition, regarding the French experience, France has the Water Committees and the Water Boards, and they are under the supervision of the Minister of Environment. There are important governmental sectors in Brasilia that ask, "How

does it work?" The main difficulty is that they are against this new environmental control system. Add to this mix the Ministry of Mines and Energy, a sector that has a tradition in Brazilian development of making dams: they want to maintain the status quo without adding an environmental impact assessment to the sector.

It is difficult. Who will head the water management system? Would a Department of Water belong to the Mining and Energy Ministry, or to an Environmental Ministry that works and exists in Brazil's current environmental control system?

About twenty years ago, in 1973, the Brazilian Environmental Policy and Control System was created. As I mentioned, Brazil is a large federal republic and would have three levels of environmental control and environmental policy. These levels were created in 1981 by the Federal Law 6938.

At the federal level is a coordinating institution called the Ministry of the Environment. Decisions are taken by a National Environmental Council (CONAMA). This National Environmental Council is very interesting because it functions with the participation of several sectors of the society: industry, nongovernmental organizations (NGOs), and all states are represented in this National Environmental Council. There is a Brazilian Institute for the Environment (IBAMA), which was created in 1989. Six thousand people work there so it is a large and important agency. But it has a weakness: it has not worried about water resources management until now.

Every state of the federation also has one secretary who works with environmental problems. Some states have a special Secretary for the Environment, and in some others, the sector is joined with Planning, for instance, or with Natural Resources Management, or with Science and Technology. (There are many Secretaries of Science, Technology, and Environment.)

Decisions about an environmental policy also are made by the States' Environmental Councils. There are state environmental agencies in every state, including Brasilia.

Brazilian federal law also prescribes at the local level for every one of the 4,000 Brazilian municipalities the creation of one Municipal Council for the Environment. At present fewer than 5 percent of Brazilian cities and Brazilian

towns have these Municipal Councils for the Environment, but the process has begun.

To conclude, despite all of these problems, the French model does apply to Brazil. However, there are problems in applying this model. The first is the problem of scale since Brazil is so much bigger than France.

The second problem is the question of federal organization. Brazil has federal rivers that go through more than one state, and state rivers. The federal law is country-wide, and the state's law is at the level of the state. Every state also has an assembly, or Congress. France's law had to be adapted to Brazil, and the various state laws had to be adapted to one another. Brazil's new constitution gives the right to every state to be more restrictive, but never less restrictive on environmental matters and environmental standards than all others.

The third problem is the question of institutional arrangement. In Brazil and in some other countries, many sectors refuse to work together with the environmental sector. Many people still believe that environmental control is an obstacle to real development. I saw this reaction when I met with authorities from several Latin American countries. They think that environmental control is good for the developed countries, but not for those that are trying to develop.

There are also international aspects and international difficulties in trying to build a French model of water management in Brazil. France, for instance, belongs to the European Community (EC). The EC already has laws and regulations specific to water. This has not yet happened in South America. In Brazil we share the La Plata Basin with some countries, the Amazon Basin with others. The South America countries must make this water management policy together.

The fourth problem in adapting France's water management system to Brazil is the price of the water. In South American countries water prices cannot be as high as the prescribed price of water in France.

My final comment is that the management of water resources is very important to all humankind, to every country. We must always be vigilant about what is happening to our water. In Brazil today only 6 percent of sewage is treated—94 percent of sewage is not treated at all. In many other countries, in poor countries especially, the situa-

tion is not so different. In his opening presentation yesterday Ismail Serageldin showed slides that are representative of the environmental horrors that have happened in the developing world.

I think that the World Bank, the Inter-American Development Bank, and multilateral and bilateral financing agencies should consider the following as previous conditions to many project loans: environmental control laws, irrigation laws, hydropower sector and sanitation programs, implementation of water resources

management systems, taking into account environmental aspects, and having significant participation of users and society. Democracy, participation, and environmental protection are essential to the implementation of environmentally sustainable development.

It is easier to say than to do it. In my opinion the main objective of national governments should be, like those agencies' objectives, to lay out the conditions for this environmentally sustainable development.

Floor Discussion

Audience members voiced their concerns and questions, raising the following issues: (1) the costs of reaching higher standards and the relative merits of penalties and subsidies in meeting standards; (2) how the French system articulates between the central imposition of water quality standards from the European Community in Brussels and the delivery of services locally; (3) how to reconcile looking at water sectorally, particularly with regard to agriculture, with sustainable development and "the polluter pays"; (4) empowerment of the poor, specifically how the Bank will take the poorest rural populations' water needs into account when Bank financial support often diverts water to the big cities, causing drought in rural areas; (5) regional integration when two or more countries share and dispute the same water source; (6) who sets the valuation and pricing structures for water, which often seem to result in the poor being charged while the rich, who use much more water, are undercharged; (7) whether the French or Polish example should be used by poorer countries, or whether they should use their own low-cost ways of developing their basic water supply; (8) mountains are the "water towers" of the world and continuing to neglect mountain ecosystems has a big effect on water.

Panelists' Responses

Guy Le Moigne: Michel Petit had to leave and asked me to answer these challenging questions. The gentleman from India questioned the World Bank's role in ensuring that the poor of India have access to water when they cannot afford to pay. The Bank is fully aware of this difficulty. We have to recognize, however, that in many poor countries, the poor, when they have no alternative,

buy water through vendors at very high prices, much higher prices than the rich pay. Of course, they buy very few gallons a day, but however poor they are, they do pay.

The pricing mechanism is a tool that can be used in favor of the poor. There are a number of examples in developing countries. I addressed pricing structures with fees for the rich when I mentioned having different pricing mechanisms. In large cities like Abidjan or Tunis, the water company is told to charge different prices. Those who consume less than 10 liters a day do not pay for water. Those who use from 10 to 20 liters a day pay a little more, and those who consume 500 liters per capita pay a much higher fee. This higher fee paid by the rich helps to subsidize the poor, even in a private company.

For example, in Tunisia there are pricing mechanisms whereby those who consume very small amounts of water pay very low prices, and the more water they consume, the higher the rate. In the Western world, in this country, the average consumption of a family is between 200 and 500 liters per capita per day. In other countries some people survive with only three liters a day.

There are different mechanisms. On the rural side, there has been a major effort in India to develop handwater pumps through local participation and local industry. Again, the comprehensive approach does have a meaning. There are cases in India where the Bank financed some irrigation projects with electric tubewells, and we completely dried up the water of the poor people and the farmers. Water had to be brought by truck. It is a very challenging difficulty, but we are fully aware of it and trying to do our best.

The integration in Bangladesh, India, and Pakistan of the international water rivers is a very delicate subject. The World Bank does have a policy based on two major principles. One is the principle of appreciable harm. We are not prepared to participate in the financing of a project that would cause major harm to another country. The second is the principle of equity.

The two principles can be contradictory. Countries feel that the equity should influence the principle of appreciable harm, but World Bank policy considers that appreciable harm is a full priority. For example, Nepal, focusing on the equity issue, says, "The World Bank should finance a big project in my country." Then India says, "This project would cause India appreciable harm." Bangladesh is at the other end. On the Ganges River, the Bangladeshi, to whom you refer, are concerned by the diversion of water by India during the dry season. In this scenario each country is unhappy. The World Bank is very willing to provide good offices to facilitate a negotiated agreement among the three parties, but the countries have to request the Bank to get involved.

In another famous case between India and Pakistan, the Bank helped work out an agreement between the two countries to share waters of the Indus Basin that has worked reasonably well ever since. Mr. Shams ul Mulk could perhaps touch briefly on this.

The issues of technical cooperation, local expertise, and stakeholder participation are a major challenge. Michel Petit referred to the implementation of the Bank's water policy. I just returned from Bangladesh, where there is major Flood Action Program under preparation. Bangladesh is well known for its floods, but what I saw was a flood of foreign consultants. There is very little local capacity building. We are becoming ever more aware of the need to develop the local capacity, possibly through partnership. We are preparing guidelines for stakeholder participation. Bangladesh has developed guidelines for stakeholder participation so there is hope. This is definitely the new trend. But as Mr. Kindler and Mr. Messias Franco said, it is easier said than done.

On the fate of the mountain people, Mr. Ives is absolutely correct. There is no Cousteau for the mountains. Erosion in the mountains is a major challenge. However, more and more Bank projects address water management protection, and

many of the watersheds, of course, have to address the mountain issue. Each country is sovereign. We have to convince them that these are delicate projects that comprise many aspects. But we are increasingly conscious of these issues, and there is now a major effort to address them.

Ivan Chéret: Concerning the first question about tariffs and money, when a deciding body, a parliament, be it French, British or European, decides on quality standards, the body never speaks about the economic impact of those standards, the investments that will be needed, and the price consequences. Thus, when, after some of the most recent laws, my chairman told the media that these new laws would double the prices, in many of our municipalities a host of people said, "That is incredible. What are those private companies doing?" But he told the truth. Obeying standards costs money.

When one controlling body thinks only about prices and the other controlling body thinks only about standards, there is a problem. As the gentleman from the United Kingdom said, we must have a global approach to the project.

Regarding taking a sectoral approach to water and the problem of agricultural pollution from fertilizers and pesticides, people from the agricultural side participate in the Water Parliaments, and these questions are deeply discussed. These River Boards have given grants under whose terms the agricultural people use less fertilizer, thus losing production, and we see whether monetary compensation can help to solve these problems. The solutions have to stem from the field, from the very local organizations. We have two or three such experiences underway in France right now, successfully as far as I know.

The Water Parliaments bring all the parties together, and their ultimate aim is for each party to express his or her own problems so that all parties understand. If we leave the problem to the Minister of Agriculture on the one hand, the Minister of Environment on the other hand, and the Water Resources Board on another hand, they will fight among themselves. But in these Water Parliaments, they seek solutions together. Each party sees why the money is used and why it is useful that maybe a paper pulp production company or a city give some money to an agriculturist in order that he or she use fewer pesticides.

Setting up this French experience was difficult. From the first conceptualization to the final vote, the law took five years. From the vote of the law to the first implementation of these Water Boards in the regions took four years. I had to devote ten years of my life to see the successful implementation of the law. Without one person pushing for ten years, we cannot achieve anything in our countries.

Janusz Kindler: Regarding charges, in Poland there is some delay in the legislative process leading to the new Water Law. Until this law is passed, water charges are being collected by the regional administration, not by the new Regional Water Authorities.

What has been proposed is a fundamental change. It is a question of diverting the money to a different channel. No one should be surprised that the legislative process goes slowly, but there are clear indications that in 1994 the new law will be passed.

Roberto Messias Franco: Last year in Brazil we invited a French corporation to address the question of water resources management. What was impressive or surprising was how easily people and local authorities could observe this experience and positively evaluate the question of participation and how strong is the resistance of the technological side, especially in the sectoral areas like mining and energy. They resist participation in the water use decisions.

Emil Salim: To sum up, the discussions on water resources management have emphasized five major points:

1. Decentralizing water service
2. Encouraging participation of beneficiaries and the affected parties in water management
3. Emphasizing incentive systems to achieve efficiency
4. Building strong legal and regulatory frameworks
5. Capacity building.

Remarks

Keith Bezanson

We will now move from theory to practice by drawing on the experience of Pakistan. We will also benefit from comments on that and other experiences relating to Mexico and Egypt.

We will raise questions about real lessons learned. What are the experiences or lessons, both positive and negative, that can be extracted from the practical experiences of those who manage water resources in these three countries? And, going back to yesterday's discussions, what do these experiences tell us about theory and the adequacy of theory?

Does practice confirm the correctness of those who yesterday reminded us of the importance of getting the prices right? Does practice confirm that price signals are important and that without respecting such signals choices are difficult and bad practices follow? To what extent can our theory be applied in the pragmatic, real, political, institutional, and human settings of Pakistan, Mexico and Egypt?

We also learned yesterday that price signals do not always work. I remember Professor Dasgupta referring to the notion of trying to get all prices right as otiose. He mentioned that qualitative and cultural factors may prove very difficult to internalize within our economic or cost accounting models.

What do we do then in pragmatic and management terms to deal with that which we cannot quantify and which may have deleterious, indeed, even irreversibly negative effects on quality of life and environment?

In summarizing yesterday's discussion, Ismail Serageldin stated that, although imperfect, our

attempts to internalize prices and get the accounting right are essential. The main lesson he told us is that we must persevere. If I may paraphrase what he said: it is important not to make the perfect the enemy of the good.

Again, our question is: what works? Are there indications of directions for new research and new thinking on policy that can be derived from our panelists' experiences?

Allow me to suggest that one question that should be very clearly on the table today is whether the real constraints are indeed good theory. Are the real constraints not related to other factors—institutional, political will, societal expectation, or a plethora of nonspecific, amorphous factors that have to do with the way people react within their societies and interact with their environments?

We should also question whether deductive reasoning should not be replaced by a more inductive approach. Should not theory derive more from practice than the other way around? I would like our panelists to address this as well.

Yesterday we did not touch specifically on what we would consider to be good water management theory. I have written down four points that may comprise guidelines to what might be good theory. I will share these with you and invite the panelists to address these points for their adequacy or inadequacy and relate them to their pragmatic national experiences.

- *First, we cannot deal with water entirely from the supply side.* We must also deal with demand. In most of the cases I know of that deal with current and projected gaps between supply

and demand, there is a clear conclusion that it will prove easier, cheaper, and less environmentally damaging to cut demand rather than to increase supply.

- Second, with regard to guidelines to good policy, *we cannot separate issues of water quality from those of water quantity*. In many cases, what appear to be deficiencies in quantity are deficiencies in quality. That is, there is enough water, but it is seriously degraded, either naturally or by the intervention of human behavior. If we hold in abeyance natural degradation, which is caused mainly by minerals and salts, experience and research show that it is almost always cheaper to avoid pollution than to clean it up.
- Third, yesterday's discussion demonstrated that almost all issues of water problems require careful attention to economics. I take this as *sine qua non*. However, all solutions to water would appear also to involve major changes in institutional arrangements. The

interface between sound theory, sound economics, and sound institutional development is something that we should touch on today.

- Four, most of the efforts in water management throughout the world focus on household consumption. The gains from such efforts are rather small for one simple reason: household water use is less than one-fifth the total water use worldwide. Most use is industrial and that includes, of course, the generation of electricity. *We must inform our action and investments with due regard to marginal cost-benefit analysis*. In developing countries the preponderant use is irrigation. Shams ul Mulk's paper states that 70 to 90 percent of the total water availability in Pakistan that has been captured is used for irrigation. Indeed, his paper informs us that 97 percent of Pakistan's flow-through in its river system per year is already diverted for irrigation. These figures raise a number of important policy questions.

Managing Water: Pakistan's Experience

Shams ul Mulk

Pakistan has a total area of about 804,000 km² of which about 415,000 km² in the north are covered by snow-clad mountains, huge ice fields, narrow valleys, and low foothills.¹ The Indus River and its tributaries emerge from these mountainous terrains and flow for about 1500 km through 320,000 km² of flat alluvial plains before the main Indus flows into the Arabian Sea.

In January 1992 Pakistan's population was estimated at 117 million. Pakistan is growing at a high annual rate of 3.1 percent, and its population is projected to increase to about 150 million by the year 2000. The population is unevenly distributed. Of the four provinces, Punjab has the largest population (56.1 percent) followed by Sindh (22.6 percent), North West Frontier Province (NWFP) (13.1 percent), and Baluchistan (5.1 percent). The distribution reflects the difficulties of topography, climate, and water scarcity. Population density is highest in irrigated areas. According to the 1981 census, two-thirds of Pakistan's population are rural and live in 45,000 villages while the rest live in 415 urban centers. Eighty-five percent of the villages have fewer than 2000 persons, and 8 of the 415 urban centers account for half the urban population.

Irrigated Agriculture

Pakistan's climate is arid to semi-arid. Annual rainfall is uneven and less than 200 mm over most of the Indus plains while evaporation is high, ranging from 1300 mm to 2800 mm. Water is the most precious resource of Pakistan because virtually nothing can grow without irrigation.

Moreover, water, not land, is the critical constraint for development of agriculture.

Irrigation is the key to Pakistan's agriculture. Of the cultivated area of about 21 million hectares (Mha), 16.2 Mha are irrigated. Although agriculture's share in the gross domestic product has declined from 53 percent in 1947 to 26 percent in recent years, it is still a crucial sector of Pakistan's economy. Agriculture employs 54 percent of the labor force and contributes 70 percent of the country's foreign exchange earnings. Irrigated agriculture provides more than 90 percent of the country's total agricultural production and is an important factor in the robust growth performance of the economy.

Water Resources

Pakistan is endowed with substantial water resources although they are inadequate for irrigating the available land. The average annual flow of the Western Rivers (Indus, Jhelum, and Chenab) amounts to 161 billion cubic meters (Bcm). Inflows from other tributaries, including surplus flows from the Eastern Rivers allocated to India, contribute about 20 Bcm increasing the total to 181 Bcm. Of these, some 131 Bcm are withdrawn by the canals, about 11 Bcm are lost in the rivers, and the remaining 39 Bcm flow to the sea.

The Indus plains are underlain by alluvial deposits of considerable depth varying from over 300 meters in the northern plains to 60 meters in the lower areas of the basin. The groundwater reservoir extends over about 16.5 Mha and is recharged annually up to 56 Bcm by seepage from

the rivers and irrigation network. However, the quality of groundwater varies widely; only 10 Mha of the plains are underlain by usable groundwater and receive an annual recharge of about 36 Bcm. In 1988 total pumping of usable groundwater was 41 Bcm, about 10.5 Bcm by public tubewells and the balance by private tubewells. The installation of private tubewells has been increasing at an annual rate of 6 percent, and it is estimated that total pumping from these tubewells alone amounted to 42 Bcm in 1992, far in excess of the usable annual recharge.

Irrigation and Drainage

The Indus irrigation system is an extensive network of three major reservoirs, 19 barrages, 45 canal commands, and over 107,000 watercourses. The five rivers of the basin—Indus, Jhelum, Chenab, Ravi, and Sutlej—are integrated by 12 inter-river link canals to optimize use of their highly seasonal flows. The storage reservoirs do not have enough capacity to regulate the seasonal flows. The system has about 61,000 km of canals and distributaries and about 1.6 million km of watercourses and field channels. Pumping from usable groundwater is carried out by 13,000 Salinity Control and Reclamation Project (SCARP) large-capacity (85 liters/sec) tubewells, 1500 medium-capacity (43 liters/sec) public tubewells, and about 324,000 small-capacity (up to 28 liters/sec) private tubewells.

More than 14,000 km of surface drains have been constructed over the years, and more are under construction or planned. However, the flat topography of the Indus plains and the problems of disposing off the drainage effluent without degrading the usable surface and groundwater resources are major constraints. The SCARP tubewells in the usable groundwater areas helped to reduce the waterlogging problems, but their success in the saline groundwater areas has been limited by the lack of effective arrangements for disposal of the pumped water. The use of tile drainage in Pakistan is very limited. The existing drainage system of the Indus Basin is inadequate.

Water Use in Other Sectors

The agriculture sector is the major user of water resources, both surface and groundwater.

However, a small part of the 131 Bcm of canal water and the 48 Bcm of pumped groundwater is also used for other sectors. Urban and rural sector water use for domestic and industrial purposes hardly exceeds 4 percent of the river flows diverted into the canals. Most urban and rural water demands are met from groundwater. Over 50 percent of village water supply is provided by small private hand pumps. In areas where groundwater is saline, canals are the main source of water supply. In Sindh province, including Karachi City, where most areas are underlain with saline groundwater, 92 percent of the urban water needs are met from surface water resources (canals and lakes). Surface water is also the source of water supply for Islamabad because groundwater, although usable, is rather deep.

Pakistan's urban population is increasing at a faster rate than its rural population. However, future water requirements for urban and rural domestic and industrial use are estimated to remain small—about 12.6 Bcm by the year 2010 and 19.6 Bcm by the year 2020. Moreover, most of these uses are not consumptive uses and return to the system, although with degraded quality.

The hydropower plants on the rivers and canals are operated to meet the irrigation demands as the first priority. Water requirements of inland lakes for development of fisheries, and of irrigated forests in the Indus plains, are met by irrigation canals. Navigation is confined to 732 km of the lower reach of the Indus River because the barrages upstream do not have navigation locks.

Management of Water Resources

The policies, strategies, and practices for effective management of Pakistan's water resources have evolved and been improved during the past 100 years, and this process continues. Although several major events during this period, such as rapid development of new projects, improved technologies, changes in objectives, and inter-provincial water disputes, led to changes in policies and management practices, the pre- and post-1960 eras have distinct characteristics in terms of the roles of institutions and their performance. This section describes the key features of Pakistan's water resources management practices in these two periods.

Water Management before 1960

Legal framework. Before partition of the subcontinent into the independent republics of India and Pakistan in 1947, the government of British India at Delhi administered the provinces through governors and delegated to them wide powers for managing all subjects except defense, communications (railways, strategic highways, post, and telegraphs), federal taxes (income, customs), and foreign affairs. Agriculture, home affairs (security), industry, irrigation, water supply, roads, public health, and local development were regarded as provincial subjects and were managed by the governors. The Central Government at Delhi provided financial support for development of these provincial sectors.

Irrigated agriculture in the Punjab and Sindh in the nineteenth century was limited to *sailab* (flood) irrigation along the rivers and to uncontrolled inundation canals, which received supplies when the river levels were high. The area irrigated by these methods was small, and the success of the crops depended on the size and duration of floods, which varied from year to year. The frequency of famines, therefore, was high. Expansion of irrigated agriculture was not possible without constructing weirs (headworks) across the rivers to control the water levels and divert the river flows to the canals on a sustainable basis throughout the year.

The need to avoid famines or to reduce their frequency was also important to avoid unrest in the northern provinces of the subcontinent, which were the main source of recruitment to the army. There was also the need to settle retired army veterans and to provide employment to loyal subjects who had supported the British government during the 1848 mutiny. The development of water resources of the Indus River and its tributaries provided the opportunity to achieve these objectives.

In 1873 the Central Government enacted the "Northern India Canal and Drainage Act," which provided the legal framework for expansion of irrigated agriculture in the Punjab and the NWFP. A similar act, "The Sindh Irrigation Act, 1879," was passed to achieve the same objectives in Sindh, which was a part of the Bombay province at that time. These Acts set out the policies for allocation, regulation, and use of river flows "in

public interest." The allocation policy defined the "prescriptive rights" (rights acquired by custom) and the rights of riparians along the river banks, who practiced *sailab* irrigation. The policy of treating "existing uses" as sacrosanct became the water law. The Canal Act included provisions for drainage, protection of irrigation works, penalties for misuse of water, and the powers of canal officers to ensure efficiency of water use.

Following the Canal Act, several acts, manuals, and regulations were introduced, such as the Land Acquisition Act, Manual of Professional Orders, Revenue Manual, Settlement Act, and Manual of Irrigation Practice, that provided policy and technical guidelines for the irrigation and revenue officers for developing irrigated agriculture.

Institutions. Initially, the Public Works Department was established with separate "branches" dealing with irrigation, buildings and roads, public health (water supply and sanitation, and electricity including hydropower). With the expansion of irrigation, a separate Irrigation Department headed by the Secretary to the Government was established. By the 1940s the irrigation network was so extensive that the Punjab Irrigation Department had four secretaries, two for operations and maintenance, one for development projects, and one for administration and personnel management. The department was responsible for planning, designing, constructing, operating, and maintaining the irrigation works. It was also responsible for certain aspects of revenue work (recording irrigation areas and crops, assessing water charges, and settling farmers' water related disputes).

The Agriculture Department was responsible for agricultural research, production of quality seeds, agricultural extension, livestock, and forestry. Some of these functions were subsequently assigned to new departments. The Revenue Department was responsible for settlement of farmers in the irrigation project areas, assessment of crops, and collection of land revenue and water charges.

Investment planning. Irrigation development programs were prepared by the provincial irrigation departments. It was an innovative and pioneering effort because there was no experience within the subcontinent or outside to guide the

development and use of the water resources of rivers carrying heavy sediment loads during the high flow season. Punjab led the pioneering effort. Each province developed its own plans. The concept of comprehensive basin planning did not exist. The irrigation systems were developed in stages, and the completion of one canal system was followed by planning the next system. The first series of canal systems used all the water that could be diverted up to canal capacities from the rivers during the *kharif* (rainy) and *rabi* (post-rainy) seasons and acquired water rights for their historic uses. The second series of canal systems were allocated what was left. Thus, the systems that were developed last received supplies only during the *kharif* season and suffered serious water shortages in the sowing and maturing crop periods if river flows were unfavorable.

Each provincial irrigation department had a planning office at its headquarters. Punjab established a large Central Designs Office (CDO), which was responsible for planning and designing new projects and addressing technical and operational problems that could not be resolved by the field staff. The Irrigation Research Institute of the department pioneered developing models and testing innovative designs of barrages, river training works, canal falls and other hydraulic infrastructures. The competition between Punjab and Sindh to excel in innovations was keen. Sindh was ahead in planning and designing the flood *bunds* (embankments) along the lower Indus; its *Bund Manual* was used as a guide by the other provinces.

The financial feasibility and economic justification of the projects prepared by the irrigation departments were reviewed by the provincial finance departments and approved by the respective provincial governments, but their technical feasibility was the responsibility of the irrigation departments. New projects were financed by the provincial governments with financial support from the Central Government. Operation and maintenance (O&M) and extensions and improvements (E&I) expenditures were financed fully by the provincial governments.

Strategy and design of the irrigation system. The policy objectives described earlier called for a strategy that emphasized an extensive rather than an intensive irrigation system to provide

water to as many farmers as possible, to spread village settlements widely rather than concentrate them in large centers, to ensure low operation costs, and to minimize human interference. The system was intended to avoid crop failures rather than to promote high cropping intensities.

The flat topography and gentle slopes of the Indus plains proved ideal for dividing the proposed irrigated area into 25-acre (about 10 hectares) squares on plans and transposing this design in the field. Village sites, pasture grounds, *mandis* (market centers), rural roads, and other facilities were marked on the plans and similarly transposed to the site. However, inadequate attention was given to planning the drainage system.

The canal systems were designed to use the run-of-the-river supplies to maximize cropped area, minimize water consumption, and simplify operation and administration. They were intended to provide "equitable distribution" of the available river supplies without consideration of the actual crop needs at various stages of their growth.

River flows were diverted by weirs into main canals and subsequently into branch canals, distributaries, and minors, and finally to outlets that supplied the farmers' watercourses. Each watercourse was a miniature irrigation network with field channels up to 16 km long and a command area that varied in size from 100 to 300 ha. Farmers received water in proportion to their land holdings. Because the outlets flowed continuously with varying discharges depending on available supplies in the distributaries and minors, the canal officers fixed the *warabandi* (water tax) for each watercourse defining the turnaround sequence of water use by the farmers and the number of hours of their entitlement for water application. The irrigation operations in the outlet commands continued day and night, rain or shine, except when the canals were closed during high floods to avoid heavy silt entry or for maintenance and repairs.

Water management. The basic water management unit is the irrigation division, which is vested with full powers for managing the O&M and revenue work. The division usually has 3 or 4 subdivisions, and each subdivisional officer manages 3 or 4 overseers (engineering staff) and 3 or 4 *zilladars* (revenue staff). The *zilladars* are

usually qualified agricultural graduates, and each *zilladar* manages 4 to 5 *patwaris* (field revenue staff). The subdivision normally managed 1500 to 2000 ha of irrigated area. It has three main functions: water management, maintenance of the irrigation works, and revenue work.

Water management involved such functions as operation of the irrigation network, silt management, water gauge and discharge observations, annual hydraulic surveys of the canals and distributaries, and measurement of outlet discharge capacities. These activities are essential to maintain the designed capacity of the channels and outlets to ensure equitable distribution of water. The silt problem is addressed in various ways, for example, by still pond operation at headworks, use of silt excluders and ejectors, designing non-silting canals, and silt clearance in the distributaries and minors. The hydraulic surveys provided the basis for preparing budgets for maintenance, extension, and improvement works.

The revenue work included such functions as measuring the area irrigated and the crops grown during the sowing and maturing crop periods; assessing crop losses due to frost, hailstorms, or floods; preventing misuse or waste of water; and settling farmers' water related disputes. The *zilladar* is required to check 100 percent of the *patwari's* measurements while the subdivisional officer checked 30 percent of the *zilladar's* and *patwari's* measurements. This management system was standard practice in the Punjab. The irrigation revenue staff duplicated some functions of the civil service staff to ensure proper recording of irrigated area and assessment of water charges. The importance attached to these functions is indicated by the fact that the subdivisional officer devoted almost 50 percent of his or her time to revenue work, and was required to spend 20 nights per month in the field. No other department was so closely involved in the affairs of farmers as the irrigation staff.

To ensure integrated management of run-of-the-river supplies, inter-river link canals were constructed. Subject to the capacity of the canals, the river supplies of all rivers, except the Indus, were utilized fully. However, the long canals and the extensive network of field channels in the watercourse commands resulted in low delivery efficiency of 35 to 40 percent from canal head to

root zone, with most losses occurring in the watercourse commands.

Water charges and cost recovery. Farmers pay land tax, which is based on the productive value of the land. In addition, farmers in the irrigated areas pay water charges, which are based on the area irrigated and the types of crops grown. Food and fodder crops (wheat and maize) are charged at a lower rate than cash crops (cotton, sugarcane, and fruits). The rates are increased periodically, but they are still low and constitute only a small part (about 5 percent) of the farmers' investment costs. However, until recently, the water charges covered both investment and O&M costs, and the Irrigation Department was a major source of revenue to the provincial government, particularly in the Punjab. Since 1975, however, the water charges are not sufficient to cover even the O&M costs because O&M costs increased considerably due to aging of the canal systems, the pumping costs of SCARP tubewells, and heavy inflation, while the water charges remained at low levels.

Interprovincial water disputes. As the run-of-the-river supplies of the tributary rivers (Jhelum, Chenab, Ravi, and Sutlej) were increasingly used through successive irrigation development projects in the Punjab, Sindh became concerned about their possible impact on its existing and future irrigation uses on the main Indus. There was a Sindh-Punjab dispute at every stage of new developments in the Punjab. These disputes, however, were settled through negotiations or arbitration by independent commissions set up by the Central Government. The main agreements executed over the years on allocation of water to the provinces were the Tripartite Agreement of 1920, the Anderson Commission Award of 1935, the Rau Commission Award of 1942, and the Sindh-Punjab Agreement of 1945.

Soon after division of the subcontinent into the independent states of India and Pakistan, a serious water dispute arose between the two countries concerning the sharing and ownership of the waters of the rivers flowing through the Indian territory. The dispute was resolved with the good offices of the World Bank, and the Indus Water Treaty was signed in 1960. The treaty allocated the three Eastern Rivers (Ravi, Beas, and Sutlej) to India and the three Western Rivers (Indus,

Jhelum, and Chenab) to Pakistan. An Indus Basin Development Fund was established with financial assistance from the World Bank and donor countries to construct the Mangla and Tarbela Dams, and a system of inter-river link canals and barrages to replace Pakistan's uses on the Eastern Rivers. These events underscored the need for a new approach to management of Pakistan's water resources as discussed in the next section.

Intersectoral water allocation and use. Irrigation remained the dominant use of Pakistan's water resources before 1960. Rapid expansion of cities such as Karachi and Lahore started after 1947 due to the influx of refugees. The main constraint was not the availability of water, but the slow development of water supply and sanitary facilities in the urban areas. The pace of development of industries also increased only after 1947. However, there were no significant problems in meeting their water requirements from irrigation canals. The future water requirements of sectors other than irrigation were not given as much attention in planning as they deserved on the assumptions that they would constitute a small part of the total requirements and that they would receive high priority as in the past.

Achievements and problems. The pre-1960 achievements of the provincial irrigation departments were remarkable. The objective of avoiding famines was fully achieved; the Indus irrigation systems were greatly expanded; new irrigation technologies were developed, and the Indus Basin became the granary of the region. The success of water management was consistent with the objectives and policies of designing an extensive irrigation system to serve as many people as possible. Equitable distribution of water was an important criteria for judging success and, despite occasional shortages at the tail outlets, this objective was largely achieved. The irrigation institutions had strong planning and designing offices and research centers. Management and decisionmaking was decentralized, and recovery of both capital and O&M costs was effective despite the low level of water charges. Although the concept of planning and developing the Indus Basin as a single hydrological unit did not exist, the plans developed by the provinces to serve their respective interests, the

timely resolution of inter-provincial water disputes through negotiation and arbitration, and the challenges provided by inter-provincial competition to excel resulted in rapid development of the irrigation systems.

While the extensive irrigation networks made the Indus Basin the granary of the region, they also caused negative environment effects. The most significant adverse effects, which were threatening the very sustainability of the success achieved, were the twin menaces of waterlogging and salinity. To mitigate these negative effects of irrigation, the Punjab Irrigation Department initiated research and reclamation activities, established the Ground Water Development Organization, constructed a series of surface drains, and installed public tubewells to supply the additional water required for reclamation. However, these measures were inadequate to address the formidable and increasing problems of waterlogging and salinity, and by the end of the 1950s some 40,000 ha of cultivated lands were going out of production annually.

Water Management after 1960

The post-1960 period was marked by events that had major impacts, both favorable and unfavorable, on the efficiency of water resources management in Pakistan. New institutions were created; green revolution technology greatly changed the potential of irrigated agriculture; the twin menaces of waterlogging and salinity received serious attention; basin planning studies for comprehensive development of water resources were undertaken; the International Irrigation Management Institute established its major branch office in Pakistan; and investments in the water sector increased. This section deals with the impact of these events on the effectiveness of water resources management in Pakistan.

New institutions. (a) WAPDA: The Water and Power Development Authority (WAPDA) was created in 1958 to prepare a comprehensive, unified plan for development and use of the water and power resources of Pakistan. The WAPDA Act also provided for preparation of projects and programs concerning irrigation, drainage, waterlogging and salinity, and inland navigation. The Act envisaged that the works constructed by

WAPDA would be transferred to the concerned agencies for operation and maintenance.

The WAPDA organization became operational in 1959-60. Its main activities on the water side were construction of the Indus Basin Program (IBP) formulated in connection with the Indus Waters Treaty, development of the Salinity Control and Reclamation Program (SCARP), and planning and development of the water resources of the Indus Basin. WAPDA completed the Mangla and Tarbela Dams and the series of barrages and link canals of the Indus Basin Program with remarkable success within the transition period specified in the Indus Waters Treaty. As regards the SCARP Program, by 1992 WAPDA completed 44 SCARP projects involving 12,800 irrigation and 1800 drainage tubewells, 9000 km of surface drains, and 5700 km of pipe drains. Additional projects involving construction of 3000 drainage tubewells, 4400 km of surface drains, and 10,000 km of pipe drains are under construction or planning stages.

Many comprehensive basin planning studies were also carried out during 1960-92. They include Harza's Master Plan (1964), the Indus Special Study (1967), the Revised Action Plan (RAP) 1979, and the Water Sector Investment Planning Study (WSIPS) 1990. These studies provided a framework for development of the water resources of the Indus Basin and dealt with issues concerning agriculture, irrigation, drainage, and hydropower. The Indus Special Study (1967) provided the basis for establishment of the Tarbela Development Fund.

(b) OFWM and WUAs: The On Farm Water Management (OFWM) organization was established in 1981 to rehabilitate watercourses and organize Water User Associations (WUAs) to maintain the watercourses and field channels. Farmers requesting assistance under the OFWM projects were required to form a WUA registered under the provincial ordinance. OFWM provided to each WUA a vehicle for carrying out construction and O&M activities, the opportunity for a collective voice in planning and operating irrigation and drainage facilities, and a mechanism for conveying irrigation related extension information. By 1991 about 17,000 WUAs were established. The OFWM projects financed lining the first kilometer of the watercourse with free labor contributed by farmers.

(c) Other organizations: Other organizations initiated by the Punjab provincial agriculture department included Command Water Management (CWM), Agriculture Extension and Adaptive Research (AEAR), Water Use and Soil Reclamation (WUSR), and Farmer Joint Management (FJM). They were intended to provide support and advice to farmers on water use and extension.

Green revolution technology. Green revolution technology was introduced in Pakistan in the 1960s. The use of new varieties of seeds with appropriate applications of fertilizers and pesticides increased wheat and rice yields four to five times the normal yields in irrigated areas. Initially, Pakistan achieved remarkable success by using this technology, but it was soon realized that the irrigation system that was designed to provide run-of-the-river supplies could not provide water in the quantities and at the time required by the new seed varieties. Farmers who had private tubewells to supplement canal supplies were able to achieve higher yields, but those depending solely on canals achieved less than optimum results.

Private tubewells. Although the use of tubewells for pumping groundwater for water supply and other uses was known before, the existence of a huge groundwater reservoir of usable water for irrigation and reclamation identified by WAPDA's investigations, and its successful exploitation by SCARP tubewells opened the way for rapid development of private tubewells. Farmers realized that they could use the groundwater below their land. By 1991 some 324,000 private tubewells were developed, and their total contribution amounted to about 50 percent of the canal supplies delivered at the outlets in the 10 million hectares of irrigated lands underlain with usable groundwater. Farmers used canal and tubewell workers conjunctively, sold water to their neighbors, increased crop intensities, and used the green revolution technology effectively.

Water management. One would expect that the availability of large storage reservoirs, the facilities provided by the inter-river link canals, the additional water resources provided by the huge ground water reservoirs, and the new institutions

of WAPDA, OFWM, and others would provide great opportunities for comprehensive management and effective use of the surface and ground-water resources of Pakistan. However, these opportunities were not adequately utilized, and in some respects the effectiveness of water resources management deteriorated instead of improving for reasons discussed below.

Interprovincial water disputes. The water dispute between India and Pakistan was settled with the signing of the Indus Water Treaty in 1960, but inter-provincial disputes on allocation of storage water from the reservoirs included in the Indus Basin Program continued for more than thirty years. First, the Indus Basin Development Board (IBDB) set up by the Government of Pakistan (GOP) in 1960 defined the allocations and the procedures for operating the Tarbela reservoir, but its recommendations were not accepted by some provinces. In 1968 a Water Allocation and Rules Committee was constituted to fix water allocations and reservoir releases. The committee submitted its report in 1970, but no decision was taken on its recommendations. In October 1970 the Justice Fazle Akbay Committee was established to address the allocations issues. Again, no action was taken on its recommendation. In 1977 GOP established a commission comprising the Chief Justices of the provinces headed by the Chief Justice of the Supreme Court of Pakistan. The commission's report was submitted in 1982, but no decision was taken. In March 1982, GOP directed the Chief Justice of the Supreme Court to recommend the allocation of water to the provinces, but no action was taken on his April 1993 report.

These results indicate the contrast in decisionmaking during the pre- and post-independence (1947) periods. The lack of decision on allocations had serious adverse effects. The provinces tended to withdraw as much water as they could even when it exceeded crop needs and caused damage to the canals. When Tarbela Dam was completed, WAPDA did not have an agreed basis for releasing water for irrigation, and a Water Distribution Committee was established to decide the storage releases ad hoc. This arrangement adversely affected power production at Tarbela. The irrigation demands from the provinces were often more than Tarbela could

meet, and in the race for establishing water rights based on actual users, valuable storage suppliers were not used productively.

The ad hoc distribution arrangements continued until the Water Apportionment Accord, which defined the respective shares of the provinces, was signed in 1991 by the Prime Minister of Pakistan and the Chief Ministers of the four provinces. The GOP passed an act in January 1992 establishing the Indus River System Authority (IRSA) for implementing the provisions of the accord. A study carried out by the World Bank in 1992 using the Indus Basin Model (IBM III) for crop production optimization under the Water Apportionment Accord scenario showed that there was substantial scope for increasing crop production up to \$100 million annually through proper management of the water supplies and that significant reduction in the system shortages could be achieved both in *rabi* and *kharif* seasons without increasing the existing canal capacities. The study indicated the benefits foregone due to inadequate management during the two decades of the post-Tarbela period.

Stakeholder participation. The comprehensive basin studies prepared by WAPDA and the consultants had little stakeholder participation, the stakeholders being the provincial irrigation and agriculture departments and the farmers. It was a top-down approach largely managed by foreign consultants. No serious attempt was made to blend the successful experience of foreign countries with the political, social, and administrative realities of Pakistan's irrigated agriculture. Every report rightly pointed out that the existing irrigation system, which was designed to distribute water equitably without taking crop needs into account, was not suitable to meet the green revolution technology's requirements, but none of the reports provided a program to address this issue. Coordination between WAPDA and irrigation departments, between irrigation and agriculture departments, and between OFWM and irrigation departments was poor. There were more turf battles than teamwork. It is difficult to evaluate the cost of such management problems, but the inability to implement the proposed basin programs as planned was partly due to the lack of effective

coordination and stakeholder participation in planning.

The lack of a unified, integrated, and coordinated effort is probably one of the reasons why some of the projects did not succeed as well as they should have. OFWM organization's approach to develop WUAs did not work well. Apparently, farmers perceived the WUAs as a means to obtain free labor for watercourse improvement. Once this was done, many WUAs became dormant. The OFWM staff shifted from one project to the next, and their relationships with farmers were not sustained. The irrigation *zilladars* and *patwaris* were in the field and had long-term relationships with the farmers, but they were not involved in the OFWM projects. Some WUAs were successful, but they were exceptions.

Conjunctive use of water. Farmers use their private tubewell water conjunctively with canal supplies. They also sell water to their neighbors. WAPDA surveys indicated that water trading is being practiced on 70 percent of the watercourses in the sweet water zones. However, neither WAPDA nor the Irrigation Department has plans for introducing conjunctive use of river flows, storage water, and groundwater in the system. Whether they are located in sweet or saline groundwater zones, the canals are drawing water based on their historic rights as though private tubewells did not exist. Equitable distribution of water was an article of faith of the irrigation department in the past, but now there is inequity in distribution at all levels of the irrigation systems.

Private tubewells are increasing at the rate of 6 percent annually. It is recognized that uncontrolled and unregulated groundwater use is replete with serious consequences and could lead to movement of saline groundwater to the sweet water zones. This is already a serious problem at the tails of distributaries and minors, where surface water is short and farmers have resorted to excessive groundwater pumping.

Water charges and cost recovery. Despite increased water resources and higher incomes, water charges are low. They amount to only about 5 percent of the total agricultural inputs and 5 percent of the net-farm income. Until 1975 water charges were adequate to meet the O&M costs,

but now they are not sufficient to cover even those. The low cost recovery is affecting the ability and willingness of the provincial governments to provide adequate funds for O&M. The canal systems are deteriorating due to inadequate maintenance.

The low revenue from water charges is also due to the difficulty in assessing the canal irrigated areas in the watercourse commands, where farmers are using both canal and tubewell water. There are no water charges on the area irrigated by private tubewells. Moreover, some 15 percent of the outlets in the tail reaches of distributaries and minors have been closed by the farmers because they were receiving little or no canal supplies. They are now depending solely on their private tubewells and do not pay water charges. The canal water saved by the closed outlets is being used somewhere in the system, but it is not fetching revenue because water charges are not based on the volume of water delivered to the outlets.

Institutional weaknesses. (a) Background: Water is developed and used to meet the needs of a society. These needs are subject to qualitative and quantitative changes over a period of time. Water resources management must, therefore, be a dynamic process that has a built-in mechanism to respond to the changing variables.

The traditional institutions responsible for water resources management have been in the government sectors that are by their very nature static in methods and procedures, ruled by precedents, and rarely innovative even when a changing scenario demands it. The decision to establish WAPDA as a semi-autonomous institution in the public sector was an attempt to rectify this situation. The experience has been successful. Water resources management goes beyond the stages of planning and project management. Water policies should ensure the productive and beneficial use of the resource. Pakistan lacked an organizational setup to oversee the entire cycle of water management.

This institutional deficiency is serious. Irrigated agriculture is the most important sector of the economic structure of Pakistan. There are Departments of Irrigation (for water input) and of agriculture (for agricultural inputs), but there is no administrative institution that reflects the multidisciplinary nature of irrigated agriculture.

The task of directing endeavors to meet the ultimate need of sustainable agricultural production and environmental protection becomes difficult in such an institutional vacuum.

Progress in institutional development in Pakistan has been achieved with the creation of WAPDA, but WAPDA's charter does not cover the entire water cycle. The management of water use—the important part of water resources management—is the responsibility of the departments of the provincial governments. Traditionally, the Provincial Irrigation Department had the responsibility of conceiving, implementing, operating, and maintaining the irrigation and drainage system. Over almost a century, the Irrigation Department acquired enviable expertise. However, when the demands on the system changed qualitatively and the complexity of the system increased, these departments did not show the needed dynamism.

The Revised Action Plan (RAP) 1979 identified the irrigation-related institutions as the key to optimize agricultural productivity in the Indus Basin. It gave detailed recommendations for strengthening such institutions at the federal, provincial, and project levels. It also recommended the creation of new institutions to coordinate the policy, planning, and management functions. The key element in the institutional development strategy proposed in RAP 1979 was to close the institutional gap between water as an input to agriculture and agriculture itself. Although some progress was made on other recommendations, this core issue has remained largely unimplemented. The WSIPS 1990 also gave detailed institutional proposals, identifying once more the close relationship of the Irrigation Department and Agriculture Department as the key factor to optimize output of irrigated agriculture.

Protection of the environment is a global concern. Irrigation and drainage activities are central to many environment-related issues. Environmental protection would require extension, modification, and capacity building within existing institutions.

In the field of irrigation and drainage, environmental impacts and effects tend to cross many sectors. While the institutions dealing directly with them should have broader interest, the assessment of the wider responsibilities of envi-

ronmental and development planning institutions has led to the conclusion that substantial benefits can be derived by exploiting existing institutional structures. This becomes all the more relevant given the shortage of environmental expertise and financial resources. Pakistan's existing institutions—the irrigation departments (PIDs) at the provincial level and WAPDA at the federal level—should be entrusted with the responsibility to address the environmental aspects associated with irrigation and drainage.

In the medium to long term an environmental capability should be introduced in each PID to enable consideration of environmental aspects and, where applicable, oversee environmental impact assessment. In the short term the main environmental capability with regard to the water sector should lie with WAPDA, which should assume greater responsibility for program and system planning, economic appraisal, environmental assessment and monitoring, and evaluation of both environmental and socioeconomic impacts. In line with this policy WAPDA should undertake:

- Planning strategic drainage networks
- Assessing the macro environment and identifying key effects and impacts
- Proposing water sector strategies that take these into account
- Overseeing environmental impact assessment of major undertakings
- Appraising programs and projects from both social cost-benefit and environmental viewpoints
- Monitoring and evaluation (M&E) of socioeconomic issues
- Overseeing environmental impact M&E
- Drafting legislation concerning groundwater observation and tubewell development
- Coordinating a national master plan for irrigation water and drainage effluent quality monitoring and analysis.

To implement the above tasks, WAPDA should be strengthened. This should include promoting the powers and status of both environmental and economic planning units, and creating the positions of a Chief Environmentalist and Chief Economist, who should have the grade and status of the Chief Engineer for Water Resources Planning. These three chiefs and their constituent divisions would make up the core for

all WAPDA's planning and evaluation activities, and might be called the "Planning and Evaluation Group." The accompanying tasks to be carried out in other organizations and other areas of institutional building would be essential to complete the picture.

No set of policies and no strategy for water resources management would be possible without the development of institutions appropriate to address the complexity and multi-sectoral nature of the tasks of water resources management. This matter is being debated in professional and official circles in Pakistan. RAP 1979 and WSIPS 1990 recognized it as an important factor for increased productivity of irrigated agriculture. A number of missions from international

agencies have recognized institutional capability as one of the major issues in the Pakistan water sector. However, adequate steps have not been taken to implement the recommendations of these studies.

Note

1. This summary of the conference paper by Shams ul Mulk was prepared by Syed S. Kirmani, World Bank consultant, and approved by Shams ul Mulk. Copies of the original 200-page paper, illustrated and documented with maps and tables, can be obtained from Shams ul Mulk, Chairman, Pakistan Water and Power Development Authority, 705 Wapda House, Shahrah-i-Quaid-i-Azam, Lahore, Pakistan, telephone 92.42.6366911, fax 92.42.6278837.

Discussant Remarks: Egypt

Mahmoud Abu-Zeid

First, the organizers of the conference were quite intelligent when they asked us to comment on lessons to be learned from Pakistan, and not lessons from France and other countries, to be applied in Egypt. The latter could have made our task quite complicated.

Second, it is very important to see how the Bank could help the developing countries transfer, or at least make use of, some of the experiences or lessons that can be applied to other countries. The convening of this conference is one way of doing it, but there must be additional ways to make available the experiences of countries to others.

The paper prepared by Shams ul Mulk reflects the experience and actual practice of an immense package of policies and applications in the field of water management in Pakistan. Undoubtedly, there are numerous lessons applicable to Egypt and to many other developing countries. However, it is also true that there are major differences between Egypt and Pakistan, the most important of which is the scale of a country whose irrigated land exceeds 40 million acres, whose water resources are over 240 billion cubic meters a year encompassing several major rivers, and whose recent population is 122 million.

In comparison, Egypt's agricultural land, which is mostly irrigated, amounts to 7.4 million acres. Its water resources do not exceed 59 billion cubic meters. Ninety-five percent of its water originates from one river, the River Nile, which is shared by nine countries, and Egypt is located as its tail end.

Nevertheless, despite these vast differences, each of the two countries has its eminent ancient

history in irrigation and agriculture that dates back thousands of years, and each is characterized by having a very intricate irrigation network starting from large dams to hundreds of thousands of kilometers of canals and drains that transfer water to the different agricultural areas.

I will comment on some of the certain principles and major issues presented in Mr. ul Mulk's paper that are of special importance to Egypt. First, for Egypt, as for Pakistan, water is the cornerstone for development. The two countries are in the middle of a process of unprecedented population and economic growth, which puts pressure on agriculture and other water users.

Second, the concerns about the quality of the environment are rapidly increasing, and water is prominent among these concerns. More people and different groups are interested in water policies than in the past. This fact will create demands for broader consideration in terms of water policies than we may have experienced before.

Third, Egypt, and definitely Pakistan, are moving towards a more open market-oriented economy. This will place different demands on water policies in terms of valuing, recovering capital recurrent costs, and sustaining the water system.

Historically, water has been a critical component for the development of Egypt. It is becoming a major constraint. All natural available fresh water resources have been exhausted. The future of water use in Egypt depends on the better use and management of the existing water resources.

The population of Egypt exceeds 59 million and is expected to go to 70 million by the year

2000 and 110 million by the year 2025. The per capita share of land declined from 0.5 acres per person in 1897 to 0.1 acres per person in 1992. The per capita share of fresh water resources is now 950 cubic meters per person per year and will drop to 350 cubic meters per person by the year 2025. You will recall the figures that Mr. ul Mulk stated. Most of Egypt's water uses are within the agricultural sector: 84 percent for agriculture, 8 percent for industry, 5 percent for municipalities, and 3 percent for navigation.

Turning to water and environmental issues, as population increases, industrial development proceeds, agricultural production intensifies, and the demands on the limited water supply greatly increase. To meet these competing demands, both countries are giving more attention to the reuse of water-recycling. This means that water being used must be kept as high quality as possible. There is a growing concern that the very limited water resources are becoming increasingly polluted because of excessive and improper use and that both countries will have to bear heavy costs in terms of the health and productivity of their populations unless actions are taken to improve resource management.

In Egypt there is still insufficient information available on water quality, and this lack requires strengthening water quality monitoring programs and water quality management.

Early in 1991 the Government of Egypt decided to prepare an Environmental Action Plan (EAP) to strengthen the management of the environmental affairs in Egypt. With the assistance of the World Bank and donor countries, the Action Plan was adopted in May 1992.

Mr. ul Mulk referred to a vast hydrologic network in Pakistan. Both countries are introducing new technologies in this area. Egypt has started a telemetering system whereby hydrologic and water quality data of the Nile and major canals and drains are transmitted through a meteor-burst technique to central decisionmaking centers.

Regarding the problems of availability of spare parts and the degree of sophistication of the telemetering system, Pakistan's experience would be of great help to Egypt with respect to the future expansion of the system.

The area of salinity control was also stressed by Mr. ul Mulk. Both Egypt and Pakistan suffer from salinity and waterlogging problems that

cover vast areas. Reasons for these problems have been studied and are recognized to be due mainly to the misuse of irrigation water and delays in implementing proper field drainage systems. About 4 million of Egypt's 7.4 million acres of land have been provided with field drainage systems.

Pakistan's experience in implementing and managing the Salinity Control and Reclamation Project (SCARP) program is immense. The dual purpose of tubewells and the Water and Power Development Authority (WAPDA) policy to transfer public wells to private ones is quite interesting to Egypt. The Delta and the Nile Valley aquifers are fed mainly through excess irrigation water and seepage from the irrigation systems. The majority of tubewells in Egypt are private and used mainly for irrigation. There are about 24,000 private tubewells and not more than 3,000 wells owned by the government. The latter are used mainly for domestic use supply.

Egypt's aquifers are managed by its Ministry of Public Works and Water Resources and the Water Research Center through licenses and monitoring of extractions of groundwater. The use of skimming wells and scavenger wells, where lenses of thin fresh water exist, is of particular interest in the coastal areas of Egypt, and it is known that these kinds of wells require a high degree of precision in operation and management of the system.

Moving to the water resources management experiences, the historical development of water resources management plans, policies, and related institutions in Pakistan is an enormous wealth of experience and educational material for water resources managers and policymakers. Of particular interest to Egypt is Pakistan's multi-purpose planning approach. I do not have time to give details on that with respect to Egypt—basin planning for integrated development, conjunctive use of surface and groundwater, and the institutional arrangements over exploitation of groundwater and intrusion of saline, provincial allocation on a seasonal basis, and creation of semi-autonomous water planning and management institutions. In contrast, in Egypt the Ministry of Public Works and Water Resources is the custodian of the national water resources. The basic planning and management of such resources is carried out by the Ministry Planning Sector.

Concerning the farmers' involvement in managing the system, Egypt has started a National Irrigation Improvement Program, which was based on considerable research work similar to that conducted in Pakistan. Egypt's National Irrigation Improvement Program establishes Water Users Associations and an Irrigation Advisory Service. This program now covers about 400,000 acres. It will take some time until the whole country is covered.

Regarding water rates and prices, in Pakistan water has been traditionally conceived as a public good. In Egypt, water rates are still a sensitive issue. Water as a public commodity has been the support for the prevailing policy. This position is consistent with Islamic religious teachings, and supporters of this perspective point to the essential role water plays in a nation entirely dependent on the Nile for food and livelihood.

Moreover, most of the water-using farmers are found among the poorest segments of the society, and inexpensive irrigation water provides a direct and obvious mechanism to help this group. However, very serious studies have been conducted towards establishing a cost recovery policy that will involve recovery of all or part of the operation, maintenance, and rehabilitation costs

required for the system. The balance between economic efficiency and the ability of farmers to pay will influence the cost-recovery level.

Regarding research, I would like to mention the salt balance studies, which are also carried out in Pakistan, with the associated risks of pollution in both countries. For the Nile Delta, 18 million tons of salts are imported to the system with irrigation water and 32 million tons of salts go out of the system annually. The need for continuing leaching is clearly justified. A water multiplier, which is about 1.6 for Egypt, resulting from recycling of the irrigation drainage water may be seriously affected if pollution of such waters continues.

In conclusion, water is a vital natural resource for both Pakistan and Egypt. The two countries have long traditional experience with handling water. The experience of Pakistan towards comprehensive water resources management and the development of appropriate institutions would benefit Egypt, which is facing new challenges regarding the complexity of the multi-sectoral nature of water resources development, management, and use.

Again, I suggest that the World Bank encourage different countries to make use of similar experiences.

Discussant Remarks: Mexico

Fernando J. González Villarreal

My comments, although, related to Shams ul Mulk's paper, are relevant to what has been said up to now about the concept of sustainable development and how to go from concept to policies and from policies to practice or to policy implementation.

My first reflection deals with Mr. Cousteau's speech about cultural diversity. I think we are talking here about another kind of diversity—the water diversity—and that has historic, political, social, economic, and ecological aspects that have to be considered before seeking a solution. But we can learn from this diversity, and we can adapt it to our own countries.

Related to those comments, there are these common issues. We have heard about different countries with different problems, but at the end, in 1975, those issues were raised in Plata, and they talked about very much the same issues: competing jurisdiction among institutions, excessive government intervention, deterioration of the infrastructure due to lack of resources for maintenance and operation, and increasing pollution.

At the same time in Mexico the First National Water Plan was formulated. Its main conclusion was that there was enough water in the country, but it had to be managed carefully.

Pollution was a growing problem. The goal that was set—and it was very conservative—was to leave things as they were; in other words not to increase the pollution problem. That goal was not achieved. The situation got worse.

In comparing the situations in Pakistan and Mexico, one difference is that fresh water availability per capita in Mexico is about three times

as much as in Pakistan. However, if we take only the arid and semi-arid parts of our country, where two-thirds of the population and 70 percent of industrial activity and most of the irrigated land are located, in that two-thirds of the country, water availability is pretty much the same as in Pakistan. This arid two-thirds is where all of our problems are.

Regarding the physical setting, our relevant difference is that, whereas to irrigate 60 million hectares in the Indus Basin, Pakistan has built 3 dams, 18 barrages, and 60,000 kilometers of canals, to irrigate hectares over 6 million hectares, Mexico has to build 1,300 dams, about 2,000 barrages and about the same length of canals, and about 25 hydrological systems. Thus, the physical setting is a bit different, but the problems are the same.

We agree with Mr. ul Mulk on the need for new approaches to water management and the need to advance rapidly on those aspects. In addition, although increasing demands in the concentration of population and economic activity are definite factors for most water imbalances, it is also clear that the real challenge rests on the achievement of efficient water use and the conservation of the environment.

Therefore, in Mexico, policy reforms are oriented in three main directions:

1. The development of the infrastructure needed to eliminate the existing gaps, which affect mainly the poor, and to meet increasing demands
2. Achieving greater water use efficiency
3. Giving higher priority to water pollution abatement and control.

Regarding these three orientations, I am going to speak about three issues: the legal and institutional framework, the role of water users and the changes in the government's role that arises from that role of water users, and sustainable agriculture development.

Legal and Institutional Framework

Under the Mexican Constitution, water is a national property to be administered by the federal government. Water can be used only through authorization by the corresponding federal authority. Policy reforms require a new institutional and legal framework since the approach adopted in Mexico rested on a delicate balance between government regulation and use and participation as well as an introduction of market mechanisms and the promotion of private investment and collaboration.

Thus, in 1989, the National Water Commission was created as the sole federal authority to deal with water management, as regards both quantity and quality. A new national water law was enacted in December 1992 to provide a regulatory framework for water management that reinforced the role of the National Water Commission.

The Commission has been set up to coordinate investment programs in the water sector. It defines priorities and constraints according to both the evolution of water balances in each of the country's river basins, and the national and regional developmental objectives.

The Commission also plays an important role in the fiscal policies related to water levies as well as their collection. Institutional and sectoral coordination is provided at the federal level by the Technical Council established as the National Water Commission's working body. The Council, which resembles a true water cabinet, is presided over by the Minister of Agriculture and Water Resources. Its members include the heads of the ministries related to water management. The Council oversees the Commission's programs and performance.

The participation of water users and interested third parties is a prerequisite in mandatory water planning as well as in the formulation of specific management rules to regulate water use at the level of specific river basins.

The River Basin Councils are the mechanisms through which state and municipal governments, the users, and other interested groups share the responsibility for planning and management of the nation's water resources.

River Basin Councils sanction regional water plans to define water allocation policies and negotiate specific responsibilities for plan execution and financing.

Mr. ul Mulk's emphasis on the water apportionment accord for the solution of water disputes among provinces and the proposal for the creation of an Indus River System Authority resembles a model adopted in Mexico for the Lerma River Basin, where full water development has taken place and severe water pollution problems have occurred.

Through the creation of the respected River Basin Council, in which five state governments participate together with representatives of all users within the river basin, water allocation rules have been defined and adopted and a very intensive program for water quality restoration is underway.

Each year one objective was to preserve the Lake of Chapala, which is the downstream user of the river. It is considered a national asset. Through this River Basin Council the five states agreed that one of the objectives was to provide enough water of adequate quality to preserve the lake. This agreement speaks to the advantages about river basin management in which we create a sense of solidarity among users all through the river basin.

The basic cell of the new institutional setting is the user. The new legislation promotes the formation of a strong Water Users Association to enhance water management—irrigation as well as water supply—within collective systems.

Greater participation of the private sector is legally a clear matter of national interest. Mechanisms for such participation in the construction of infrastructure and the provision of water services have been defined.

Additional features of the new law include more effective mechanisms to regulate the over-exploitation of aquifers and other national waters, especially by upgrading the existing system of water rights and introducing market mechanisms. Regulations are combined with a system of water fees or levies that act as pricing mechanisms.

Special attention is given to water quality conservation and pollution control including that from non-point sources. A system of permits has been established and coupled with a fiscal policy of fees decided on the polluter-pays principle.

Other environmental concerns, such as protection of wetlands and due consideration to minimal flows, are also considered under the new law.

Mexico's national water law explicitly establishes technical development as its main objective in guiding water management and development. It is still "the devil is in the details."

The Users

Within this new policy framework, the National Irrigation and Drainage Program and the National Water Supply and Sanitation Program were launched. They both involve heavy investment with financing from the World Bank and the Inter-American Development Bank for development, but what is interesting is the new role attached to water user organizations.

To increase the efficiency and productivity of existing irrigation systems, a task for which government used to assume full responsibility, a strategy was initiated in 1990 to transfer to users the management of 78 large irrigation districts, which account for 50 percent of total irrigated land or 3.2 million hectares.

Implementation has required the creation of User Associations, each responsible for managing irrigation systems of 10-15,000 hectares with which negotiations are carried out to design and implement actions for achieving financial self-sufficiency, enhancing water use efficiency, and organizing the operation and management of the irrigation district as a whole. Typically, an irriga-

tion district includes more than 5 and up to 20 User Associations. The program has involved complex negotiations with over half a million farmers.

As of today, more than 1.5 million hectares have been transferred to 199 User Associations involving around 200,000 users. Financial self-sufficiency for all operation and maintenance costs has been achieved in most irrigation districts. Rehabilitation projects are being implemented and are partially financed by users. In the last three years, water use efficiency has increased from 59 to 64 percent. By the end of the next year, 88 percent of the total area will have been transferred.

The strengthening of Water User Associations is going the same way in the Water Supply Sector, in which the program is based on the consolidation of water utilities at the city level. Thus, the new strategy for water management in Mexico relies heavily on the constitution of Water User Associations. That is one of the key issues in any sustainable water management program. Without a strong User Association to which the centralized responsibilities authority, the task is almost impossible.

Finally, regarding sustainable agricultural management, once the Water User Associations have been reinforced, a new farm project is being developed in which the User Associations will take more responsibility. Thus, the role of the government has changed. It is not doing things for the users, but assisting the users to do things and providing technical and financial assistance. Sustainable water development means a new role for the government. It is one not of doing things, but of leading our cultural change in which the users strengthen their organizations, bear the costs they impose, and have a stronger conscience about the environment.

Floor Discussion

Audience members voiced the following concerns and questions: (1) the importance of conceptualizing a sustainability model block by block, developing holistically from country to region to the globe; (2) the importance of engineers and economists talking together to share their knowledge instead of operating in isolation; (3) how important have empowerment and participation of local beneficiaries been in the different experiences we have heard? (4) which types of institutions—private sector, governmental, or NGOs—have been most successful in ensuring that investments in water projects last? (5) what mechanisms are being used to make projects sustainable in the long term—market-based, participatory, or some other form? (6) what is the view of the Pakistan Water and Power Development Authority (WAPDA) on the economic efficiency of the massive investment by the World Bank and the Pakistan government in Mangla and Tarbela Dams and a series of link canals, particularly the huge storage investments of Mangla and Tarbela?

Panelists' Responses

Keith Bezanson, moderator: Regarding participation, Mr. Aguilar of Mexico [representing Mr. Villareal] emphasized this in his presentation. It is probably not, as my children say, politically correct to question participation. It is one of the driving forces in the body politic today, impelling institutions, including the World Bank, to reach out in a more inclusive way. "Inclusion" of others in the planning and conceptualizing process is one more phrase fast becoming a cliché. However, at the risk of being heretical, I would like the panelists to address this question as well: at what

point does participation become destructive, cost ineffective? At what point does it introduce so many variables that no decision can be made? At what point in dealing with large issues can we localize them? I agree with the concept, but is there anything in the experience that suggests how we can move to a more inclusive, more participatory model without losing the gains of more comprehensive, more strategic national and transnational conceptualization and planning?

Shams ul Mulk: The huge system of Mangla and Tarbela Dams and link canals was necessary to replace the waters of the Eastern Rivers (Ravi, Beas, and Sutlej), which were allocated to India under the Indus Waters Treaty. The main justification for these huge investments was the peaceful settlement of a serious water dispute between Pakistan and India. What is the economic worth of peace? It may be difficult to quantify but the decision to finance these works reflected the judgments of Pakistan, the World Bank, and the donor countries that the investment was fully justified. Subsequent experience of the benefits of including the Mangla and Tarbela storage reservoirs in the irrigation system and the integration of the rivers through the link canals demonstrated that the system was economically viable. The investment in Tarbela Dam was paid back by its power benefits within a decade after its completion.

Thus, in my opinion, the investment in Mangla, Tarbela, and the link canals has been one of the best. Not only has it given Pakistan better control of its water resources, but also Tarbela

now has a powerhouse of 3,740 megawatts. It started with 700 megawatts as a part of the Indus. Mangla has 800 megawatts, and 200 are being added. The link canals have provided us with transfer capability. We had to have that capability because some of our rivers are early rising and some have surplus water. Unless we had these inter-river link canals, we would not have good control of our water resources.

Regarding the missing linkage between engineers and economists, many things are missing. Water projects have been conceived previously by uni-disciplinary forces or uni-disciplinary organizations. Sustainability is multi-dimensional. To address these problems adequately, we must conceive of multi-disciplinary professional inputs in projects. We have to develop these institutions, and the earlier the better. Otherwise, we will continue to have problems in the projects. When there is a problem at the design stage, if we defer it to the construction stage, we pay a heavy price.

Regarding the beneficiaries and the Water Users Associations (WUAs), Pakistan has a mix of two types of water systems: public and private. Long before water systems became private elsewhere, they had been privately managed in Pakistan for hundreds of years. However, we have not yet been able to develop privately held institutions that can take over a system with an average canal command of 1 million acres.

For us the problem is size. We tried with the water courses through the WUAs. Unfortunately, that experience has also been a mix of success and failure. We are pursuing it, but we have disinvested in the public Salinity Control and Recla-

mation Project (SCARP) tubewells. In the future 13,800 tubewells will be transferred to the private sector, and the fresh groundwater area will be entirely a private initiative.

Keith Bezanson: There was a generic question regarding the thinking on the new indications of and the major directions in how we make water sustainable.

Shams ul Mulk: There has to be a significant input into research. The deceptively simple interaction between land and water is a very complex phenomenon. *Problems are generic only in their description, not necessarily in their solution.* Where we have not accepted this principle, we have suffered. What is needed is site-specific, project-specific, area-specific research for application of a particular technology before it is accepted used on a large scale. This research would test its validity on the basis of parameters, which we must decide and design beforehand to ensure sustainability. In Pakistan in 1991 we conducted a major study on the environmental assessment of the drainage sector. We have concluded that, rather than a project or program approach, we should lay down strict environmental safeguards or criteria for projects. As Mahmoud Abu-Zeid said very rightly, Egypt has the problem of what to do with 30 million tons of salt. Pakistan is faced with the problem of about 60 million tons of salt, of only which 9 million tons are washed away; 51 million tons stay in the system. Making sustainable water projects requires a lot of work, and I entirely agree that we have to pursue that work from a multidisciplinary standpoint.

Summary of the Issues

David Kinnersley

The thread running through these presentations can be summarized in the words, "Towards a new coherence." I stress the new coherence because much of what we have heard has described some masterpieces of technical coherence. The Pakistan story is wonderfully coherent in technical terms, but the paper explains that it was much less coherent in economic terms because its ability to maintain itself, even to meet operating and maintenance costs, deteriorated as the system got older. That seems to me a characteristic of much water management in that it is, in a sense, not all that coherent, but it has been very durable for two reasons. First, historically, it has not been under so much stress as it is under now. Second, a great deal of water use depends on habit and routine, and people do not like their habits interfered with. They do not readily change their habits and, therefore, the system has a durability despite its incoherence.

Nobody has ever suggested that water is fattening yet I want to suggest that our discussion is about putting communities on a diet in their use of water. We are also saying that government alone cannot put people on diets, and we are daring to say that engineers are not good for dieting because they always want to provide more and more.

If we want people to diet, we have to tell them there is not any more. Even if we think there might be a little more, we tell them there is not any more.

In these discussions we have seen that most people were quite good dieters. This is the point at which coherence joins with participation. There has to be coherence through participation

through decentralization. Participation does not need to mean indecision. I do not think we should take it as suggesting indecision. Participation means, partly, moving away from the rivalry of government departments, and that is a much bigger source of indecision and incoherence than public participation ever is. If you want to see a decision delayed, watch two government departments trying to take different decisions on the same subject.

There are two linkages here. One is essentially economic. We have heard this morning about prices. In praise of the French system, Mr. Chérét talked about prices, but he also talked about grants and loans. He was talking about recycling money, not just taking it from people and burying it, and not taking it from people and giving it to the government. The French system agrees the fees and recycles the money.

I emphasize this point because the British passed new water laws in 1963 at almost exactly the same time as the French. Working from the same time, we have a much more disappointing record than the French. If I had to give a crisp answer as to why our record has been disappointing, I would give two reasons. First, we never succeeded in getting enough local participation. Our local government system, which has various shortcomings and various strengths, never developed enough positive identification with a river basin system.

Second, we were afraid about the pricing. We put prices on abstractions, and it took something like thirty years to put pricing on discharges. We put pricing on discharges in 1991, and, even then,

we put it on in a very limited way. We have put on cost recovery pricing, not incentive pricing. Considering that Britain is a much more crowded island, great deal of the weakness of our system derives from that.

The purpose of the economic links is *signalling* because we have got to have a signalling system for all of the participants in a decentralized system. Another purpose is *funding* because we must have money to do what needs doing. A third reason for the economic linkage is *incentives and motivation*. The system has to motivate local people.

Water professionals are hardworking, serious people but they have one shortcoming. They talk a certain amount to one another, but they generally are rather silent. Water is not a subject that they talk about in the street because it is a matter of habit. To make effective participation and decentralization and new coherence, water professionals have to become communicators. They have to communicate so that people understand what the issues are. If they communicate well, they will reduce transaction costs. They need to speak about more equal sharing of water. They need to speak about more efficient sharing of water, and they need to speak about reducing

damage. I tire of economists talking about how much improvements cost. What we are talking about most of the time is reducing damage, and that is not the same thing as an improvement: the "cost" is a cost to ourselves in self-discipline as much as in economic terms.

What these points amount to is speaking about sustainability. There is a great case for speaking about sustainability in terms of water because I believe that ordinary people all over the world often understand a great deal more about sharing water and the implications of that than we assume they do when we just think it is a matter for experts. The level of public understanding, even among farmers, about sharing water, is actually much higher than expert documents often suggest, and this is a major step to sustainability.

To those of you who are obviously troubled about more aggressive pricing of water. I think pricing is going to come because water is getting scarce, but it does not mean that water will be treated like any other supermarket commodity. In my view, water will always be special and different from other commodities, even when it is priced.

Part Four

The Road Ahead: A Roundtable

Three Questions:

One and a half years after Rio, what has been achieved?

**What are the most interesting things you have learned
in the last two years that have changed your view?**

What are the questions we don't know now but should know in five years?

Remarks

Mohamed T. El-Ashry

Thus far the discussions have moved us from concepts to policy, and from policy to practices. This session will move us from practices to action. I must share with you a short true story about an ultraconservative United States governor who gave a dinner speech on the environment. Afterward, a friend of mine who knows the governor well, said to him, "Your speech rivaled any by the president of the Sierra Club. How come?" The governor answered, "The rhetoric of the environment is so wonderful. Unfortunately, the policy and the implementation are very difficult."

To a large extent these difficulties on the policy and the implementation sides explain the meager progress on the sustainable development front since the Rio Conference, as reported by Nitin Desai. After Rio there do not seem to be any great ideological or philosophical disagreements on the importance of environment and the need for sustainable development. The disagreements are more on the how than on the what.

Yet, as we have heard from many speakers, both social and environmental change are moving at a very rapid pace and not in the right direction. The more than 1 billion poor and hungry in the world cannot wait until all issues are fully debated, resolved, and agreed. We know enough to take the necessary actions to pursue sustain-

able development. Rio has clearly taken us beyond problem identification, and, difficult as they may be (as the governor said), actions are now needed and on a scale that matches the challenges before us, actions that are informed by the lessons of the last two to three decades.

Clearly, one of these lessons is that the social dimensions of development and the environment cannot be ignored and that people must be placed at the center of sustainable development. This, as you recall, is the third side of the ESD triangle, the triangle that is also the symbol of this conference. In this regard, I would like to inform those of you who do not know that we have established in the Environment Department in the World Bank a Social Policy Division to assist our Bank colleagues in addressing this important dimension of sustainable development.

The road forward is not a matter of new approaches. It is a matter of pragmatic and practical actions stemming from many years of research, analysis, and documentation, much of it by many of you in this room. Our next two speakers have both the knowledge and expertise to address these important issues of implementation. One of them will represent the international institutional perspective; the other will present the developing country perspective.

Remarks

Elizabeth Dowdeswell

I come from Kenya. Had it not been for the senseless murder of one of my staff in the last two weeks and the fear, anger, and hopelessness of my colleagues, my approach to this meeting might have been quite different. I am impatient. For me the question of new approaches has to start right now.

In Kenya more than half the population are teenagers or younger. The future generations are already born. The agricultural sector has reached the limits of its absorptive capacity; retaining a growing population in the countryside would accelerate environmental destruction. The only alternative is migration to the cities and towns, but there are few jobs and economic opportunities, dramatically fewer than are needed.

Nevertheless, urbanization is proceeding at breakneck speed. Already faced with massive unemployment and underemployment, Kenya also faces the prospect of having to create an additional three million jobs by the end of this century for youths entering the labor market for the first time. Failure to meet the needs and aspirations of its burgeoning urban population will guarantee continued political and social instability for Kenya in the future.

In an urban setting rural forms of subsistence are no longer feasible so it would be foolhardy to say simply that the answers lie in past experience. Kenya's dilemma is mirrored in many, if not most, developing countries although it may take different forms. And for those who point to the Dragons and Tigers of east Asia, I would remind us that the present economic successes of countries such as Malaysia, the Republic of Korea, and

Taiwan were also preceded by wide-ranging land reforms in the 1950s that increased economic opportunities, narrowed gaps in income distribution, and opened up avenues for social mobility for wide segments of the population. Without these, it is doubtful whether these countries would be where they are today. Furthermore, the world at large around us has changed. The sea-change in international affairs with the fall of the Berlin Wall has concentrated the minds of leaders everywhere and dominates the global political agenda, forging new frameworks and arrangements for international political stability and cooperation.

On the economic front, the global political changes and the advent of a new world order have greatly accelerated the momentum toward the establishment of a one-model world economy based on markets and liberal economic principles. The establishment of such an integrated global economy may have been unexpected; it may even have been a response to the political necessities of the moment. But it has also come to be seen by many as the opportunity to provide the global economy with the long periods of sustained growth that have eluded it for many decades. This growth is envisioned particularly through the creation of larger markets and the opening up of new ones, especially in Eastern Europe and South and East Asia, with billions of new potential consumers.

Given this possibility and given the domestic pressures for jobs and economic growth facing political and business leaders in virtually every advanced industrialized country, this is an

opportunity that, from the point of view of those in positions of responsibility in both the economy and the government, cannot be squandered.

The question that immediately arises, however, is whether this pursuit of a deepening and expansion of the global economy under market conditions as it is being pursued now is compatible with or complementary to the pursuit of sustainable development. Or does it constitute a strategic and direct shift away from the commitments that we made at Rio? Are we engaged in two parallel pursuits that are at cross-purposes? Is it coming down to a choice between sustained growth or sustainable development? Or are there compatibilities and complementarities between this globalization of the economy and sustainable development that can be exploited and pursued?

Is it possible for one to piggyback on the other? Globalization favors the introduction, simultaneous dissemination, and implementation of new ideas and methods. The establishment of new institutional arrangements and frameworks for cooperation, including regional markets, offers the opportunity to introduce principles, standards, and regulations favoring sustainable development, and to some degree this is occurring.

But on the other hand, it is equally true that accelerating global economic growth through intense exploitation of new markets in particular has serious implications for both the integrity of the planet's environment and the rate of natural resource use. It therefore has serious implications also for achieving sustainable development and the kind of equilibrium between development and the environment that is in the long-term interest of us all.

One would think that I would be content in the post-UNCED period. After all, Agenda 21 and the ancillary agreements that were reached in Rio succeeded in giving political legitimacy to this concept of sustainable development. The Rio Summit was the successful culmination of two decades of continuous effort and hard work on the part of many to place the environment at the center of the development debate and to make key environmental and natural resource issues strategic factors in economic decisionmaking globally as well as nationally.

The general expectation was that the 1990s would become the decade of sustainable devel-

opment, thus setting the foundation for both human progress and environmental viability through the next century. But as I hear pledges to work for sustainable development from the mouths of Boy Scouts, farm laborers, environmental activists, heads of multinational corporations, politicians, chambers of commerce, Greenpeace, and indigenous peoples eking a subsistence living from a marginal environment, I question whether all these groups could really have embraced sustainable development so unquestioningly and so fast.

One of the lessons that I have learned in my very short tenure at the United Nations is the imprecision of language. In a multi-lingual atmosphere, one becomes aware very quickly that the same word used by two people can mean radically different things. For example, the World Bank has been one of the organizations that has committed itself to a future through sustainable development. But now comes the hard part: deciding for it and for our respective organizations exactly what sustainable development means.

Herman Daly of the World Bank is very aware of the many uses to which the term "sustainable development" can be bent. Writing last summer, he noted that currently the term "sustainable development" is used as a synonym for the oxymoronic "sustainable growth." It must be saved from this perdition. I sense the flaw that makes sustainable development so easy to agree to in principle yet so hard to implement. If we equate sustainable growth with sustainable development, we are on the wrong track. To grow, Mr. Daly writes, means to increase naturally in size by the addition of material through assimilation or accretion, whereas to develop means to expand or realize the potentialities of, to bring gradually to a fuller, greater, or better state. In other words, that when something grows, it gets bigger; when something develops, it gets different.

In very much this way, the earth and its ecosystems develop or evolve. Given finite resources, however, it does not grow. Its subsystem, the economy, must eventually stop growing but continue to develop. If we are not using the phrase "sustainable development" to mean different things but are singing from the same song sheet, then it remains to all of us to further articulate this theme of sustainable development so

that our other partners in a sustainable future—corporations, governments, NGOs, and citizens around the world—know what we mean.

The Rio Declaration is fairly specific on this point. The plain-language version of the declaration stresses that development today must not undermine the development and environment needs of present and future generations. It underscores that to achieve sustainable development, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it. And finally, it says that nations should reduce and eliminate unsustainable patterns of production and consumption.

These are elements that we must build into our economic future. We cannot pay lip service to sustainability. It must be the fabric of our daily national and global existence. When we say sustainable development, we mean a sustainable future, a sustainable life. We do not mean the sustaining of exponential growth until the resources run out.

Let me underscore the view Mr. Serageldin expressed yesterday—the development aspects of sustainable development, especially the focus on meeting the immediate necessities of people, on the alleviation of poverty, on participation, and on providing people, especially those in the lower socioeconomic rungs of society with avenues for advancement and mobility. In short, the focus on human development. Such an approach is as pragmatic and realistic as it is innovative and attuned to the changing realities of the developing world.

Poverty contributes significantly to environmental decline, especially in rural areas of developing countries, just as it is a drag on economic and social development. By focusing on its alleviation, we also help to achieve the two principal goals of sustainable development. Participation in decisionmaking, real empowerment, not only allows people more control over their daily lives, but it also forces them to take responsibility for new policies, thus ensuring social acceptance for innovation rather than generating resistance and opposition to it.

The final test of any model of development is its social acceptability and consequently political sustainability. In a world that is rapidly drawing together with rising levels of education and

awareness, facilitated in great part by the information and communications revolution, any model of development that does not satisfy in the short and medium term such basic human aspirations as a steady job, secure shelter, daily food, and greater opportunities for one's offspring will not be politically viable.

We are entering an era of mass participation in decisionmaking. The nature of civil society is changing rapidly, especially in developing countries. We as policymakers and as thinking individuals must respond to this challenge, and here the past may not be a proper guide toward the future. Rather, we must respond creatively and on the basis of equality with those whose needs we serve, and this is best done through an approach advocated by sustainable development.

Although in my impatience and perhaps my naiveté, I would ask us very simply to agree that we can return to the original meaning of the word "development," meaning to unfold more fully, to bring out all that is contained. We need to reclaim the word "development" to mean the unfolding of the potential of all the peoples of this earth.

The second thing that I want is action. The Rio Summit and Agenda 21 were statements of intent on the part of governments and the international community. Following up on that expression of commitment, turning sustainable development into an operational reality globally, nationally, and locally, and turning it into coherent and complementary policies and programs are not easy tasks. Doing something new for the first time involves the risk of false starts and mistakes. This is a learning process for us all, and it may require course corrections, responses to unanticipated problems, and certainly new approaches.

We have to learn by doing, but the most important thing is that we make sure we are going to continue to do the "doing." Otherwise, sustainable development stands the risk of joining the catalogue of good intentions of the international community and, in particular, of the United Nations. This list ranges from import substitution to integrated development, from basic needs to the new international economic order, all of which in their time caught the imagination and fired the enthusiasm of the world community. All of them were consequently marked for priority attention by policy and decisionmakers only to pass from center stage as the political

momentum favoring them faded and circumstances changed.

It is time to remind ourselves that we have been here before. In this post-UNCED period we simply must move from talking about principles and concepts. We must move from defining so precisely the cost-benefit analysis to prove that there is a benefit to cleaning up a dirty river when we know intuitively that there is a benefit to a clean environment. There is a Zen saying: "After enlightenment, the laundry." After the continuing process of conferences, studies, and negotiations, surely now it is time to leave the talking behind.

The striking conclusion that I drew from the first meeting of the Commission on Sustainable Development was that governments were saying, "Help." We all know we are saying the right thing, but we just do not know how to do it. I guess I am really tired. I am tired of the rhetoric and the excuses. I want us to recognize that we are creating for ourselves a Tower of Babel if each of us tries to define sustainable development in our own way for our own benefit. What we are really talking about is a paradigm shift in the way we live and the way we do business in this world. Consequently, we cannot go on declaring one thing on the philosophical level—espousing the principle of sustainable development—while everything we do—our rules or methods of operating—point us in another direction entirely.

The paradox is that for some of us, while our spirit may be moving ahead, the practice lags far behind. All of our efforts now must not be in defining to death the concept of sustainable development but in simply accepting the shift and translating it into a workable reality. Let us not spend all of our time and effort getting our economic models perfect before we start to act. We are reasonable and intelligent people. Let us

start making some reasoned and reasonable assumptions and start down the path.

I believe that this challenge will be met and that the basic philosophy of sustainable development will carry the day because it is in our self-interest as is human survival. This realization may come to all of us later rather than sooner, but it will come.

Ultimately, the final proof that we are on the path to sustainable development may be that we never have to mention the word again. We will have internalized its basic concepts and principles so much in our everyday routines and practices that they appear as the norm, just like a whole number of innovative ideas that in their time were labeled as utopian and even subversive but that today raise barely an eyebrow. One of these, of course, is the idea of democracy itself.

Let me conclude with one piece of good news that is symbolic of why, notwithstanding my desperation over the last couple of weeks, I continue to have hope. I want this audience to be the first to know that as of today, we have thirty ratifications for the Biodiversity Convention, and it will come into effect on December 31, 1993. That is less than a year and a half after Rio, and it is something that people said could not be done—and, in fact, was done notwithstanding the distinct lack of support of many countries around this world. There is hope on some of the most basic issues that we face.

When we talk about new approaches, the most fundamental new approach is simply one of changing mind-set. As we define the ecological ground rules for sustainability, I hope that we can remind ourselves to think like people of action and act like people of thought because there really are only two choices in life. We can either accept things as they are, or we can assume responsibility for changing them. I am counting on the latter.

Remarks

Shri Kamal Nath

The challenges that confront us are vast and manifold. The imperatives of providing for our people an ever-better life, in every sense of the term, have deep and tangled ramifications. This exchange of ideas to further our understanding of sustainable development and the true value of the environment will have far-reaching consequences in shaping a correct appreciation of the inter-relationships between the human and natural economic functions. National economic policies are, after all, to some extent an expression of how environmental resources are valued.

The nature of environmental degradation, and the interdependence it creates among nations has become a driving force for multilateral cooperation. Rio initiated the process of a global partnership based on shared values relating to the natural environment, its use, and its conservation. The significance of Rio is the recognition that environmental quality as an essential life support system is a common concern. This concern is not more important than national interests, but it is an important factor in the shaping and realization of national interests. It follows that the international community needs to consciously design systems that improve upon existing resource allocation mechanisms, and valuing the environment is the fundamental step in that direction.

The essential characteristic of international environmental problems is reciprocal externalities. Countries both contribute to environmental damage and suffer from it. But they do not do either in equal amounts. Some economists feel that it is a myth to argue that there is no essential conflict between environmental protection and

industrial development. In rich countries, where environmental protection is itself an industrial activity, it contributes to GNP; but in biomass-based subsistence economies, the costs of elaborate and highly technical pollution control measures can be exorbitant. There is no doubt about the long-term benefits of environmental protection, but costs and benefits accrue at different levels of society, and reconciling these in the short term is where the problem presents itself.

The Rio process has brought about a greater clarity in our understanding of the contextual relation between environmental degradation, affluence, and poverty. The 1987 Brundtland Report pointed out that developed countries, with only 26 percent of the world's population, are responsible for about 80 percent of the world's consumption of energy and minerals, and about 40 percent of the food. The priorities and agenda of the developing countries—indeed, of the world—which got recognition in Rio, are in danger of being relegated to the background. One and a half years after the unprecedented Rio Earth Summit, what “extra” has been done for commitments to Agenda 21? This is a question to which I can find no pleasing answer.

It may be premature to assess and comment upon the developments that have taken place since the Earth Summit. However, it cannot be denied that there is a growing sense of impatience and a feeling that the bold political initiatives of Rio have been submerged in diplomatic rhetoric and that despite some positive events, funding and other commitments are still much below the expectations raised at the Summit. We, by which

I mean all of us—in this room, in this city, on this planet—cannot allow this disillusionment to spread. Rio holds our hope for the future. If we allow it to be snuffed out, we will not be forgiven by future generations. We must be imbued with a sense of urgency and commitment.

While a framework for multilateral cooperation had been agreed upon at Rio, the global environmental facility, which is the principal instrument for the transfer of what some call—erroneously—“green money,” seems to restrict the objectives of the Environmental Conventions by limiting incremental costs to “agreed global environmental benefits.” This distinction is at best fuzzy, and many conclusions based upon the wide latitude of interpretation it affords are not supported by sound science: bio-geo-chemical cycles that determine the quality of the environment make no distinction between the national and global levels. The distinction in effect transfers development aid away from vital needs in developing countries to so-called global concerns, which really enhance the affluence of developed countries and does not ameliorate the scope or scale of the problems faced by the poor, who are the vast majority of the human race. This concern has been voiced in the UN’s Commission on Sustainable Development (CSD) and in the on going negotiations in the Environmental Conventions. To maintain the momentum of Rio, an early resolution to set up identifiable and effective mechanisms for transfer of financial resources and technology based on equity considerations is essential.

Societies that draw on the ecosystems of other societies that are dependent on local biodiversity for their survival and food security need to compensate them. In fact, the opposite is happening at present. Reversing trade and capital flows to correct the present imbalances requires a thorough consideration of trade barriers, prices of primary commodities, improvement in the terms of trade and interest rates, and new funds. Otherwise, how can developing countries grow to service their debts, and at the same time provide for the “better life” that comes with development, without over-exploiting their natural resources? The General Agreement on Tariffs and Trade (GATT) should not be looking at the relationship between “trade and environment,” but between “trade and sustainable development.”

If sustainable development needs to go beyond being the buzzword it has unfortunately become, and be translated into a reality, it requires not just adequate and equitable distribution of “ecological space,” but also adequate “financial space.” As Indian Finance Minister Dr. Manmohan Singh said to the World Bank only last week:

Efficient domestic policies are a necessary, but not a sufficient condition for the alleviation of poverty and sustainable development. It is also necessary to accelerate the flow of concessional finance to undertake new investments and modernize the economy.

Sustainable development means that we internalize the costs that are being externalized. It also means that we take the present and the future, the short-term and the long-term, into account; and especially in developing countries, it means that we consider the welfare needs of the poor, the “safety net” as it is called.

The international market tends to externalize the ecological costs of its commodities. Somehow, we have to build into the costs the payments, for the use of others, shares of the global commons, for example the atmosphere. Sustainable development is expensive, but we have to make a choice. Within the next fifty years, some 95 percent of the world’s additional labor force will be added in the developing world, but this huge increase will make only 5 percent of the world’s financial investment.

It is also true that the burden of the expected *doubling* of population in the developing countries in the same period will have a lower adverse impact on the environment than that exerted by the *10 percent* of the world population added in developed countries. This is neither a plea nor a justification for continued population growth, but a warning that *only a change in the patterns of consumption and of economic relations* coupled with an urgently honest and concrete effort to implement Agenda 21 will help us. We have a choice—sustainable development, or mass poverty with its concomitant problems of law and order, war, and mass migration. In fact, we have no choice....

The harmonization of environmental standards has to come in with the harmonization of

international living standards. Only then will the potential gains from international cooperation be realized. Because of increasing globalization, we cannot put a boundary around the economies of States, nor would we wish to do so. It is not within the purview of a non-economist to go deeply into this, but there is no denying the fact that proper valuation of the environment will place us and our future generations in a better position, and equip us with tools superior to those we have at present to analyze our situation and to attempt solutions.

In India we have started the process that we expect will lead to proper accounting of natural resources. I have stated in many fora how India's forests are sustainably used and give sustenance to millions of poor families and their cattle. They give them food, fodder, fiber, fuel, and medicine, none of which is given monetary value. The total annual input of our forests into the Indian economy is estimated at \$10 billion. I would like to emphasize that this huge figure does not come from logging, which has practically been stopped in our country, but only from lops and tops and headloads, and is generated not at all on an organized commercial basis. This is a direct subsidy from the forests that sustains the living standards of the rural poor and the forest dwellers. I suspect that the non-valuation of the usufruct results in a great degree of complacency on the one hand and ignorance of the magnitude of sustainability on the other.

India's commitment to the preservation of forests is such that we did not even consider financing our way out of our balance of payment problem by resorting to the commercial exploitation of our forest resources. The total woody biomass of Indian forests is estimated at 5,000 million cubic meters, valued at more than \$500 billion—and that is not counting the usufruct, the biodiversity, and the forests' value as carbon-sinks. Monetizing a relatively small portion of this would render India into a debt-free nation overnight. Far from doing this, we have chosen of our own free will to conserve our forests, and even to opt for the import of routine requirements of pulp and timber. We are thus managing what is essentially a national resource in the interests of human at large. But the financial resources we have been required to raise and the sacrifices our people have had to make for the

protection of this priceless biodiversity has gone largely unrecognized by the world community. Debts and deficits are very enthusiastically evaluated in fiscal terms. What about the lost opportunity costs in relation to forest conservation, and for that matter, in relation to any ecological conservation an economically poor society embarks upon?

Bio-geo-chemical cycles are the essential life-support systems. So far we have recognized only the importance of the carbon-cycle and of biodiversity; we need to give equal importance to the water cycle. I see the problem of water becoming one of the major environmental issues of the twenty first century. In India we have started work through some of our major academic and scientific institutions to look at our resources of water, forests, biodiversity conservation, air, soil, coastal zone biodiversity, flora, and fauna. Even aesthetics and valuation of ethno-knowledge figure in this list because we do not believe the exercise will be of any value if considerations of existence-value or equity do not enter the picture. The Delhi Declaration issued recently by the First Ministerial Conference of the Forestry Forum of Developing Countries explicitly called for precisely this kind of valuation. This declaration had the backing of almost forty developing countries, including Brazil, China, India, Indonesia, Kenya and Malaysia.

It is all very well to talk about natural resource accounting, but this can be a valid process only when the price tags attached to resources are valid, and not the result of artificially depressed or artificially shored-up terms of trade. Economic development essentially means conversion of the natural capital into human-made capital. This progression is how economies move from rudimentary stages to complex and developed stages. This is what the North did to develop. For development to be sustainable, the exploitation of the natural capital must be sustainable. But if countries were to get so little in return for their natural resources that they cannot meet even their current consumption needs, then naturally they would just keep consuming their natural resources and not move towards a modern and sustainable economy. Finally, the natural capital would dwindle, and they would be left with nothing. This is precisely what is happening to the South.

Externalization of the ecological costs makes economies that are already strong and flourishing sustainable while it makes those that are relatively underdeveloped become unsustainable. Developed economies can import their food and raw material requirements and then produce value-added products, earning enough for still more imports. Thus, their own environment remains protected and pristine while they deplete the natural resource base of poorer countries.

What we do not seem to realize is that the earth is one, and environmental degradation in some other part will eventually catch up with us. There is no place to hide on the planet if the planet itself is in danger. To what extent can we use economic instruments to achieve environmental ends? If market prices for commodities imported from developing countries reflected the internalization of the ecological costs, this would provide some amount of the "financial space" I spoke about earlier, leading to sustainable development. Internalization of ecological costs would provide the financial wherewithal to plant trees, to set up pollution treatment plants, to build a safety-net for the poor, and to link this with ecological regeneration. In this regard there are some questions we need to consider. Who puts the value on the environment is important because the market alone, as it is presently constructed, cannot do the valuation; the value is much more than the market price. This implies greater community involvement; the community has to determine the composition and the value of the goods and services that produce well-being. We are familiar with the "Not in My Backyard" syndrome in the location of hazardous units. National income figures also do not reveal the real composition of income or the real beneficiaries. Valuation will be also a social, and not merely a technical or economic, question and must be recognized as such.

While developing methodologies for valuing the services provided by natural resources, we have much to learn from the indigenous knowledge, social objectives, and local institutions that characterize the transactions related to common property resources. For example, 33 percent of the developing countries, energy requirements are met by renewable bio fuels as against 3 percent of those of the developed countries. The "social use" value of a resource should include

the value of the options foregone not just by the immediate user but by all others affected by its use. Overuse of the assimilative capacity of the atmosphere has to be paid for. This requires joint empirical research by ecologists, economists, anthropologists, and other social scientists while doing a valuation of the environment.

But will economic valuation by itself take us "where we want to go" as Partha Dasgupta asks? We have to think this through carefully. Human ingenuity is not to be scoffed at, and there are perhaps no realizable limits to where it can take us. But the problem arises when it does not take us anywhere or promises more than it can achieve. Science and technology are powerful aids to human progress, but it has been repeatedly demonstrated that they can be double-edged, as with advances in nuclear science or, in the absence of predictive knowledge as with chlorofluorocarbons (CFCs) when they took us to the wrong place through what seemed a correct route. While valuing natural resources, we must keep these pitfalls in mind and keep at the back of our minds the need to constantly test hypotheses with real life experience.

I must also caution our environmental valuers that there are ecologists in our midst who worry that economic valuation and market-based environmental policy instruments will only take us further down the path of ruin. Their fears are based on the "clout" that economists enjoy everywhere and the possibility of their valuation exercises being treated as the last word. Therefore, assigning a "value" to natural resources could reinforce "business as usual," with development and consumption following the same old unjust, unsustainable, and wasteful patterns as before with the added patina of a mathematical justification! These fears are realistic. Statistical tools and methodologies of valuation, however complex, cannot provide for all possible contingencies. In any case, we cannot push economic models to the point that it appears that a life of simplicity is not worth living. Poverty has to be conquered, and economic amelioration in developing societies is a must. But, if such societies have values of equity, conservation, and community life that are keeping them together and happy, we should not lightly break them up.

Yet we cannot be oblivious that this is a world in which people are coming together faster than

ever before due to advances in informatics; therefore the impingement of our lifestyles on one another's is becoming inevitable. Economic valuation of environmental resources or no, we can ignore the effects of either too much poverty or too much consumerism only at our collective peril. The South is undergoing the travails of

structural adjustment and the pains of integrating into the global economy. Will the North now make a commitment to undergo structural adjustments, especially to account for the ecological debt it has incurred over the years? A better world can emerge only if pain is equally shared.

Discussant Remarks

Kamla Chowdhry

Since I was not present at Rio, my comments are based on the people I have met, the meetings I have attended, and my impressions of what has emerged from the Rio conference.

First, Rio brought North and South together, and they tried to listen to each other with greater understanding of each other's point of view. What emerged was not only a greater understanding of the environmental the problems and concerns of the South, which Kamal Nath has very ably stated, but the realization that the South's emphasis is different from problems and issues of the North. In meetings I have attended since Rio, the climate of listening between North and South has improved very considerably.

There is still a long way to go to try to understand the North's point of view or the South's point of view, but we have taken the first step. They may be faltering and halting steps, but it is likely to increase as time goes on.

The second highlight was the legitimacy that the NGOs' participation acquired. The NGOs made a significant contribution in Rio. The significance is that the voluntary sector, the NGO sector, which has a different point of view on many issues from the government, as Wangari Maathai so ably pointed out, acquired visibility and legitimacy. To have the NGOs represented in bodies like the World Bank and other international agencies, to realize that it is not only the government's point of view that matters in discussions before such audiences, is a significant step forward. NGOs are closer to the people at the grassroots and local problems, and often their perceptions are very different from the govern-

ment's. As Nitin Desai mentioned, considerable consultation and consensus-building took place in Rio. The emergence of the NGOs' voice in national and international fora is becoming a reality after Rio. This will enrich future dialogue and hopefully result in more transparent and equitable decisions. In the last eight to ten years that I have attended international meetings, it has been largely the government's point of view that was presented to audiences. There is now a greater acknowledgment that the voice of the people may be different and that there is a need to relate differently to governments and people.

In the Narmada Dam project the World Bank finally listened to the voices of the NGOs talking on behalf of the displaced people, but also to the voices of people who believe in an alternative form of development. This legitimacy of NGOs that emerged from Rio will have many repercussions. From Rio emerged a vision; yet, as Elizabeth Dowdeswell mentioned, not much action has taken place. Nitin Desai, too, expressed concern that the consensus building of Rio has not resulted in action so far. Why has there been no action? When someone asked Mahatma Gandhi why his political movement had such great success in mobilizing the country, he said, "My life is my message." For Rio's vision to be fulfilled, we also need to say "My life is my message."

If we were to ask our environmental leaders to what extent their lives are a message to the people, we could perhaps understand why so little action has emerged. We have discussed issues of economic growth, new ways of accounting, valuing the environment, new technologies to solve

environmental and poverty issues, and safeguarding the earth, but ethical and moral issues are generally pushed under the carpet. I was happy therefore in the session on economics that ethical and moral issues were raised.

Fundamentally, I believe economic growth and the removal of poverty, hunger, and malnutrition are not merely functions of economic planning or technological innovations but stem from a moral force that does not accept hunger

and does not accept the widening disparities between the rich and the poor. If Rio is to succeed, leadership on ethical and moral grounds, as was provided by Gandhi, must emerge to lead the environmental movement. This leadership would emphasize equity, justice, and compassion for the oppressed. In a final sense environmental concerns are moral and ethical, and until we recognize this, there will be only talk and no action.

Discussant Remarks

Herman Daly

I would like to continue in the line that Elizabeth Dowdeswell began by expressing a certain impatience with the slowness and lack of action, and to think in terms of three kinds of actions with which we might begin very soon.

First is what I would call a remedial action, and this is the basic principle: *stop counting natural capital depletion and liquidation as income*. How can one disagree with that? Just stop doing that. There are three areas in which I think we need to stop this error. First is the *system of national accounts* (SNA). We need to improve these. This has already been talked about a lot. I will not say any more about it.

Second, at the micro level of project evaluation, here also we fail to *count natural capital depletion as a cost*. Therefore, it enters into net revenue. It thus biases upward the rate of return on projects that deplete natural capital relative to all projects that do not deplete natural capital. It is a very important step toward sustainable development to count user costs correctly. I hasten to add that in the World Bank this is done as best practice (in the natural gas sector). It is not, however, yet general practice so we need to push that all the way in the system.

Third, is the area of *balance of payments accounting*. For many countries when the depletion of natural capital is exported, it enters into the current account and gets considered as income. It should be reclassified to the capital account. If the International Monetary Fund and others would do that, some countries that appear to have balance of trade surpluses would have deficits financed by the transfer of capital abroad. Deficits imply different policies than surpluses.

These three corrections are overdue. We should all be embarrassed as economists that we have not yet been effective in getting them enacted.

The second principle would be: *tax throughput more, and tax income and value added less*. Through-put is the material and energy flow from the environment through the economy and back to the environment as waste. The principle is to tax that which we want less of and do not tax that which we want more of. Do not tax value added, but rather that to which value is added.

We want more value added; we want more income; and we want to reduce depletion and pollution so let us tax these things. This is not the same as Pegovian taxes, whereby we try to estimate social costs and correct for them by taxes, which is a very difficult thing. This is a blunt instrument. It just says we have to raise a certain amount of public revenue by taxing something. Why not tax those things that we want less of. In doing so, we will raise their prices and increase resource efficiency. This can be sold politically as revenue neutral, simply shifting the tax from income onto through-put. We would need to retain an income tax on high incomes to offset the regressivity of the resource tax, but this would not be so difficult.

The third point is much broader and more general: *recognize and adapt to a very basic and fundamental change in the pattern of scarcity*. We must recognize that *human-made and natural capital are fundamentally complementary*. That is, a fishing boat is not worth much unless there are populations of fish in the sea. They are complementary.

At the margin, they are substitutes, but basically they are complements.

When goods are complements, when factors are complements, the one in short supply is the limiting factor. Thus, currently, the fish catch is limited not by human-made capital—the number of fishing boats—but by remaining natural capital—the number of fish in the sea and their capacity to reproduce.

Likewise with forests and sawmills: sawmills are human-made capital; forests, natural capital. What limits cut timber production is not the number of sawmills anymore: it is the remaining forests and their capacity to grow. Economic logic tells us that we should maximize the productivity of the limiting factor in the short run, and we should invest in increasing its supply in the long run.

Economic logic stays the same, but what changes over time is the pattern of scarcity. Human-made capital used to be the limiting factor. Nowadays, natural capital is more and more the limiting factor. We should shift our economizing effort more onto natural capital. We should invest in natural capital in the long run. How? By reviving the old Marshallian notion of investment as “waiting”—through following and allowing the regeneration of natural systems—and by investing in substitutes, particularly resource efficiency.

Since I am an economist, many of you expect me to tell you a fairy tale, and so in closing I would not disappoint. Just a little vignette from Hans Christian Andersen’s story of the Snow Queen. A little boy in Copenhagen was playing in the snow with his sled, and he decided to hitch a ride on the Snow Queen’s chariot as she drove through town. He tied up his sled, got an exciting ride across town, and then decided he was going to untie his sled. But his hands were frozen, and he could not untie the knot. When you get that close to the Snow Queen, it is very cold.

So out she went from the town, faster and faster, to her ice castle up in Lapland. The little boy was beginning to experience a rather legitimate sense of urgency, and in his panic he decided that he should say his prayers. He tried to recite the Lord’s Prayer, but all he could remember was the multiplication tables, the recitation of which did not comfort him. I think the reason for that in the story is this insistence on perfection. Prayers are imperfect. The multiplication table is perfect. Another point that Elizabeth Dowdeswell made is that we have to resist being seduced by our desire for perfection. Let us just say some imperfect prayers about sustainable development and untie the knot to perpetual growth. Later we can run it through the multiplication table, and try to cross-foot our rows and columns to weed out errors.

Discussant Remarks

Saad Ibrahim

When I was an undergraduate student in 1960, Prime Minister Nehru of India came to visit Cairo. At that time he was a very good friend of Nasser. Nehru wanted to meet the new generation of Egypt so they collected a number of us student activists, and we visited Nehru. One question on our minds was why India had used force to liberate the Portuguese colony of Goa when Nehru was the successor of a great pacifist, Gandhi, who preached *satia-graha* (non-violence).

In his very dignified, subtle way Mr. Nehru said, "Young man, do you know the difference between a saint and a statesman?" "No," I said. "Well," he said, "a saint preaches truth, regardless of who is listening, but the politician or the statesman, while also claiming to preach the truth, always has to count how many people are listening. Gandhi was a saint; I am a politician. That is why I used force."

I start with this story because the question of listening in Rio—one of the great achievements that emerged, if nothing else—was a process, the Rio process. The North and the South got together, and they listened to each other. The question is was it an active listening? Those who are training us in conflict resolution start with this principle of "active listening": not just hearing, but truly listening to one another. Active listening means taking to heart what we listen to, reacting, giving feedback, and taking action. When one year and several months later we review what happened in Rio, I am afraid that even the reports by UN agencies seem to say very little. But the fact that the World Bank has established

a Vice Presidency for Environmentally Sustainable Development (ESD) after Rio means that some important actors were actively listening; and they have been acting. Our conference today is a case in point.

In preparation for this conference, I asked my staff in the Ibn Kahldoun Center for Development Studies to do a content analysis of the frequency of the words "Rio," "Earth Summit," "sustainable development," "development," "environment," and all related words that have become interchangeable, using June and July 1992 as a benchmark or rough index of public media concern. Six months later, we ran through the frequency of these words in the same print media. In three of our daily newspapers we found that frequency of the three, four, or five interchangeable words dropped from the 100 index of June and July 1992, to 53 in January 1993, to 30 in April, to 11 percent in June 1993, one year after Rio.¹

One of the foibles of social scientists, especially sociologists, probably is to read too much into the significance of such quantitative indicators. The terms "recency," "immediacy," and "primacy" refer to public focus and public attention vis-a-vis any issue. Elizabeth Dowdeswell expressed apprehension that the words "sustainable development" or "environmentally sustainable development" may fade away as have many of the celebrated phrases coined in the last four or five decades. I share her fear that "environmentally sustainable development" may go down in history to join that long list of once-favorite phrases such as "import substitution,"

“basic needs,” “integrated development,” and “self-reliance.” With these alerts I wanted to focus on the heartening thing that Ismail Serageldin made very clear in his eloquent and moving opening presentation—that the “missing link” in the ESD triangle is the social or socio-cultural dimension, something to which economists and natural scientists probably have paid lip service all along but have never *actively listened*.

If environmentally sustainable development is not to go down as one more legacy, that socio-cultural component is the one that we have to hang on to. What does the social component mean? It does not mean “bringing” people back into participating in the development process because whoever “brings” people back in can always kick them out. People have to come in voluntarily on their own and as full participants. “Participation” and “empowerment” are words that we probably have to stop and think about in more meaningful and operational ways. We have used words such as “mobilization” in the last three or four decades, without realizing that unless it is followed by “participation,” the inevitable result will be mass frustration.

“Participation” and “empowerment” mean that people have to do for themselves what nobody else including the World Bank can do for them. The moment that people recognize that they have to do for themselves what the state and other international organizations cannot do for them, then we are really on the road to true environmentally sustainable or sustainable development.

In the introductory remarks to his paper Kamal Nath talked about how people in his village could not relate to the big words he uses. His village in India could have been my village in Egypt. I have a weekly television program that highlights local development initiatives. I may use big words, such as “environmentally sustainable development” occasionally. Then people in my village ask me what they mean, and I have to explain to them. What Kamal said about his village probably applies to three-fourths of today’s human beings. They do not understand what we are talking about. Our group here today is caught between wanting to help the “needy” and wanting to stem the impulses of the “greedy.”

But who is listening to us? Who is listening to this group of development experts, scientists, and academicians? Are the ones who are polluting and undermining the environment listening to us? Are they putting forward the kind of finances that are needed to clean up the planet? I doubt it. They are not here. I looked at the list of participants and did not find any representatives of the great multinationals of the world, nor did I find people like my own fellow villagers. Are we going to be like Nehru’s “saints,” preaching the truth in the wilderness regardless of who is listening?

We here today are a group of academicians, intellectuals, and experts of good will who are trying to get the rich of the world to actively listen and, even better, to do something. The poor, people like my or Kamal’s fellow villagers, could listen if we could speak to them in the language they can understand, if we can put environmentally sustainable development in a paradigm that they can relate to.

In Egypt we have an example in a small village, Bassiasa, of 500 people. It is an isolated hamlet. Twenty years ago only five people could read and write. As a result of a small-scale experiment in the use of bio-gas and solar energy to generate power, introduced by one of the five educated individuals in the village, a developmental chain reaction was triggered. That one act caused the villagers to demand to learn how to read and write. Every adult in the village is now literate.

Their real income per capita increased eight times between 1973 and 1993. The people in Bassiasa, who have not added one acre of land to their property, have managed to form five different associations to deliver goods and services to the villagers. Numerous small enterprises sprouted, including small land reclamation in Sainai, several hundred kilometers away, in what the old village calls “New Bassiasa.” Other villagers around Bassiasa have caught the same spirit and are following suit.

This is an example of what Ismail Serageldin said yesterday about keeping associations alive as a means or a moving spirit in development. These villagers have done for themselves what no Egyptian state could have done for them, and this is what empowerment is. If we want to translate the sociocultural side of the ESD triangle

operationally, it is empowerment through non-governmental organizations (NGOs). This is how people learn to organize, create new solidarities, and generate new opportunities. Empowerment is to enable people, to give them a chance to do for themselves what nobody else will or can do for them.

Note

1. Aymen Khalifa, "Media Report on the Frequency of Reporting and the Interest in Environmental Issues in the Egyptian Local Newspapers" (Environment Division, Ibu Khaldoun Center for Development Studies, Cairo, Egypt, Nov. 5, 1993).

Discussant Remarks

James MacNeill

Elizabeth Dowdeswell spoke of her impatience, a feeling that I know we all share, and Kamal Nath spoke of the very real dilemmas that politicians face on these issues. I would like to make two or three additional points about the politics of these issues. Two of them are positive, and one is not so positive.

The panel was asked to comment on progress since Rio, but at the opening, I found my mind going back not eighteen months but some thirty years to 1965, when I attended my first international meeting on the environment, seven years before Stockholm. It was a very small meeting. Very few people were interested. There was no media. And here we are, almost thirty years later, twenty-one years after Stockholm, attending the First Annual International Conference on Environmentally Sustainable Development on the occasion of the Annual Meetings of the World Bank and International Monetary Fund.

That contrast says something to me, and I hope it says something to you. It says that these values and ideas that we all share, ideas that have been wrapped and rewrapped over the past three decades, and that are now so ably and eloquently personified by Liz Dowdeswell and other leaders, have come a very long way in a very short time.

The road from there to here has gone through many deep valleys and over a few very high peaks. I would like to tell one brief story to illustrate this point. Last night when the President of the World Bank was saying things like, "There can be no development unless it is environmentally sustainable," and "Lending for environ-

mental purposes is now the fastest growing segment of our operations," I recalled a dinner at OECD in the early 1980s on the occasion of its annual meeting of finance and foreign ministers. I was then OECD's Director of Environment in Paris. It was during that long period of stagflation. Environment had disappeared from the polls.

I found myself sitting opposite the permanent head of treasury of a member country that shall go nameless. Late in the meal he clinked my glass and said, "Jim, you will be pleased to know that at my request the head of personnel of my department has devised a set of questions to weed out all candidates for positions in our department who betray the slightest sympathy for the environment. You guys with your bleeding hearts and soft heads have no place in the central councils of any nation."

My response was X-rated. But if the poor fellow, now dead, is looking down on this First Annual International Meeting on Environmentally Sustainable Development on the occasion of the Annual Meetings of the World Bank and IMF, he must be spinning in his grave.

These values and ideas are moving into the central councils of nations, industry, and multi-lateral banks. But, and this is my next point, we still have a very long way to go and a very short time to get there. No one who has lived through the past eighteen months since Rio can fail to understand just how far we still have to go. The last eighteen months have confirmed what most of us know in our hearts, that the international and domestic politics of these issues, and of the

policy changes that we are advocating and that were summed up so eloquently by Herman Daly, are difficult at the best of times and almost impossible at the worst of times.

And these past two years have been the worst of times. Apart from the two weeks in Rio itself, 1992 and 1993 have not been years of the environment and sustainable development. We have been living through one of the worst environmental recessions that I can recall. This is not to say that there has not been some progress. Internationally there have been some excellent appointments. We have seen movement in industry—the Business Council for Sustainable Development (BCSD) in Geneva and other organizations. The election of a sympathetic government in the United States must be noted. In my country I could cite the work of the International Development Research Centre (IDRC). In Rio the Canadian prime minister announced a new mandate for IDRC and a floor for its budget. Since then, under Keith Bezanon, IDRC has been moving ahead with great vigor.

But by and large governments have been in retreat on most of the promises that they made in Rio, certainly on finance, which is the ultimate test of political rhetoric. In Rio, OECD governments promised to move to devote 0.7 percent of their annual GNP to the environment as soon as possible. It is urgently needed. Recall what Elizabeth said about Kenya: 0.7 percent does not offer very much financial space, to use the tenn employed by Kamal Nath, but it offers some, and it was a part of the Rio bargain. Yet most OECD leaders returned home and promptly cut their budgets, and diverted much of the remainder elsewhere.

While this is very disappointing, I persist in being optimistic. I expect that over the next couple of years, perhaps a little longer, we will see the beginning of another turnaround, as we have so often over the past three decades. Environmental cycles—cycles of awareness and poll pressure for action—tend to follow economic cycles with a time lag of months or a couple of years.

Moreover, if we look back over the past three decades, every peak in the environmental cycle has been higher than the preceding peak because we are starting at a higher baseline of awareness each time.

The last peak was in 1988. It was strong enough in all OECD countries to force all of the Group of Seven leaders and many others to undergo a public baptism as a born-again environmentalist. It was strong enough to force a change in rhetoric. But it was not strong enough to force any change in the demographic and economic and fiscal and sectoral policies underlying the dismal trends. These trends continue to accelerate. Perhaps next time poll pressure will be strong enough to force real policy change. Perhaps sometime before the turn of the century, this Annual Meeting on Environmentally Sustainable Development will be held not just after but just *before* the World Bank/IMF Annual Meetings. It could then set some of the environmental parameters within which the ministers can act—parameters that reconcile the Bank's traditional goals for sustainable growth with the imperatives of sustainable development to which Elizabeth referred.

If that were to happen sometimes in the next few years, it would represent real progress.

Closing Remarks

Ismail Serageldin

It is an awesome task after two days of exceptionally rich discussion to attempt to bring it all together and answer the unanswered questions. Let me begin by responding to the concerns expressed by many about what was *not* covered. Precisely because it is impossible to address an issue like Environmentally Sustainable Development in one conference, precisely because we believe that it should be more a process than a product, precisely because we are cognizant of the evolving nature of it, do we call this an *annual* conference.

We had to make hard choices. We could have picked sanitation or biodiversity or issues dealing with forests; but for this First Annual International Conference on Environmentally Sustainable Development we decided to focus on valuation of the environment since it impacts so much on the work of economists, a topic of concern to many environmentalists. We also focused on the issue of water, which touches so many aspects of everyone's life.

To pull together the various pieces of the many valuable contributions to this conference, as an organizing principle I will remind you of the logo of this conference: the triangle. Our triangle has three equal sides: environment, economics, and sociology. The technical dimension is the manner in which a proposal or an idea is formulated, an idea that must be put into that triangle and tested to establish its viability on each of the three dimensions: economic, environmental, and social.

I remember when economists in the Bank felt as lonesome as sociologists and anthropologists

do now. That was the time, about twenty years ago, when the engineers ruled. Economists have come a long way since then. Now we see the sociologists coming on, and rightly bringing to the fore issues about empowering people, active listening, and participation—in short, trying to change the processes by which development institutions like the Bank make decisions. These issues will affect our approaches as profoundly as the economists did in changing the way people looked at projects from twenty years ago to the present.

This is not to say, of course, that environmentalists, the third leg of our triangle, have not been active. They have been extremely active!

But the problem is that there has not been a broad and all-encompassing vision that could tie together these multiple dimensions into a holistic paradigm. In his keynote address Captain Cousteau reminded us that we human beings all are engaged in an exceptionally dangerous adventure: we have divorced ourselves from the rules of nature. In the arrogance of power granted to us by new technology and by the ability, for the first time, to bend nature to our will, we thought that rules no longer matter, that there were no limits to what we could do and where we could go.

For a few short moments, it did seem that way. In 1969 Neil Armstrong walked on the moon. That same exciting journey also contributed to our seeing the Earth as never before, to sensing the fragility of our planet, to recognizing an atmosphere that needs protection. In the last twenty years or so from Stockholm to Rio a growing consensus has taken hold—albeit at different

paces in different disciplines—that interconnect- edness and interdependence are very much the order of the day, and that we human beings are part of, not separate from, the larger whole. Therefore, we must, as Captain Cousteau reminded us, recognize that this divorce from the rules of nature cannot continue. We have to think again. We have to think about and respect genetic diversity, as well as cultural diversity.

In short, this unprecedented rate of change in our times requires changing paradigms. To illustrate with one stunning image about the speed of change with which we live today, think in terms of visiting the Smithsonian Institution here in Washington, D.C. There, visitors can see the very small aircraft used by the Wright Brothers in 1903 for the first powered flight by human beings; and nearby is another small craft, the *Spirit of St. Louis*, in which Lindbergh crossed the Atlantic twenty-four years later, in 1927. That little plane represented the peak of technology after twenty-four years of effort! Only forty-two short years later, Neil Armstrong walked on the moon. In the last ten years, we have witnessed changes in telecommunications, in financial transactions around the world, in the globalization of markets that make many of the old ways of thinking about sectors and markets obsolete. So it behooves us all, if we want to be relevant to this world, all the more if we want to be active participants in it, to rethink the way we approach problems.

In this spirit I would like to recall the earlier comments made by President Lewis Preston and Managing Director Sven Sandström. They stressed that the World Bank is an institution that is profoundly committed to a development mission. Its development mission must ensure that the systems, the markets, the procedures, are, in reality, working for the vast majority of humanity. Our mission must, therefore, also recognize that today at least twenty percent of humanity are being completely marginalized, and this is not acceptable.

These marginalized people are found in south Asia and Sub-Saharan Africa. They are also found in pockets of poverty everywhere in the world. There are poor people in rich countries, just as there are rich people in poor countries. We have, therefore, to rededicate ourselves to the profound change in attitude and to emphasizing the ethical concerns that Liz Dowdeswell spoke

about, the ethical concerns that we must bring to the tasks at hand, if we are to serve this large, marginalized group of humanity.

One out of five human beings goes hungry every day. This is a stunning figure at a time when food surpluses are being destroyed, when subsidies are being provided to limit production in different parts of the world, and when distribution systems are left to mechanisms whose efficiency is unknown. Exactly two months from today, we will hold another conference with the specific intention of rededicating the World Bank's poverty efforts towards the issue of hunger. Surely we cannot talk about poverty reduction—or even that more esoteric term, “alleviation”—without dealing with that most extreme form of poverty, hunger. I rejoin the comments of my friends who spoke about sanitation because hunger and sanitation are in a very profound sense basic needs, not just needs in a biological or economic sense. They are also essential to human dignity. The definition of absolute poverty is a state that is beneath human dignity.

Saad Ibrahim asked, “Where are the heads of large multinational organizations in this group?” As I look at the representatives of many governments and agencies in this audience, we are a group who should be able to matter. We are a group whose voice and opinions must matter, and we have the instruments by which we can make these changes. These changes will be profound, and not simply by the sheer value of the money that will be provided—because the World Bank has provided a lot of money! In a few short years, we have invested over \$5 billion in environmental components of Bank-financed projects. As Mr. Preston said, we invested some \$2 billion in environment in the last year, and we recently committed \$1.8 billion to Mexico alone for environmental projects over the next three years. The money is there. But much more significant is the ability to permeate, to integrate in practically everything that is being done, from macro policy to sectoral policy to actual design of operations, the multiplier effect that comes from internalizing the concepts of environmentally sustainably development—social, environmental, and economic—in the holistic view.

In this sense we can make a big difference. The World Bank Group commits \$15-25 billion a year, which affects something like \$40-60 billion of

total investment. Over a decade this translates to over a half a trillion dollars in the developing world that would be affected by the perspective that collectively we can bring to bear among governments and institutions.

Here I return to the specific comments of various participants. Nitin Desai reminded us of the value of looking at sustainability from the whole and sectoral perspectives rather than breaking it up into small pieces. Unquestionably, most people recognize that the prevalent practice in economics is not sufficient. Nobody, least of all the World Bank, assumes that any single measure—gross national product, net national product, gross domestic product—is sufficient to capture the reality of the situations we deal with, and we need to improve our indicators of progress.

But we also need to move forward without waiting for perfection. Rather than going through the elegant and careful discussions that Partha Dasgupta, David Pearce, and the discussants at the valuation panel made, I would like to bring my own vision to this discussion. When we are seeking, as Partha Dasgupta said, representations of truth, representations of what we see through economics are only a partial view.

On one level human beings are nothing more than three buckets of water and a handful of minerals held together by chemical reactions. This view has served us well in science and in medicine, and has brought about major improvements in well-being for human beings. But it is clearly a partial view. It misses completely the difference between a Hitler and a Mother Teresa, between a Stalin and a Mozart. It misses all the qualities that make us relate to other people as human beings.

Reducing a society to the sum of its economic and financial transactions is the equivalent of reducing it to three buckets of water and a handful of minerals. It is a reductionist view. It has its uses, and we should be very much aware that it is an important exercise, just as for science it is often useful to adopt this reductionist view. But we also have to understand the limits of this view. Therefore, as we heard from the economists' panel, there should also be no claim that economic measurements alone are capable of capturing everything that we need to capture about human society.

We need to have a more holistic view, one that recognizes both the value and the limit of eco-

nomics. Just as by adopting economic analysis, no one claimed that we no longer needed the expertise of the engineers, today there is much to be learned by going for other types of skills while not foregoing the skills of the economists and the value that they bring.

This point came through clearly in our discussion of water resource management. Among so many other topics that we could have picked, why did we pick water? We feel very strongly that water is likely to become one of the biggest environmentally sustainable development issues at the beginning of the next century. As we turn from the second to the third millennium, we are likely to find that it is not oil but water that will be the scarcest commodity, certainly in many parts of the world.

If the world's population grows from 5 billion now to 8.5 billion by the year 2025, this represents an increase of 650 percent in terms of water consumption associated with current trends of growth, which are very limited for the poorest of the poor and certainly for the bulk of humanity. These huge increases will be added to the 1 billion people who already have no access to clean water, and the 1.7 billion who have no access to sanitation. Water is a life and death issue for many people and is likely to become more so.

I was pleased that the water resources management panel recognized the need to stop the fragmentation of looking just at bits and pieces and come back to this holistic view. David Kinnersley referred to it as a sort of a coherent-based participation.

We need to do much more on participation. Wangari Maathai's eloquent plea reminded us that in addition to dichotomies between the rich and the poor, the North and the South, there are often dichotomies between elites and the people. This image was picked up with moving eloquence by Minister Kamal Nath when he spoke about the village and how it relates to the concerns of others.

Thus, we come full-circle to the need to change the paradigm through which we look at and diagnose problems. We need to change the way we arrive at what we think are the solutions. We need to realize that the way we approach the identification and the implementation of the solutions is itself a solution. Only by involving people in their own destinies, in decisions that

affect them, will we be able to put together the safeguards against going astray and making wrong decisions.

We are aware of the answers. In my opening slide presentation I showed the hand of Le Corbusier building the model city, which epitomized a philosophy of the 1930s that specialized technicians had the answers and that they were going to make development work. We have learned since then that this is not the case. It is, in fact, the most basic human right for all peoples to have a say in their own destinies, to improve their destinies, to be themselves. It is inconceivable that we should remove the notion of freedom from the notion of development. We could conceive of the hypothetical possibility of a society of well-fed, well-educated slaves, but that is nobody's image of development. Ideas about human rights, about the right to participate, the right to have a say in the future, the notion of empowerment, must be central to our development paradigm.

As we move in this direction, we must consider the place of democracy, and good governance. Two stunning facts speak of the value of good governance and democratic participation. First, there is no record of famine occurring in a democratic country. Professor Amartya Sen has documented in a massive study with Jean Drèze that even where there is persistent and chronic malnutrition, the extreme forms of massive death by starvation that accompany famine have never occurred in any country that was democratic.

Second, in this century of killing and slaughter, there is no record of two democratic countries fighting a war with each other. (I do not consider some of the emerging states in Eastern Europe and Central Asia as established democracies yet. They are still in a transitional stage.) Surely this must tell us something about where we should be going and to what we should be looking for the future.

While institutions like the World Bank, by statute, cannot get involved in the political dimensions of democracy, the work we do in promoting good governance through transparency, accountability, pluralism, participation, and the rule of law is important to lay more solid foundations for developmental activities. Indeed, from a development paradigm perspective, the work on participation is especially relevant.

This brings me to the concept of how we apply participation in practice. How do we make it more than a buzzword? How do we make empowerment the centerpiece of participation? How do we define the roles of the different actors in the decision process?

The solution is leaping at us from the very problems that we are complaining about. We are complaining about the lack of funds that are available from government sources. We are complaining about the inability of the Organisation of Economic Co-operation and Development (OECD) countries, given their deficits, to provide the 0.7 percent of GNP that they promised at Rio. We are complaining, in country after country, about how government deficits are constraining government ability to do this and that. There is much to be done in redistribution within government budgets right now. Nevertheless, the idea that the solution to every problem is to create a parastatal agency funded out of a budget and headed by someone at the level of deputy minister, which was the prevalent view in most countries in the developing world up to ten years ago, is no longer viable. That option is no longer available.

Decentralization and devolution of power from the federal to the state to the community to the most local sort of organization have become necessities. It is not even a matter of options, of choosing to do so or not. The alternative has been foreclosed. There is something profoundly useful in the current financial crisis that most countries are undergoing because this crisis will give those of us who argue for a paradigm shift stronger evidence that the paradigm shift is upon us. Change is here, and we must embrace it or be trampled by it.

I also would like to caution against the notion that somehow we will do away with government—that between the trends towards globalization and localization, devolving down to local communities and recognizing world markets, governments will wither away. We would be mistaken to replace the discredited ideology of statism with an equally fallacious ideology that free markets will solve everything.

We need to temper the ruthless efficiency of the market with a compassionate and caring state. Without it, the meaning of government, the associative nature of the expression of society

itself, has no content. We have to accept this as a basic premise. Governments have important roles to play. Their function will be to create an enabling environment in which people and organizations can blossom.

Neglect of the political dimension, the viability of the institutions, and the political processes of participation in decisionmaking all would lead toward the disasters that we see in Somalia and Yugoslavia and Zaire. It is with this profound belief that we are embarked on a journey—a journey in which we look at the problems differently, and we look at the solutions differently. We are not seeking the holy grail of some perfect solution. Rather, we are seeking to change the processes by which we identify the

solutions and implement them, and thereby moving forward, bit by bit, on a constructive path of change.

For this purpose I stretch out my hand to all of you here and to many who are not here to say that at the World Bank we want to do our share. We want to make sure that this paradigm shift will be a profound one. We intend to bring to bear whatever we can in terms of consensus building, analytical rigor, and morale suasion so that we do not lose sight of the tremendous predicament of that fifth of humanity who live in abject misery. The poorest of the poor, those whom most of the past efforts have failed to reach effectively, and for whom there is hope only if we shift our perceptions to the new.

Part Five

Appendixes

Appendix 1
Environmental Accounting:
An Operational Perspective

Peter Bartelmus, Ernst Lutz, and Jan van Tongeren

Abstract

The economic dimension of development, that is, economic growth, has been overemphasized in the past.^a As a consequence, distributional aspects, the environment, and other dimensions of development have been neglected. The message of "sustainable development" is to incorporate these dimensions in comprehensive broad-based development planning.

Some attempts at measuring such development by means of an overall index such as the "Human Development Index" have been made, but with limited success. Integrated environmental and economic ("green") accounting, is therefore, more narrowly focused on addressing a number of more obvious deficiencies of conventional national accounts with regard to the environment. A satellite System of integrated Environmental and Economic Accounts (SEEA) has been developed by the United Nations Statistical Division (UNSTAT). The concepts, classifications, and methods of such accounting have been issued in a handbook entitled *Integrated Environmental and Economic Accounting*.^b This handbook incorporates the results of many research and field studies, expert group discussions, and pilot studies in Mexico, Papua New Guinea, and Thailand.

The purpose of this paper is to summarize the more practical recommendations of the handbook and to illustrate the key steps that need to be taken in implementing these recommendations by national statistical services. This overview also is intended to facilitate a better access to the complex methodologies of integrated accounting for planners, decision makers, and others interested in learning about and using an operational instrument for merging environment and economics.

Notes

a. The draft of this paper submitted to the First Annual International Conference on Environmentally Sustainable Development was revised by two of the authors and published in 1994 as United Nations Department for Social Information and Policy Analysis (DESIPA) Working Paper Series no. 1. The views expressed herein are those of the authors and do not necessarily reflect the views of the World Bank nor of the United Nations. The designations and terminology used are those of the authors.

This paper is intended to make the results of research available in preliminary form to encourage discussion and to elicit comments. Comments should be addressed to Peter Bartelmus or Jan van Tongeren, Statistical Division, Department for Economic and Social Information and Policy Analysis, Room DC2-1652, United Nations, New York, NY 10017, U.S.A.

b. United Nations, *Integrated Environmental and Economic Accounting* (Sales no. E.93.XVII.12) (New York: United Nations, 1993).

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Introduction

National accounts have provided the most widely used indicators for the assessment of economic performance, trends of economic growth, and the economic counterpart of social welfare. However, the new emphasis on sustainable development, in particular by the Earth Summit, the United Nations Conference on Environment and Development in Rio de Janeiro (June 3-14, 1992), draws attention to the need for a broader assessment of growth and welfare by modified national accounts.

In this context two major drawbacks of conventional accounts have been stressed. In their assessment of cost and capital, national accounts have neglected (1) the new scarcities of natural resources that threaten the sustained productivity of the economy and (2) the degradation of environmental quality, mainly from pollution, and consequences on human health and welfare. In addition, some expenditures for maintaining environmental quality are accounted as increases in national income and product, despite the fact that such outlays could be considered as a maintenance cost to society, rather than social progress.

Joint workshops organized by the United Nations Environment Programme (UNEP) and the World Bank set out to examine the feasibility of physical and monetary accounting in the areas of natural resources and the environment and to develop alternative macroindicators of environmentally adjusted and sustainable income and product.¹ A consensus emerged in the workshops that enough progress had been achieved to develop the links between environmental accounting and the United Nations System of National Accounts (SNA).

Parallel to this revision, the Statistical Division of the United Nations (UNSTAT) has developed methodologies for a System of integrated Environmental and Economic Accounting (SEEA), issued as an SNA handbook on *Integrated Environmental and Economic Accounting*.² Various components of the SEEA were tested in case studies in Mexico, Papua New Guinea, and Thailand. Those studies found that environmental accounting not only is feasible but also can provide, even in tentative form, a valuable information base for integrated development planning and policy. The main objectives of the SEEA are presented in box 1.

Box 1. Objectives of integrated environmental and economic accounting

(a) Segregation and elaboration of all environment-related flows and stocks of traditional accounts

The segregation of all flows and stocks of assets, related to environmental issues, permits the estimation of the total expenditure for the protection or enhancement of different fields of the environment. A further objective of this segregation is to identify that part of the gross domestic product that reflects the costs necessary to compensate for the negative impacts of economic growth, that is, the "defensive expenditures."

(b) Linkage of physical resource accounts with monetary environmental accounts and balance sheets

Physical resource accounts cover the total stock or reserves of natural resources and changes therein, even if those resources are not (yet) affected by the economic system. Natural resource accounts thus provide the physical counterpart of the monetary stock and flow accounts of the SEEA.

(c) Assessment of environmental costs and benefits

The SEEA expands and complements the SNA with regard to costing

- The use (depletion) of natural resources in production and final demand
- The changes in environmental quality, resulting from pollution and other impacts of production, consumption, and natural events, on the one hand, and environmental protection and enhancement, on the other.

(d) Accounting for the maintenance of tangible wealth

The SEEA extends the concept of capital to cover not only human-made but also natural capital. Capital formation is correspondingly changed into a broader concept of capital accumulation allowing for the use/consumption and discovery of environmental assets.

(e) Elaboration and measurement of indicators of environmentally adjusted product and income

The consideration of the costs of depletion of natural resources and changes in environmental quality permits the calculation of modified macroeconomic aggregates, notably an Environmentally adjusted net Domestic Product (EDP).

Source: Peter Bartelmus, "Accounting for Sustainable Growth and Development," *Structural Change and Economic Dynamics* 3 (2) (1992): 241-60.

In the absence of an international consensus on how to incorporate environmental assets and the costs and benefits of their use in national accounts, the Statistical Commission of the United Nations requested UNSTAT to develop an SNA *satellite* system for integrated accounting rather than to modify the core system of the SNA itself. This approach was confirmed by the United Nations Conference on Environment and Development (UNCED) in its Agenda 21 in 1992. On the other hand, as part of the revision of the SNA, selected elements of environmental accounting are already elaborated in the SNA.³ They include the classification of non-produced tangible (natural) assets, the incorporation of asset accounts, and a separate chapter on satellite accounts that deals with, among other things, the links between the SNA and integrated economic-environmental accounting. Such linkage is a prerequisite for a meaningful comparison of conventional economic and environmentally adjusted indicators.

Reflecting the controversial nature of some of the methodological proposals, in particular those on the monetary valuation of non-marketed environmental "externalities," the handbook has been issued as an *interim* version. It addresses numerous technical questions of valuation, accounting procedures, and classification, and also discusses alternative solutions. In practice and at this stage of development, it thus might not be easy to choose among different approaches and methodologies.⁴

The objective of this paper is, therefore, to provide a more concise guide through the intricacies of integrated environmental and economic accounting. A step-by-step discussion of how to implement the SEEA will be applied as far as possible, providing elaboration and concrete materials from country studies in text boxes and tables. Cross-references to the handbook facilitate its consultation for further details and explanations.

I. Adaptation of National Accounts for Environmental Analysis

Sections I and II demonstrate how the SEEA is derived from the overall national accounts framework, the recently revised 1993 SNA.⁵ Close links between the two systems are maintained, facilitating the direct comparison of conventional and

environmentally adjusted indicators. This is achieved by the incorporation of produced and non-produced (natural) asset accounts in the 1993 SNA, which are elaborated and expanded in the SEEA. The implementation of the 1993 SNA thus would produce a *first-step (limited)* version of the SEEA. For this reason the adaptation of and transition from the SNA—to obtain a broader system of integrated accounting—is discussed in some detail.

Figure 1 shows how the data systems for produced and non-produced (natural, non-financial) assets can be integrated into one table of supply and use and asset accounts. Such integration is essential for integrated environmental-economic analysis as it permits extending and linking conventional accounts and accounting identities, incorporating environmental assets and changes therein. Box 2 lists those identities in terms of the "blocks" of figure 1.

A. Supply and Use Accounts

Figure 1 introduces two classifications for the further breakdown of its supply and use blocks. The first classification is by industry, based on the International Standard Industrial Classification

Box 2. SNA accounting identities

The supply and use accounts in figure 1 reflect three basic national accounts identities:

- The supply-use identity:
 - output + imports = intermediate consumption
 - + exports + final consumption
 - + gross capital formation
- The value added identity:
 - value added = output - intermediate consumption - consumption of fixed capital
- The domestic-product identity, which only holds for the economy as a whole:
 - net domestic product (NDP) = final consumption
 - + gross capital formation + (exports - imports).

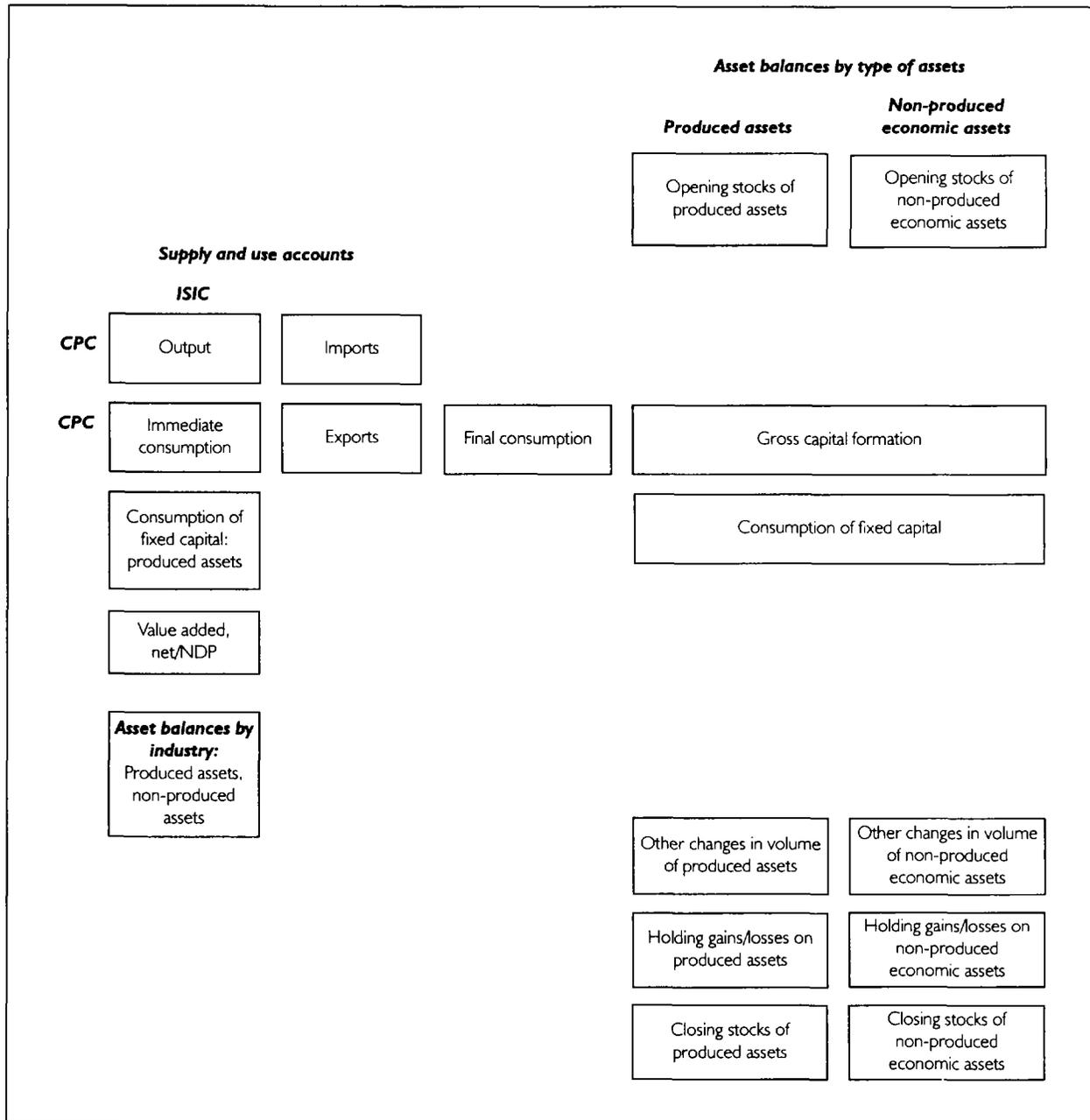
The incorporation of the asset balances in figure 1 adds another set of identities that explain the difference between opening and closing stocks of assets by flows during the accounting period. For produced and non-produced assets, the balances are defined as:

- Closing stocks = opening stocks + gross capital formation - consumption of fixed capital
- + other changes in volume of assets + holding gains/losses on assets.

(ISIC), and is applied vertically to the blocks of output, intermediate consumption, and value added.⁶ The second classification is by products, based on the Central Product Classification (CPC), and is applied horizontally to the blocks of supply (output and imports) and use (intermediate consumption, final consumption, capital formation, and exports).⁷ As a result of applying

the two classifications at the same time, the blocks of output and intermediate consumption become "make-and-use matrices" with cross-classifications of output and intermediate consumption by industry and product. The blocks of imports, exports, and final consumption are vectors with a single breakdown by products. The block of value added is a set of vectors consisting of

Figure 1. 1993 SNA, supply and use with asset balances for economic assets by type and industry



Explanations:

ISIC = International Standard Industrial Classification of All Economic Activities (United Nations, *International Standard Industrial Classification of All Economic Activities* (Sales no. E.90.XVII.11) (New York: United Nations, 1990))

CPC = Provisional Central Product Classification (United Nations, *Provisional Central Product Classification* (Sales no. E.91.XVII.7) (New York: United Nations, 1991))

compensation of employees, net indirect taxes, and operating surplus.

Gross capital formation and consumption of fixed capital are the only supply and use blocks that intersect with the blocks of the asset accounts. As a consequence, gross capital formation is cross-classified by the type of products that are distinguished in the rows of the supply and use section of the table and by type of assets that are distinguished in the asset accounts or balances (see Section I B). Within the latter, a distinction is made between produced and non-produced assets and corresponding capital formation.

The above-mentioned identities apply also to the different categories of the CPC and ISIC. The supply-use identity holds for each product category that is distinguished in the supply and use rows of the table and the value added identity holds for each industrial sector. The identity between supply and use of products is complicated, however, by the use of different valuations in supply and use. The supply blocks of output and imports are valued in basic prices—excluding trade and transport margins and taxes on products less subsidies—and uses are in purchasers' values that include the tax, trade, and transport margins. To maintain the identity in value terms between supply and use, an additional column vector of those margins could be introduced for each product.

B. Asset Accounts/Balances

The two columns of the asset balances for produced assets and non-produced assets in figure 1 are further detailed in terms of transactions in the SNA. Box 3 lists those transactions for the different blocks of figure 1.

Gross fixed capital formation, changes in inventories, and consumption of fixed capital generally refer to additions to and reductions in the value of produced assets such as buildings, roads, machinery, and stocks of commodities. However, gross fixed capital formation may also include additions to non-produced assets such as improvement of land, cost of transferring land and other non-produced assets between owners, and reforestation. The value of capital formation is added to the value of non-produced assets, but separately "depreciated" as other changes in volume (see box 3).

The account for other volume changes in produced and non-produced assets is one of the most relevant accounts of the SNA for environmental analysis, reflecting environmental impacts on natural and other assets. Economic appearance of non-produced assets (K3) covers the additions to non-produced assets that are used or made available for production activities, including additions to proven mineral reserves, virgin forests that are added to the economic reserves used in lumbering, and land that is cleared for use in agriculture or the development of human settlements. Further additions to non-produced assets are natural growth of non-cultivated natural resources (K5), which refers to the growth of natural biota that are not produced assets. Economic disappearance of non-produced assets (K6) covers all aspects of depletion of mineral assets, forests, and other natural resources, as

Box 3. SNA asset accounts categories

Opening stocks

Capital formation

- P.51 Gross fixed capital formation
- P.52,53 Changes in inventories
(acquisition less disposal of valuables)
- K.2 Acquisition less disposal of non-produced
(non-financial) assets
- K.1 Consumption of fixed capital (-)

Other changes in volume of assets

- K.3 Economic appearance of non-produced
assets
- K.4 Economic appearance of produced assets
- K.5 Natural growth of non-cultivated
biological resources
- K.6 Economic disappearance of non-produced
assets
- K.7 Catastrophic losses
- K.8 Uncompensated seizures
- K.9 Other volume changes in non-financial
assets not elsewhere classified (n.e.c.)
- K.12 Changes in classification and structure

Revaluation

- K.11 Nominal holding gains/losses

Closing stocks

Note: Codes refer to SNA transaction and balancing items (Inter-Secretariat Working Group on National Accounts, *System of National Accounts* (Sales no. E.94.XVII.4) (New York: United Nations, 1993)).

well as the degradation of non-produced assets. Economic appearance of produced assets (K4) refers mainly to additions to the stock of produced assets in the form of works of art, historical monuments, and the like, which heretofore had not been recognized as economic assets.

The categories discussed so far refer to changes in assets that are a consequence of economic decisions that may or may not affect the environment. The remaining categories in box 3 are either caused by economic decisions but have no environmental impacts (K8, K12), or reflect catastrophic losses (K7) that may have environmental impacts but are not directly caused by economic decisions.

Produced assets (in figure 1) may include natural assets such as livestock for breeding, orchards, plantation, timber tracts, and inventories of agricultural crops standing on the land or stored after harvesting. Growth of cultivated assets is treated as gross fixed capital formation, and growth of agricultural crops is treated as changes in inventories. Non-produced assets in the SNA refer only to *economic assets*, that is, assets over which ownership rights are enforced and which provide economic benefits to their owners. Their products are generally valued in the market, either directly or indirectly (see Section III A 1). The SNA classification of the tangible non-produced assets is shown in box 4, together with a cross-reference to the—more detailed—SEEA classification (CNFA, in parentheses). The SEEA categories of non-produced natural resources are similar to those of the SNA but in principle include all non-produced natural assets, not only “economic” ones. An important category of non-produced assets in SEEA is air, which is not included at all in the SNA as it does not (yet) represent an economic asset.

An alternative breakdown of the asset balances by industry is suggested in figure 1 as a separate block. Asset balances by industries that distinguish between produced and non-produced assets should be particularly useful in tracing the effects of industrial activities on different natural resources.

C. Identification of Environmental Elements in the SNA

The SNA already contains information that is related to environmental concerns. Part of this information is explicitly identified in various cate-

Box 4. Classification of tangible non-produced assets in SNA and SEEA (in parentheses)

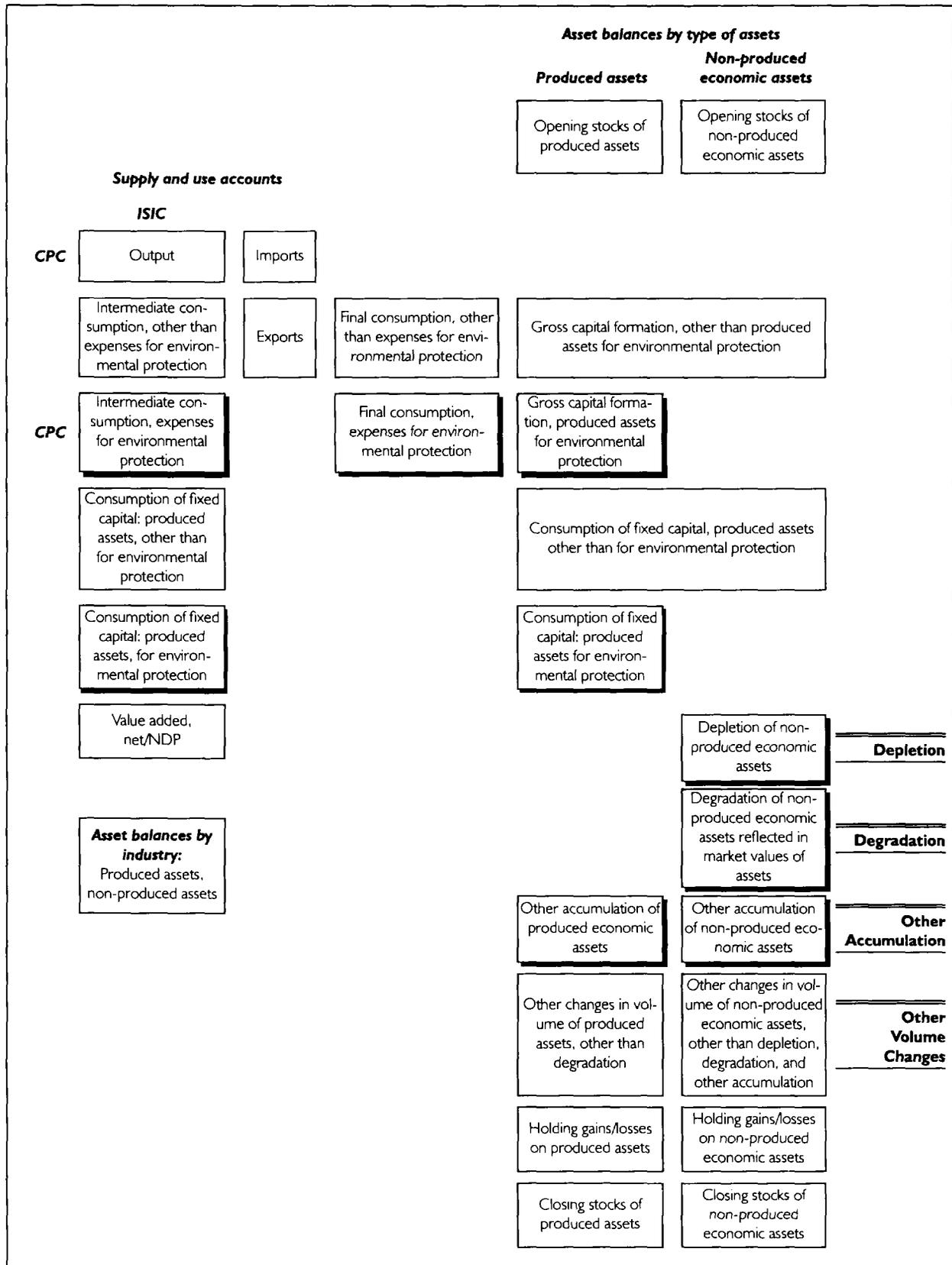
AN2	Non-produced assets (2)
AN21	Tangible non-produced assets (2.1 non-produced natural assets)
AN211	Land (2.1.3 land with ecosystems and soil)
AN2111	Land underlying buildings and structures (2.1.3.2.1)
AN2112	Land under cultivation (2.1.3.2.2 agricultural land)
AN2113	Recreational land and associated surface water (2.1.3.2.4, part of 2.1.3.3)
AN2119	Other land and associated surface water (2.1.3.2.5, part of 2.1.3.3)
AN212	Subsoil assets (2.1.2)
AN2121	Coal, oil, and natural gas reserves (2.1.2.1 fossil/subsoil assets)
AN2122	Metallic mineral reserves (2.1.2.2 metal and other ores)
AN2123	Non-metallic mineral reserves (2.1.2.3)
AN213	Non-cultivated biological resources (2.1.1 wild biota)
AN214	Water resources (2.1.4 water)
N.A.	(2.1.5 air)

Source: Inter-Secretariat Working Group on National Accounts, *System of National Accounts* (Sales no. E.94.XVII.4) (New York: United Nations, 1993); and United Nations, *Integrated Environmental and Economic Accounting* (Sales no. E.93.XVII.12) (New York: United Nations, 1993), Annex IV.

gories of its classifications, notably those of the asset accounts as shown above. Further information can be obtained by disaggregation of SNA transactions and classifications without modifying the basic accounting structure. This approach has been applied in various satellite accounts (in a narrow sense) that aim at providing greater details of transactions in particular areas such as health, education, and, indeed, environment.⁸ *Integrated Environmental and Economic Accounting* discusses such environment-related disaggregation of the SNA in a separate version (chap. II), referring to environmental protection expenditures and non-financial asset accounts. Figure 2 illustrates this disaggregation in terms of the building blocks of figure 1 by highlighting the environmental components of those blocks.

1. *Environmental protection expenditures.* Environmental protection services are identified

Figure 2. 1993 SNA, supply and use with asset balances for economic assets and separate identification of environmental elements



Explanations: See figure 1.

within intermediate consumption of industries, final consumption by government and households, and investment (capital formation). Depreciation of assets used in environmental protection is also recorded separately from consumption of fixed capital of other assets.

Separation of environmental protection expenses requires the identification of, on one hand, establishments that produce environmental goods (waste/pollution treatment facilities, filters, or cleaning materials) and protection services and, on the other hand, similar expenses for environmental protection that are not identified as separate establishments in the SNA. The latter may range from simple cleaning activities to maintenance of environmental protection equipment. In-house construction of environmental protection facilities is not included in such "ancillary" activities since own-account construction is always dealt with as a separate establishment in the SNA.

The headings of a draft Classification of Environmental Protection Activities (CEPA), proposed in *Integrated Environmental and Economic Accounting*, is reproduced in box 5. CEPA includes only those categories that are an immediate response to environmental degradation caused by production units, the government, and households. It does not cover activities related to health protection and cure that are in response to effects *borne* (usually by others than those who caused them) and that are sometimes referred to as part of a broader concept of "defensive expenditures."⁹ Details of the accounting procedures for the "externalization," that is, creation of a new "environmental protection industry" within the SEEA framework, are discussed as a separate version of the SEEA in the *Integrated Accounting* (chap. V).

The separate identification of environmental protection expenses provides a comprehensive picture of the efforts that have been undertaken by the different sectors and institutions of the economy to protect the environment. Input-output analyses could assess the direct and indirect value added contributions to gross national product (GDP) in connection with environmental protection expenses, including employment created by such expenses. Such accounting also could indicate how capital-output ratios are affected by investment in environmental protection equipment.

2. *Environmental accounting elements in other volume changes of assets.* Figure 2 groups the data recorded under other changes in volume in the SNA into categories of depletion and degradation, and other accumulation and volume changes. Depletion and degradation that apply to non-produced assets are accounted as production costs in the SEEA—contrary to the SNA, in which those items are part of other volume changes, outside the production accounts.

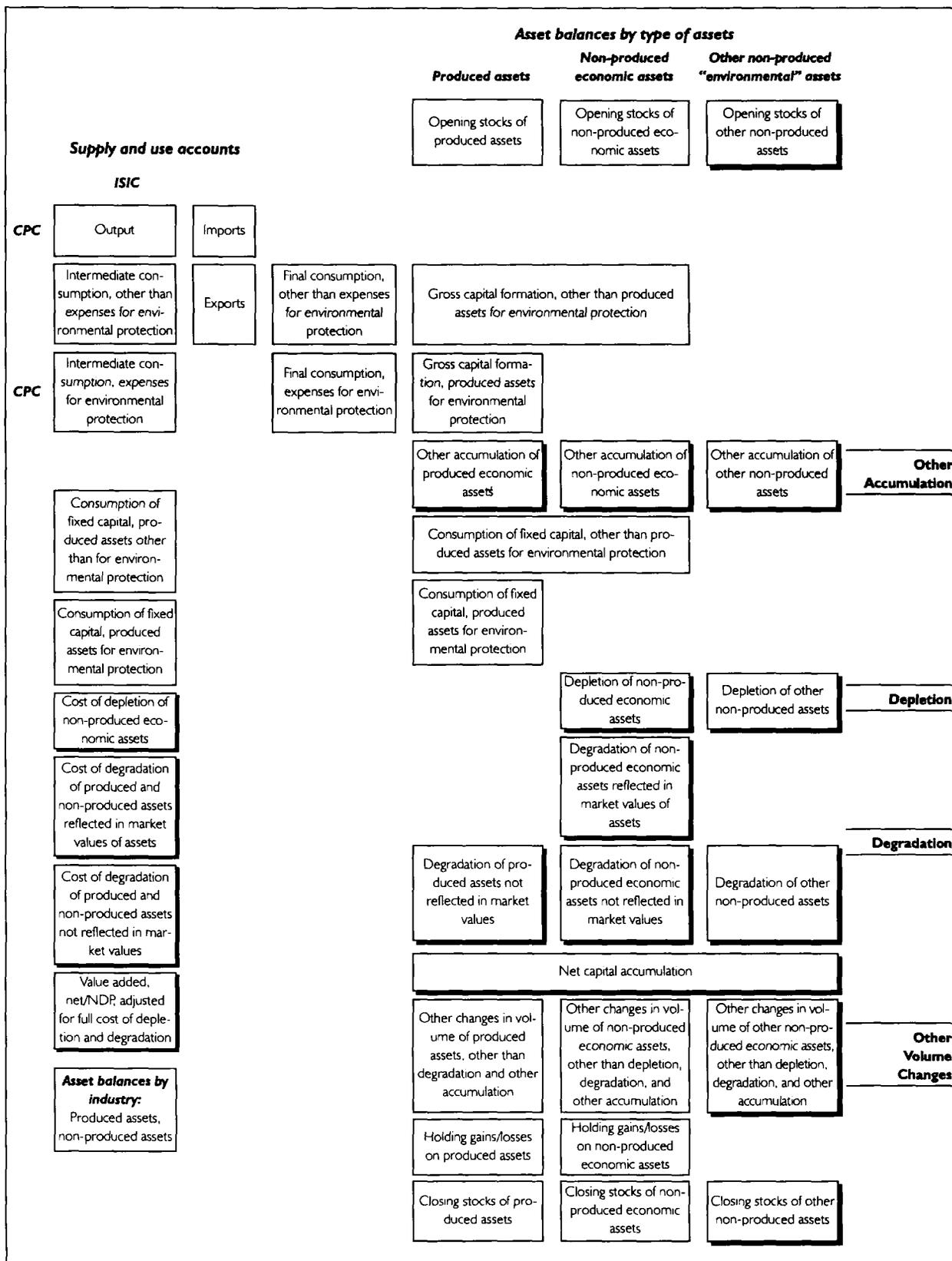
Depletion of non-produced economic assets refers to the depletion of natural resources. Degradation of those assets (part of K6 in SNA; see box 3) includes quality changes (including restoration of quality) and degradation of land and other non-produced natural assets due to economic uses or due to the discharge of residuals. Other accumulation elements are additions to the volume of *economic non-produced* assets that are caused by economic decisions, such as new finds of subsoil resources, or transfers of land and natural assets to economic use (part of K3 in the SNA). The remaining flows of other volume changes are those that are not caused by economic decisions but have political, natural, or other non-economic causes that affect the economic

Box 5. Classification of Environmental Protection Activities (CEPA)

1. Protection of ambient air and climate (prevention of air pollution, treatment of exhaust gases)
2. Protection of ambient water, excluding ground water (prevention of water pollution, industrial pre-treatment plants, sewage, treatment of cooling water)
3. Prevention, collection, transport, treatment and disposal of wastes (collection, transport, treatment of waste, and prevention of waste generation)
4. Recycling of wastes and other residuals
5. Protection of soil and ground water (decontamination of soil, cleaning of ground water)
6. Noise abatement (traffic, industrial process noise)
7. Protection of nature and landscape (protection of species, habitats; erosion, fire, and avalanche protection)
8. Other environmental protection measures (education, training, administration)
9. Research and development.

Source: United Nations, *Integrated Environmental and Economic Accounting* (Sales no. E.93.XVII.12) (New York: United Nations, 1993), Annex III.

Figure 3 SEEA, supply and use with asset balances for economic and environmental assets, including costing of depletion and degradation



Explanations: See figure 1.

system. They include seizures of assets by governments (K8), and destruction by natural and human-made disasters (K7).

II. Modification of the SNA: Toward a System of Integrated Environmental and Economic Accounting (SEEA)

Section I describes the first-step version of the SEEA, as derived from the SNA, by introducing additional environmental detail without changing SNA concepts and accounting procedures. For more comprehensive environmental-economic analysis, modifications in the SNA are required. These are discussed in *Integrated Environmental and Economic Accounting* as further “versions” of the SEEA. The following describes two basic modifications whose implementation appears to be more practical than other SEEA versions. They are (1) the second-step version of the SEEA that simply shifts elements of other volume changes as environmental costs to the production/income accounts, and (2) a third-step version that attempts to cover non-economic “environmental” assets by replacing SNA’s market valuation by a maintenance-cost valuation. The different valuation methods, estimation procedures, and consistency problems encountered in both market- and maintenance-cost valuation are discussed in Section III. As a consequence of those valuations, alternative “green” indicators of value added, net domestic product (NDP), and capital formation can be calculated. Figure 3 illustrates these modifications by highlighting elements shifted within or added to the SNA.

A. Environmental Costs and Capital Accumulation at Market Values

The shift of the depletion, degradation, and accumulation elements of other volume changes in the SNA to the production and capital formation accounts in SEEA is shown in figure 3 as a relocation of figure 2 blocks. This rearrangement does not require additional data beyond those required for figure 2. The depletion and degradation blocks are presented together with the consumption of fixed capital as additional negative entries that reduce the value of non-produced assets. At the same time, positive counterpart cost items are imputed to those industries and final consumers

that cause the depletion and degradation. The items constituting other accumulation of non-produced economic assets are shown together with gross fixed capital formation.

In general, it will be possible to identify separately the cost of degradation, as reflected in market price changes of economic assets, only in severe cases of degradation that can be traced unequivocally to their causes (production/consumption activity). Examples are industrial accidents such as oil spills that contaminate urban or agricultural land property, or environmentally unsound production (cultivation) and waste disposal resulting in land degradation (erosion and contamination). In those cases, conventionally measured value added should be adjusted to a more realistic value that measures more accurately the contribution of the—degrading—sector to net domestic product. An example of such analysis are cost estimates of land degradation in Costa Rica.¹⁰

Gross fixed capital formation that refers to produced assets and other accumulation of non-produced assets together defines a new concept in environmental accounting called *gross capital accumulation*. The capital accumulation concept could replace gross capital formation in integrated growth analysis. Such analysis would recognize the usually neglected role of natural assets in the growth of output.

B. Incorporation of Environmental Costs and Capital Not Reflected in Market Values

In addition to the elements of other volume changes, reclassified to cost, and other accumulation, figure 3 includes environmental cost and asset categories that are not reflected in the market values of assets. Those elements refer to pollution of environmental media (air, water, land) and the depletion and contamination of wild species and ecosystems that are not economic assets. Degradation effects are included even if they are not recognized in the market values of assets. Alternative valuations can be applied, notably maintenance costing, discussed below in Section III B.

The alternatively valued (costed) environmental cost items are allocated to the industries and consumers causing the environmental depletion and degradation. Degradation or depletion caused

by households is treated as cost of household production activities, identified as a separate industry in the SEEA. Environmental degradation caused by the government is recorded as an additional cost item of production of government services. However, if the government removes degradation effects through clean-up activities, such reduction in degradation is treated as a decrease in government consumption and an increase in capital formation because the quality of assets is improved. Cross-boundary effects—across the borders of the

Box 6. Capital accumulation in EDP calculation

SNA defines Net Domestic Product as:

$$NDP = C + I + (X - M).$$

If net capital accumulation in produced and non-produced economic assets ($A_{p.ec} + A_{np.ec} - A_{np.env}$) replaces net capital formation (I), the identity becomes:

$$EDP = C + (A_{p.ec} + A_{np.ec} - A_{np.env}) + (X - M)$$

where

NDP = Net Domestic Product

C = Final consumption

I = Net capital formation

X = Exports

M = Imports

EDP = Environmentally adjusted net Domestic Product

$A_{p.ec}$ = Net capital accumulation in produced assets

$A_{np.ec}$ = Net capital accumulation in non-produced assets.

$A_{np.env}$ = Depletion and degradation in environmental assets.

To maintain the identity, the negative element for the economic counterpart of changes in natural assets other than economic assets ($-A_{np.env}$) is added. This implies that expenditures and, in particular, net capital accumulation of economic assets are only partly derived from net product of economic activities reflected in EDP; an important part of the expenditures may reflect the transfer of environmental assets and/or their services to economic activities. This can be shown more clearly by re-arranging the terms in the above EDP identity as follows:

$$EDP + A_{np.env} = C + (A_{p.ec} + A_{np.ec}) + (X - M).$$

nation—are also accounted for in the SEEA according to cost-caused or cost-borne principles (by residents or the “rest of the world”).

An important part of depletion and degradation affects non-economic, “environmental” (in a narrow sense) assets. They are assets such as air, oceans, rivers and lakes, forests, or lands “in the wilderness,” which are not used for economic purposes (see the “environmental assets” column in figure 3). Complete asset accounts can be compiled for most of those assets in physical terms as suggested in figure 3 with the possible exception of air. These physical asset accounts are fully elaborated in *Integrated Accounting* (chap. III).

Degradation and depletion effects can be offset by environmental protection (expenses) in the form of produced capital formation. For example, reforestation may replace virgin forests that had been depleted or degraded. Such reforestation is capital formation, that is, the production of (produced) assets. As those assets do not add to the value of an economic asset, they should be considered as enhancement (increase) of environmental assets.

C. Environmentally Adjusted Economic Aggregates

When all environmental cost and other accumulation are expressed in value terms, alternative aggregates of NDP, final consumption and capital accumulation can be derived that still meet the basic accounting identities described in box 2. Deduction of environmental costs from NDP thus obtains an environmentally adjusted net domestic product (EDP). The defining equations of NDP and EDP, in final demand categories, are shown in box 6.

III. Valuation of Natural Assets in the SEEA

As indicated in Section I B, natural assets are valued in monetary terms in the SNA only if they are under the controlled ownership of economic agents and provide actual or potential economic benefits to their owners. These *economic* assets are accounted for with a positive monetary value in the balance sheets of the SNA. All other natural assets obtain a zero economic value and thus are not recorded in monetary balance sheets but could be presented in physical asset accounts.

Most of the changes in economic natural assets are recorded as “other volume changes”—outside the production and income accounts of the SNA.

The SEEA treats these environmental impacts as cost and introduces them into the production accounts as “imputed” values. However, the limitation of this approach, which deals with economic assets only, is that it excludes, by definition, all other *environmental* assets. The depletion and degradation of air, water, forests, or biota in the wilderness have been considered as “social costs” of economic growth and development for which economic activities should be made accountable (see Section III B). These aspects of natural assets are captured as additional environmental costs in alternative valuations of the SEEA.

Integrated Accounting introduces three categories of monetary valuation of natural assets, changes therein, and effects on human welfare therefrom. Accordingly, three different basic versions of the SEEA are proposed. One version (IV 1 in *Integrated Accounting*) applies a *market valuation* approach, which rearranges only environmental changes already contained in the asset accounts of the conventional SNA. A second version (IV 2) uses a *maintenance valuation*, which estimates the costs that would have been required to keep the natural environment intact during the accounting period. The third version (IV 3) combines the market valuation of the first version with a *contingent valuation* approach to assess the environmental costs borne by industries with those borne by households (as welfare losses from environmental deterioration).

The three versions reflect to an increasing degree problems of consistency of valuations and of data availability. The handbook focuses, therefore, on the first two versions as widely applicable guidelines for environmental accounting. The third version, based on contingent valuation (willingness-to-pay and similar approaches), and other versions (which extend the production boundary of the SNA) are intended more for ad hoc analyses and research than for routine data collection. They are not discussed further here.

A. Market Valuation of Natural Resources

The first-step, market-valuation-based version of the SEEA is the closest to conventional account-

ing in identifying changes in the values of natural assets, already accounted for in asset accounts as other volume changes. These volume changes include the depletion of natural resources, as well as their degradation from pollution and other degrading activities—to the extent that the underlying environmental impacts are reflected in changed market values of those assets. Section II A explains that part of the SNA category of other volume changes is shifted in the SEEA as environmental cost to the production accounts.

Market values have to be compiled or estimated in principle for both the stocks and changes therein. In practice, it might be easier in some cases to value observed (physical) changes only than to assess the total available stock of a natural resource.

1. *Valuation methods.* Stocks of non-produced fixed assets that are marketed, such as land, could be valued by applying the market prices observed in statistical surveys of market transactions. If these assets are not marketed, the market prices of similar assets could be used. The flow of services of marketed, but not produced, fixed assets can be estimated by using data on rents or leases that were actually paid for the permission to use these or similar assets.

Stocks of depletable natural assets such as subsoil assets or wild biota usually do not have a market price, as they are rarely sold/bought in total. A number of methods to estimate the market price/value of the stocks of scarce (depletable) natural resources, and, by implication, changes in the value of stock (between the beginning and the end of the accounting period) have been proposed and applied in practice. Box 7 presents formalized descriptions of prevalent approaches whose assumptions, advantages, and drawbacks are briefly discussed in the following.

a. *Discounted (present) value of natural resources.* A market value of natural assets can be calculated by using the prices of the goods extracted or services provided by those assets as the future sales value, reduced by the exploitation costs (net return). If the exploitation is spread over a lengthy period, the flow of future net returns has to be discounted as indicated in box 7. In some cases, the reserves of depletable natural assets and exploitation rights are marketed. The market prices then will reflect to a high degree the

Box 7. Methods of market valuation of natural resource stocks and stock changes

Present-value method: The present value V_0 of a natural resource is the sum of the expected net revenue flows $N_t Q_t$, discounted at nominal or real interest rates r for the life T of the asset:

$$V_0 = \sum_{t=0}^T \frac{N_t Q_t}{(1+r)^t}$$

where N_t is defined as the total unit value of the resource less the costs of extraction, development, and exploration, and Q_t is the quantity exploited over the period t .

Net-price method: The value of the resource at the beginning of period t , V_t , is the volume of the proven reserve R_t (or ΣQ_t over the lifetime of the resource) multiplied with the difference N_t between the average market value per unit of the resource p_t and the per-unit (marginal) cost of extraction, development and exploration c_t :

$$V_t = (p_t - c_t)R_t = N_t R_t$$

The net-price method is based on the Hotelling rent assumption, which claims that in a perfectly competitive market, the price of a natural resource rises at the rate of interest of alternative investment, offsetting the discount rate. Accordingly the Hotelling rent, defined as the difference between the price of the resource and the marginal cost of extraction, would reflect the unit value of the natural resource stock.

Replacement-cost estimates: The basic idea is to treat exhaustible resources as renewable because of exploration and discoveries, estimating incremental annual unit costs of adding reserves to the reserve base. The unit cost of booked reserves is multiplied by the number (units) of remaining established reserves to obtain an economic value of total reserves.^a This rather speculative (about expected discoveries) method is more experimental in nature and is therefore not further discussed in the text.

Depreciation/depletion of a natural resource stock: Depreciation of a natural resource stock can be calculated simply as the difference between the values of the stock—as calculated above—at the beginning and the end of the accounting period. An alternative approach, which does not address the valuation of the stock or reserve but focuses on potential income generated from extraction (sales) has been proposed by El Serafy.^b If R is the annual net revenues from the sales of the resource, assumed to be constant over its lifetime (of n years), a “true income” element X can be calculated such that $R - X$ represents a “capital” element whose accumulated investment at an interest rate r during the n years would create a permanent stream of income of X (per annum). X is calculated as $X = R [1 - 1/(1+r)^{n+1}]$ and the user cost $R - X = R/(1+r)^{n+1}$, that is, the discounted (last) net revenue.

Notes

a. A. Born, *Development of Natural Resource Accounts: Physical and Monetary Accounts for Crude Oil and Natural Gas Reserves in Alberta, Canada*. Statistics Canada, 1992, 43-45.

b. Salah El Serafy, “The Proper Calculation of Income from Depletable Natural Resources,” in Yusuf J. Ahmad, Salah El Serafy, and Ernst Lutz, eds., *Environmental Accounting for Sustainable Development*. A UNEP-World Bank Symposium (Washington, D.C.: World Bank, 1989), 10-18.

expected net returns from the exploitation of the resource since investors would base their decision of buying an asset on relative present values of future net income streams.¹¹

However, it is difficult to estimate future returns and costs of natural resource exploitation by economic sector (agriculture, forestry, mining, construction) or type of natural resource used by different sectors. Estimates would require information on availability of future stocks (reserves), prices, and interest rates, which are usually available, if at all, only at the microeconomic, rather

than sectoral, level. In addition, the choice of the discount rate is controversial, with proposed (real) rates ranging between 0 and 17 percent.¹²

b. *Net-price method.* A simplified method that neglects future (discounted) losses of net returns from resource depletion, the “net-price valuation,” has been proposed and applied in various studies.¹³ As shown in box 7, the value of a natural resource is thus calculated as the product of the quantity of the natural resource stock and the net price. The net price of the asset is defined as the actual market price of the raw material minus its

marginal exploitation costs including a “normal” rate of return of the invested produced capital. In the case of non-renewable (mineral) resources, this stock comprises only the “proven reserves” that are exploitable under present economic conditions and, therefore, have a positive net price. The net price method could also be applied in the cases of wild biota and water as long as these natural assets are considered as economically exploitable assets.

This valuation method for estimating stock values can, of course, also be applied for valuing volume changes of natural assets in the accounting period. In the case of depletion of natural assets such as wild biota, subsoil assets, or water, the net price method calculates the value of depletion by multiplying the depleted quantities of the natural assets with the net price.

The general validity of the Hotelling rent assumptions, underlying the net-price method, has been questioned. Where a natural resource reflects different qualities, marginal exploitation costs increase with lower-quality resources extracted, and the rents on marginal tons would increase at a rate lower than the interest rate.¹⁴ As a consequence, the Hotelling rent would overstate natural resource depreciation. This effect is compounded if average costs are used instead of marginal costs, assuming that, in general, marginal costs exceed average costs. The net-price method can thus be considered an “upper limit on economic depreciation,” an assumption that has been confirmed at least by one empirical comparison of the present values of oil and gas reserves (in Canada) with their net-priced values.¹⁵

c. *User-cost allowance.* For the depletion of exhaustible resources a “user-cost” valuation has been proposed as an alternative. The idea is to convert a time-bound stream of (net) revenues from the sales of an exhaustible natural resource into a permanent income stream by investing a part of the revenues, that is, the “user-cost allowance,” over the lifetime of the resource; only the remaining amount of the revenues should be considered “true income.”¹⁶ Given a particular net revenue for an accounting period, the calculation of the user-cost allowance is straightforward, requiring only two additional parameters, the discount rate (r) and the lifespan (n) of the resource (see box 7).

It can be shown that the user-cost method is a special case of defining depreciation as the change

in the discounted value of a resource, for example, over one year of exploitation, assuming that the yearly net returns are the same for the remaining life of the resource.¹⁷ Apart from this—simplifying—assumption, the above-mentioned controversy surrounding the choice of a discount rate and the question of availability of appropriate investments of the user-cost allowance (for maintaining the capital base of production) also impair the general validity of this approach. In addition, this approach does not address the role (availability and consumption) of natural capital in particular production processes, that is, their sustainability. If, on the other hand, the maintenance of *income* flows (irrespective of their domestic or foreign origins) is envisaged, the user-cost allowance might gain relevance in estimating a (more) sustainable national income figure.

2. *Measurement and valuation in natural resource accounts.* Different concepts, definitions, data sources, and estimations have to be used for measuring physical quantities of natural resource stocks and changes therein and for applying monetary values to these quantities. For the most commonly applied net-price method, the following steps are required:

a. Establishment of the physical asset account, which, according to the SEEA (*Integrated Accounting*, table 3.6), can be described in simplified terms as:

- (1) Opening stocks
- (2) Depletion
- (3) Degradation of land
- (4) Discharge (and treatment) of residuals
- (5) Other volume changes
- (6) Closing stocks.

Physical accounts are fully elaborated as a separate version (III) of the SEEA in the *Integrated Accounting*. They represent an important data base, either for the direct management of particular natural assets, or as data input into physical models of environment-economy interaction (for example, input-output analysis). In principle, general equilibrium models can expand such modeling into the analysis of price formation and consequently the estimation of monetary aggregates. An example of such expansion of physical resource accounts into macroeconomic and general equilibrium modelling is the Norwegian approach to environmental accounting.¹⁸ Of

course, the usefulness of such modelling depends to a great extent on the validity of the underlying assumptions about production, consumption, and investment functions and the existence of overall general equilibrium in the real-world markets.

b. Determination of the net price of the resource, consisting of the following steps:

- (1) Determining the market price of different resource categories
- (2) Assessing the total factor cost, including a normal return to capital, of producing one unit of those resource categories
- (3) Calculating the net price as the difference between (1) and (2).

c. Valuation of items (1), (2), and (5) of the asset account (Step (a.) above) by multiplying them with the net price of (b)(3). The valuation of items (3) and (4) is carried out (in market values) by direct observation of (changes in) market values; in other words, quality changes in natural resources are usually neglected by the net-price method unless they affect the productivity of production processes.

d. Determination of the value of the closing stocks by applying the net price at the end of the accounting period to the remaining resource stock (item (6) of Step a).

e. Estimation of a revaluation item as the remaining difference between opening stock plus

Table 1. Measurement and valuation in natural resource accounts

	Forests	Minerals/oils	Soil	Fish
A. Physical accounts				
1. Opening stocks	Standing volume of timber, trees > 10cm (20 cm), ^a thereof; actually commercialized	Proven reserves		Estimated biomass for selected species
2. Additions (part of other volume changes in SEEA)	Growth, reforestation, plantation ^b	Discoveries, upward revisions		
3. Reductions (depletion and part of other volume changes in the SEEA)	Harvesting, deforestation (forest conversion ^b), logging damage (waste ^b), fire damage, stand mortality ^c	Depletion	Soil loss and productivity decrease due to soil erosion, volume of soil erosion in fertilizer terms (kg of fertilizer per kg of nutrient lost)	Estimated sustainable yield and actual catch of selected species
4. Net change (net capital accumulation in the SEEA)	Net change	Net change		
5. Closing stocks		See opening stocks		
B. Unit value				
	Stumpage value of standing timber (FOB export prices minus production and capital costs)	Net price/rent (average wellhead price ^d /FOB export price minus production and capital costs), replacement costs (exploration and development cost) per unit exploited ^d	Per-ha cost of revenue lost from 1% of productivity loss, per-ha cost of replacing lost nutrients with commercial fertilizer	
C. Monetary accounts				
	Net price/rent valuation of all of the above, user-cost valuation for depletion only ^c	Present value of future net cash flows from production for stocks only, ^d reserves at replacement cost value, ^d net-price valuation for all of the above, user-cost valuation of depletion only ^{a,c}	Capitalized value of net revenue lost from soil loss, nutrient replacement cost of soil loss	Depreciation of fishery assets as annual change in the capitalized (sustainable rents) value of assets

a. Papua New Guinea: Peter Bartelmus, Ernst Lutz, and S. Schweinfest, "Integrated Environmental and Economic Accounting: A Case Study for Papua New Guinea." Environment Working Paper no. 54 (Environment Department, World Bank, Washington, D.C., 1992).

b. Philippines: Department of Environment and Natural Resources (DENR), Republic of the Philippines, and United States Agency for International Development (USAID), "The Philippine Natural Resources Accounting Project, Executive Summary" (Manila: International Resources Group, Ltd., 1991).

c. Mexico: Jan van Tongeren and others, "Integrated Environmental and Economic Accounting: A Case Study for Mexico." Environment Working Paper no. 50 (Environment Department, World Bank, Washington, D.C., 1991).

d. Canada: A. Born, *Development of Natural Resource Accounts: Physical and Monetary Accounts for Crude Oil and Natural Gas Reserves in Alberta, Canada*. Statistics Canada, 1992.

Source: Robert C. Repetto and others, *Wasting Assets, Natural Resources in the National Income Accounts* (Washington: World Resources Institute, 1989); and/or R. Solórzano and others, *Accounts Overdue: Natural Resources Depreciation in Costa Rica* (San Jose, Costa Rica: Tropical Science Center and Washington, D.C.: World Resources Institute, 1991) unless otherwise indicated in footnotes.

volume changes and closing stock (neglecting measurement and other errors) in monetary terms.

This generic approach will vary for the measurement and valuation of different types of natural resources. Table 1 gives a synoptic view of some of those approaches actually applied in case studies.

3. *A case study: subsoil assets in Papua New Guinea (PNG)*. Concrete problems encountered in applying the net-price method in a country with very limited statistics regarding its natural resource base are described in box 8. The box illustrates some of the initial difficulties and provisional solutions that might be typical for establishing natural resource accounts in less developed countries. Those resource-dependent countries are indeed the ones that most urgently need a rational assessment of natural resource stocks and their exploitation for production and consumption purposes.

Table 2 presents an example of accounting for subsoil assets of copper, gold, and silver mines in PNG. For the years 1986-88, discoveries, included under other volume changes, contributed to an increase in the value of the mineral stock. The cessation of activities in the Bougainville mine in 1989 led to a negative adjustment of the extractable (and extracted) mineral assets. A slump in mineral prices resulted in negative net prices in the same year. Under the above-discussed assumptions, the

net price in this year reflects the pessimistic expectations about the profitability of the mine(s).

Table 3 compares the calculations of user costs with those of the net-price-based depreciation (see box 7) of mineral resources. The user cost is considerably lower (ranging between 12 percent and 46 percent of the depreciation allowance). This is not surprising considering that the user-cost method would split up the net return from sales (equalling the depreciation amount without appreciation) into a true-income and a user-cost element. Table 3 also illustrates differences in the relative importance (with regard to value added generated) attached to depletion in the mining sector by the two valuation methods. The above consideration of the net-price values as upper limits should be borne in mind when comparing these figures.

B. Maintenance Valuation of Environmental Assets

The market-value approach covers only those natural assets that have an economic value (in the SNA sense), in other words, that are connected with actual or potential market transactions. It does not include environmental assets, such as air, wild land, waters, and species. Nor can it account for all environmental functions of "economic" assets if those functions have not been reflected in the economic (market) valuation of natural assets. To obtain a more comprehensive picture of the changes in the value of the environment, a

Box 8. The use of net prices for the valuation of subsoil assets of Papua New Guinea

Data available from quarterly reports of the Department of Minerals and Energy included reserves (*t*, *kg*), production (*t*, *kg*), unit values (Kina) and estimated lifetimes of the reserves by mine and mineral. In the absence of cost data per unit of mineral extracted, a net price could not be calculated for each mineral and the net value of total annual mine production (deducting also an estimate for a normal return to capital) had to be used instead as the indicator of depletion (cf. table 1). Even those values, based on detailed cost-structure information of the mines were difficult to obtain, and in some cases "net values per unit of ore" had to be extrapolated for years for which no cost information was available. Published or otherwise revealed or estimated information on "net earnings before taxation" thus can generally be expected to be fraught with assumptions and uncertainties.

In the next step, opening stocks in monetary terms were calculated by multiplying net revenue with lifetime estimates of the mines. Those estimates were based on assumptions about production patterns and future earnings by the mining companies themselves. Clearly those estimates are quite ambiguous and should be revised by using net prices for different minerals and estimates of proven reserves rather than "hiding" behind opaque lifetime estimations.

Source: Peter Bartelmus, Ernst Lutz, and S. Schweinfest, "Integrated Environmental and Economic Accounting: A Case Study for Papua New Guinea." Environment Working Paper no. 54 (Environment Department, World Bank, Washington, D.C., 1992) and unpublished material.

Table 2. Accounts for subsoil assets in Papua New Guinea
(million Kina)

	1986	1987	1988	1989	1990
Opening stocks	1,750.0	2,648.7	3,683.7	1,584.4	-154.7
Depletion	-126.8	-209.7	-106.3	-25.2	-180.7
Other volume changes	9.0	122.8	175.6	-383.3	0.0
Revaluation	1,016.5	1,121.9	-2,168.6	-1,330.6	N.A.
Closing stocks	2,648.7	3,683.7	1,584.4	-154.7 ^a	N.A.

Note: The data presented reflect various assumptions and do not consider the intermediate stages from initial prospecting until the reserves are "proven." If all the leases for minerals prospecting and developing were auctioned off yearly, the incremental values would reflect additions to the capital stock.

a. The negative value is not considered an accurate representation of the value of mineral reserves in PNG by the technical specialists working on the country, illustrating the difficulties in producing quantitative estimates of expected (future) returns from mines operating under uncertain political conditions.

Source: Peter Bartelmus, Ernst Lutz, and S. Schweinfest, "Integrated Environmental and Economic Accounting: A Case Study for Papua New Guinea." Environment Working Paper no. 54 (Environment Department, World Bank, Washington, D.C., 1992), 14.

Table 3. Comparison of user cost and depreciation of mineral resources in Papua New Guinea
(million Kina, percentage)

	1985	1986	1987	1988	1989	1990
(1) User cost	8.8	16.2	39.6	24.5	9.2	35.8
(2) Depreciation (depletion)	74.1	126.8	209.7	106.3	25.2	180.7
(1) / (2) .100	11.9	12.8	18.9	23.0	36.5	19.8
User cost/value added (mining) (percentage)	3.7	4.9	8.1	4.0	2.6	9.5
Depreciation/value added (mining) (percentage)	31.0	38.4	42.8	17.4	7.1	47.8

Source: Peter Bartelmus, Ernst Lutz, and S. Schweinfest, "Integrated Environmental and Economic Accounting: A Case Study for Papua New Guinea." Environment Working Paper no. 54 (Environment Department, World Bank, Washington, D.C., 1992), 20, 22.

maintenance cost valuation is introduced in the SEEA as an alternative to market valuation. Considering both the nature of this valuation—focusing on *changes* in environmental quality—and the scope and complexity of environmental functions and values, no attempt is made in the SEEA (at least for comprehensive national accounting) to compile full environmental asset accounts that include stock information. Only changes in environmental assets are accounted for as "capital accumulation" and other volume changes in the production and asset accounts.

Maintenance costs are defined as the costs of using the natural environment that *would* have been incurred if the environment had been used in such a way that its future use had not been affected. These costs are, of course, hypothetical because in reality an actual use *did* take place that affected the environment. The rationale behind this approach is based on the following two criteria:

- Application of the sustainability concept that has gained a central role in the discussion of integrated (environmentally sound and sustainable) development
- Extension of the national accounts concept of replacement cost of the consumption of fixed capital to valuing the use of non-produced natural assets.

The sustainability concept reflects a conservationist view of the environment. The uncertainty about possible long-term hazards from disturbing the natural environment and possible irreversibilities of environmental impacts from economic activities call for a high degree of risk aversion and the maintenance of at least the present level of environmental quality. In addition, the use of the maintenance-cost approach for valuing the use of environmental functions is similar to valuing the services of human-made capital in the national accounts through consumption of fixed capital. The consumption of fixed capital is estimated as the amount necessary to keep intact the level of the human-made assets by means of replacement investments. Such calculation of capital consumption is also hypothetical because whether actual investment expenditures will be incurred at maintenance-cost levels is not certain. From this point of view, maintenance cost valuations of produced and environmental asset use are quite consistent.

In the case of subsoil assets, replacement cost could be calculated in principle in terms of required exploration and development costs. This approach is highly speculative, and it might be unrealistic to estimate the costs for potential replacement of those stocks (see box 7). The environmental problems of depleting those assets are

Box 9. Prevention and restoration activities in maintenance costing

Five types of measures for preventing or restoring environmental deterioration by economic activities can be distinguished:^a

- Reduction or abstention from economic activities
- Substitution of the outcomes of economic activities, that is, production of other products or modification of household consumption patterns
- Substitution of the inputs of economic activities without modifying their outcomes (outputs) by applying new technologies
- Activities to prevent environmental deterioration without modifying the activities themselves, for example, by end-of-pipe technologies
- Restoration of the environment and measures diminishing the environmental impacts of economic activities.

The calculation of imputed depletion costs depends on the specific type of activity considered. When depletion, for example, of biota or freshwater, results in a reduction of economic production, the value added foregone caused by diminished production activities could be taken as the imputed costs at maintenance value. In the case of substitution, additional substitution costs could be used for calculating those costs. If new environment-friendly industries have to be established to avoid a decrease in output, the incremental costs could be calculated for estimating depletion costs. Alternatively, the allocation of a part of the operating surplus, the user-cost allowance, for alternative investment has been proposed.

In the case of discharging residuals, different types of activities could be carried out to adhere to environmental sustainability standards. These activities include the reduction in production and household consumption, modifications of the composition of products and of consumption patterns, technological changes to introduce environment-friendly technologies, as well as end-of-pipe technologies. The choice of activities for calculating the imputed degradation costs of discharging residuals will depend on relative costs and efficiencies. Imputed prevention costs of industries should be based on the most efficient method for meeting environmental standards.

Source: United Nations, *Integrated Environmental and Economic Accounting* (Sales no. E.93.XVII.12) (New York: United Nations, 1993), chap. IV.C.

Note

a. R. Hueting, P. Bosch, and B. de Boer, *Methodology for the Calculation of Sustainable National Income*, (Voorburg, The Netherlands: Central Bureau of Statistics, 1991).

usually local and limited (exceptions are surface mining, pollution from mine tailings, and oil spills connected with the exploitation and transport of crude oil). The application of a weaker sustainability concept, therefore, can be justified in the case of subsoil depletion. This concept would include the possibility of substituting subsoil assets by other natural or human-made assets to maintain income levels (rather than particular categories of natural capital). The above-described user-cost valuation caters to this approach.

The maintenance-cost concept implies that uses of the environment that have no impacts on nature have a zero (monetary) value. If, for instance, water that is available in sufficient quantities is used, water abstraction has no maintenance costs. The same holds for fishing and logging if natural growth offsets exploitation. The disposal of residuals in natural media has no maintenance costs if nature can safely absorb these residuals. The deterioration of natural assets can also be partly or completely offset by activities that aim at restoring the natural environment. In fact, the value of the environment could even

be enhanced. Those restoration/enhancement costs are already included in the conventional SNA as gross capital formation and would be treated in a manner similar to reforestation of virgin forests, discussed above in section II B.

Obviously, the value of the maintenance costs depends on the—hypothetical—restoration, replacement, avoidance, or prevention activities chosen. Box 9 lists some of these activities that could be applied under existing conditions of available technologies and knowledge about possible net effects of pollution and depletion. By applying the maintenance valuation as an alternative to market valuation, double counting is avoided in costing the environmental effects in the production accounts.

The actual estimation of maintenance costs of environmental quality degradation can be illustrated by the approach taken in the PNG case study. In this study, three steps can be distinguished:

- *Review of environmental conditions and socio-economic interdependencies.* Figure 4 represents the results of a qualitative review of environmental problems and their causes in terms of

Figure 4. Impacts on environmental quality—Papua New Guinea

On		Agriculture	Forestry	Fishery	Mining	Energy (hydro)	Transport (marine)	Manufacture	Government (municipalities)	Households	Natural events	Rest of the world
From												
Water	Fresh	Some			Considerable	Some					Some	
	Marine	Some			Considerable		Some	Some	Some	Some		
Land/soil		Some	Some		Some	Considerable					Some	
Air												
Biota/habitats	Marine			Some	Considerable	Some	Some				Some	
	Forests	Considerable	Considerable		Some							
	Other			Some	Some							
Cultural values		Some	Considerable		Some	Some						
Rest of the world ^a					Some							

a. Imports/exports of residuals.

	No significant impacts
	Some (potentially significant) impacts
	Considerable impacts

Source: Peter Bartelmus, Ernst Lutz, and S. Schweinfest, "Integrated Environmental and Economic Accounting: A Case Study for Papua New Guinea." Environment Working Paper no. 54 (Environment Department, World Bank, Washington, D.C., 1992), 28.

impacts on environmental media within and beyond (on the "rest of the world") the country from sectors of production, the government, households, nature ("natural events"), and the rest of the world.

- *Measurement of physical impacts from socioeconomic activities.* The data base for impacts on environmental quality from soil loss/erosion and residuals of economic activities has been weak in PNG. There is no independent nation-wide monitoring of emissions or ambient concentrations of pollutants, nor of the contamination of biota and humans. Information on environmental effects is thus either of a descriptive nature or produced as part of an "environmental plan" or impact assessment for selected projects such as logging, hydropower development, or mineral exploration. The situation is similar in the case of soil loss through erosion where only selected local

or provincial surveys have been carried out in the country. Thus, one obvious conclusion from the data search in this study is the need for more comprehensive monitoring and data collection—not only for environmental accounting but also for environmental management. Methodologies for the development and compilation of environmental statistics and indicators have been proposed by UNSTAT.¹⁹

- *Valuation/costing.* Three types of valuation have been applied, in some cases alternatively, in PNG. Avoidance and restoration costs represent maintenance cost valuations. Compensation costs are based on negotiations between those agents causing environmental impacts (companies, government) and those affected by them (landowners). This type of valuation can be interpreted as a simulation of markets for trading environmental effects. Box 10 provides details on these valuations and their results.

Box 10. Valuation of environmental impacts in Papua New Guinea

Avoidance costs: Two types of avoidance costs were estimated for the environmental impacts (discharge of tailings destroying downstream aquatic life) of the mining sector. The conservationist option of closing the mines provided an upper-limit value of value added foregone of 432 million K p.a. (1986-1990). The more realistic approach of constructing tailings dams and/or detoxifying wastes and hauling waste to safer dumping grounds provided cost estimates between 35.7 million K and 101.2 million K p.a., if an earthquake-proof solution is applied. The example illustrates the significance of choosing between least-cost and most-efficient strategies that may involve considerable value judgments about environmental risks.

Restoration costs: Expenditures to remedy losses from flooding and river bed migration (due to soil erosion and ensuing sedimentation) were based on the cost calculations for a "priority work program" in this regard. In line with SEEA procedures those costs of natural events (disasters) were accounted as other volume changes rather than production costs.

Compensation values: Customary land ownership, in combination with traditional compensation requests for "wrongful deeds," have created a unique negotiation process in the field of natural resource exploitation in PNG. Almost all land and water, and related natural resources, are owned by tribal groups or clans. Since local communities shoulder most of the burden of environmental impacts, and direct commercial benefits are accrued by means of direct remuneration of services or payments of royalties, additional compensations typically reflect environmental or environment-related social and cultural value losses in connection with resource exploitation. Compensation for losses of social, cultural, and ecological values has been established through negotiation of landowners and the government with logging companies. In principle such compensation would be reflected in the cost accounts of these companies and consequently in conventional national accounts. However, actual disbursement of compensations rarely occurred. Those amounts were therefore applied in valuing environmental effects resulting from logging and forest clearing for shifting cultivation.

IV. Implementation of Integrated Accounting

A. National Programs of Environmental Accounting

At the outset of any national program of integrated accounting, there should be a clear perception of the overall objectives, the accounting framework, data availability, and the mode of implementation. Such an approach would facilitate the effective coordination of data gathering by different agencies. Elements of implementing a strategy could include pilot, benchmark, and annual compilations as well as special studies. Initially, gaps would have to be filled with rough estimates; later, these estimates should be replaced by more reliable data. A national program of environmental accounting should be long-term (say ten to twenty years) because the statistics required take a long time to be developed and the analysis of some environmental effects may require long time series.

1. *Pilot compilation.* A pilot compilation of environmental accounts would start with the development of an accounting framework and

supporting software. When determining the scope and classifications of such a framework, data availability and analytical objectives should be taken into account. Data availability should, however, not be the most restrictive factor because the framework should be designed for long-term analysis allowing for improvement in the data base. The pilot compilation would be based on existing statistics. Considerable data gaps can be expected at the start of the program, requiring estimates as illustrated above in Section III A 3 in the case of PNG.

However weak in terms of data, a pilot compilation serves important purposes. It would familiarize national staff with the concepts and methods of integrated accounting, assist in setting up coordination mechanisms (see Section IV A 5), and, last but not least, guide future data development. At the end of the pilot phase, data reliability, compilation methodology, and coordination mechanisms should be assessed and a course of action set for future work.

Based on past experience, it is suggested that the pilot compilation be carried out as an interdisciplinary research program in which the statistical office and universities or research institutes

play key roles. Approximately one year would be required to conduct a pilot study of integrated accounting in a country.

2. *Benchmark compilation.* A benchmark compilation would be similar in scope to a pilot compilation but would be carried out, not at the beginning, but in the course of the long-term program, possibly every five or ten years. Its purpose would be to update the economic-environmental data base as a basis for time series analysis (extrapolations). Benchmark compilations of integrated environmental accounts thus would make use of extensive data sets that accumulate over time and would incorporate the results of detailed environmental studies (see Section IV A 4).

Preferably, the benchmark compilation would coincide with a similar benchmark compilation of the national accounts. In this case, the national accounts data could be used as the point of departure for the compilation of the environmental accounts, notably the first-step version of the SEEA (see Section II A).

3. *Annual compilation of reduced-format accounts.* The compilation of pilot and benchmark studies is costly and time consuming since a large variety of economic and environmental data needs to be integrated in a common accounting framework. In general, it would not be possible, therefore, to carry out such compilation annually. In addition, the coordination mechanisms between institutions would most probably be overtaxed on an annual basis.

It would be advisable, therefore, to carry out annual compilations in a reduced format and with a lesser degree of integration between economic and environmental data. One possible scenario for an annual compilation would be a reduced-format presentation of national accounts, supplemented by environmental data that would summarize the changes in environmental cost and capital used in various economic activities. Summary presentations of the most important natural asset accounts could also be prepared in this approach of reduced-format accounting. UNSTAT has developed a Personal Computer (PC)-oriented compilation methodology that would not only serve the implementation of the SNA but also facilitate the implementation of SEEA as (reduced) satellite accounts.

The actual scope of the annual compilation would depend on available staff resources, statistical expertise, the extent to which coordination between the national accounts and environmental accounts compilations have advanced, and analytical requirements and priorities for policy formulation and evaluation (see Section V).

4. *Special studies.* Once the framework for environmental accounting has been established, it also can serve in implementing special studies that aim at improving the data contents and analysis of particular sectors of the framework. One type of studies could focus on the asset accounts for in-depth studies of particular natural assets. Those studies would elaborate the highlighted blocks in selected asset columns of figure 3. Detailed inventories of natural resources would measure not only asset stock but also changes therein and their economic and non-economic causes. Examples of such studies are the *Philippines Forest Resources Accounts*²⁰ and a more experimental compilation of crude oil and natural gas accounts in Canada.²¹ The use of the SEEA framework would avoid the risk of non-compatibility with national accounts concepts and procedures, a major drawback of ad hoc studies carried out outside the national statistical services.

A second type of special studies could focus on the industries causing the depletion and degradation of the environment. They either could deal with one specific aspect of depletion or degradation across all industries, or with specific industries, assessing their contribution to different kinds of environmental impacts. Those studies would reflect data compilation and analysis across the rows of figure 3.

Finally, in-depth studies also could be undertaken at a more restricted geographical level such as an ecological zone of particular interest (value) in the country or an administrative entity (province, state) in which the sustainability of development activity is at particularly high risk. Interest in such a regional approach has been expressed in the context of country projects of integrated accounting in China and Indonesia. There is an advantage in compiling environmental data at the local/regional levels that, however, might be offset by lack of information on eco-

conomic production and capital formation in the region and transboundary flows, usually unavailable in the required detail at subnational levels.

5. *Coordination of national activities.* Integrated environmental-economic accounting requires the integration of data from different subject areas. Those data usually are dispersed over a large number of line agencies, departments, or institutions, unless a comprehensive program of environment statistics has been established in the country. From the outset, effective mechanisms of coordination and cooperation among those agencies need to be established to ensure the availability of data for their incorporation into the accounting framework.

Coordination could be carried out by an inter-institutional committee with representatives of the national statistical office or the agency responsible for compiling national accounts, departments dealing with different natural resources (forestry, land/soil, minerals/energy, water), the ministry of finance and planning, and relevant research institutes. Given the technical expertise required for compiling national accounts, the national statistical office usually will have to adopt the lead coordination role in implementing integrated accounts.

This does not mean that actual data collection has to be carried out only by the statistical office, which usually is not familiar with environment statistics such as monitoring data. Rather, a decentralized approach should be taken in which specialized agencies develop and maintain their own data bases but contribute relevant data to the statistical office for incorporation into the integrated accounting system. The first task of the inter-institutional committee would be to agree on a joint work program in which clear commitments to data production and delivery are made.

B. International Cooperation

In the absence of international standards of environmental accounting, many developing and—to a lesser degree—industrialized countries have embarked on one type or other of natural resource accounting in physical terms and/or monetary environmental accounting. The proliferation of concepts, methods, and definitions undoubtedly has advanced the knowledge about “green”

accounting but has yielded hardly comparable results. Worse, in various instances, countries were faced with different protagonists that all attempted to “sell” their own approaches, generating great confusion about the merits and drawbacks of those approaches. In Indonesia, for example, a U.S. nongovernmental organization (NGO), a U.S. university, several governmental agencies of industrialized countries, and a consultancy firm all have carried out accounting studies differing in scope, coverage, and methodology.

The publication of a United Nations handbook on *Integrated Environmental and Economic Accounting* is the result of an international effort to collate the more relevant, that is, feasible, methodological proposals within a common framework. Such a framework would facilitate the interpretation and evaluation of these methodologies as to national use and usefulness. Considering that the generally accepted aim of integrated accounting is the integration of environmental costs and benefits into economic aggregates that account for economic costs and benefits, the obvious choice of a common framework was the worldwide adopted system of economic accounts, the SNA. Moreover, as discussed above, the recently revised SNA already incorporates a great number of environmental concerns, especially of natural resource depletion, in its asset accounts.

While there is still no full consensus on all methodologies in the field of integrated accounting, the interim version of *Integrated Accounting* and its underlying framework, the SEEA, are expected to act at least as the baseline for future national and international activities in natural resource and environmental accounting. Of course, countries or international organizations may modify this baseline approach to better reflect particular environmental conditions, priorities, and statistical capabilities. Experience gained from concrete uses and modifications of the SEEA will be essential in future revisions of *Integrated Accounting*.

As part of its generic mandate to coordinate international statistical activities, UNSTAT has been developing joint program and projects with other international organizations, in particular the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP) and the World Bank. International workshops on natural resource and

environmental accounting were conducted jointly with UNDP in Costa Rica (1991) and China (1993) for Latin American and Asian countries respectively. The workshops generally endorsed the SEEA and requested international assistance in implementing national pilot studies or more comprehensive programs of environmental accounting.

A joint work program between UNEP and UNSTAT has been agreed in which various workshops, seminars, and national projects will be carried out. UNSTAT also has promoted the development of environmental satellite accounts as part of its program to implement the 1993 SNA. A broader "global project" is envisaged for joint activities of UNDP and UNSTAT that will focus on technical cooperation, training, and research, as well as the coordination of international activities. The World Bank has focused on integrating environmental concerns in its macroeconomic sector and project work, in particular, by means of improved statistics and indicators. Such work will be carried out in close coordination with UNSTAT, UNDP, UNEP, and other international organizations, as well as NGOs interested in this field.

V. Use of Integrated Accounting in Planning and Policy Analysis

The "compartmentalization" of human activities and their effects within nations into sectors and areas of environmental, social, and economic concerns; and the neglect of economic and ecological "interdependences" among nations can be blamed as the main reasons for policy failures in both environment and development.²² Figure 4 illustrates some of the economic-environmental interactions in a matrix of economic sectors and their environmental impacts in PNG. The obvious response to this situation is *integration* in assessing interactions and interdependences for integrated policy formulation and evaluation. "Sustainable development" has been advanced by both the World Commission on Environment and Development and UNCED to address effectively environmental and socioeconomic concerns in an integrative and anticipatory fashion.

Integrated accounts can be used, in particular, in the assessment of two major aspects of economic policy: (1) *the sustainability of economic*

growth as conventionally measured by increases in NDP and its main determinant capital formation and (2) *the structural distortion of the economy* by environmentally unsound production and consumption patterns.²³ The former would give rise to macroeconomic policies that would reorient economic growth toward a sustainable—natural and produced capital maintaining—path. The latter would make use of economic instruments of cost internalization into the budgets of economic agents.

The following brief discussion of some policy uses of the results of green accounting is quite tentative. It is based on fairly theoretical analogies of the use of conventional indicators and very limited experience with the possible role of integrated accounting in establishing a national sustainable development strategy.²⁴ Clearly, more experience needs to be gained from country projects that do not stop at the establishment of integrated accounts but pursue their use in integrated policies and management of the economy and the environment. It is from such policy use that environmental accounting will earn its ultimate justification or dismissal.

A. Sustainability of Economic Growth

The above definitions of environmentally adjusted indicators in the SEEA and the application of valuation methods that aim at sustainability of natural (non-produced) and produced capital point to possibilities of modifying key economic policy variables such as output, income and expenditure, capital or profit.

The environmentally adjusted net domestic product (EDP) accounts for the costs and benefits of natural resource depletion and environmental quality degradation and enhancement. Conventional indicators of national income or product typically are used in the measurement and analysis of economic growth. EDP or similar aggregates could therefore be introduced into such analysis, and a definition of sustainable economic growth as an upward trend of EDP could be advanced. Box 11 presents such a definition and discusses its underlying assumptions. Replacing conventional growth indicators, notably GDP or NDP, by EDP and expanding the scope of key variables such as capital and capital formation to include natural capital (use) in dynamic growth models could

thus provide early warning signals about the trends and limits of sustainable economic growth.

Table 4 refers to relatively short time series (1986–1990) for EDP in PNG that would have to be extended and the underlying data base improved for the analysis of the sustainability of growth in the country.²⁵ The table also presents some information on the key determinant of growth, capital formation (Δ CAP). A brief analysis of how the modification of conventional indicators may affect capital formation, productivity, and final consumption is given in box 12.

An additional factor affecting economic growth is foreign trade. In the environmental context, and in particular in PNG, foreign demand for natural resources can be considered as a strong driving force for over-exploitation and under-pricing of non-renewable and renewable resources. Integrated accounts can provide the basic information for input-output analyses that assess the effects of foreign demand throughout the national economy and on the allocation of environmental (depletion and degradation) costs resulting from such demand.

B. Accounting for Accountability

Given the inefficiencies of command-and-control measures in environmental protection and natural resource conservation, the application of market instruments of setting economic incentives and disincentives generally has been advocated.²⁶ These instruments aim at the internalization of external (dis)economies into the budgets of households and enterprises to achieve an optimal allo-

cation of scarce resources in the economy. The rationale behind this cost allocation is reflected in the polluter-pays and user-pays (for the depletion of natural resources) principles. The aim in both cases is to make those who cause environmental problems accountable for their environmental impacts. Economic instruments of cost internalization include effluent charges, user taxes (such as an energy tax based on the carbon context of energy consumed), tradable pollution permits, and deposit-refund systems. Integrated accounting can help define these instruments and measure the appropriate level of incentives (subsidies) or disincentives (charges).

The deduction of environmental costs from conventional indicators of value added does not necessarily imply that these costs are or are about to be internalized by individual economic agents. These costs are imputations that do not suggest any particular role of environmental costs in actual price formation. Such pricing would have to be modelled according to prevailing elasticities of supply and demand. While such modelling of "shadow prices" is beyond the object of accounting, imputed environmental cost information could provide the initial input into such simulations of market behavior of producers and consumers. In fact, full or partial internalization seems to have been carried out in some of the high-risk (accident-prone) and resource-dependent industries. In those cases, accounting for environmental costs merely adjusts net value added to a more realistic value.²⁷

In PNG estimates of environmental depletion and degradation, costs of economic sectors have

Box 11. Definition of sustainable economic growth

Based on possibilities of accounting for the depletion and degradation of natural capital, sustainable economic growth can be defined as:

Positive trend in (real) Environmentally-adjusted net Domestic Product (EDP) that allows for the consumption of produced capital and the depletion and degradation of natural capital, taking into account that trends of depletion and degradation can be offset or mitigated by technological progress, substitution, discoveries of natural resources, and changes in consumption patterns.

Other factors such as the effects of natural disasters, changes in the productivity of human capital, or high inflation and indebtedness also affect the sustainability of economic growth. The allowance for produced and natural capital consumption in the above definition reflects therefore only a "more sustainable" growth concept that requires further refinement (modeling). (Peter Bartelmus, "Accounting for Sustainable Growth and Development," *Structural Change and Economic Dynamics* 3 (2) (1992): 241-60, 244).

Table 4. Comparison of conventional and environmental accounting indicators: Mexico and Papua New Guinea

	Mexico (1985)			Papua New Guinea (1986-1990) ^a		
	Conventional accounts	Integrated ("green") accounts		Conventional accounts	Integrated ("green") accounts	
		EDP 1 ^b	EPD 2 ^c		EDP 1 ^d	EDP 2 ^e
NDP	42.1 billion P	39.7 billion P	36.4 billion P	2 760 million K ^f	2 580 million K ^f	2 580 million K ^f
EDP/NDP	—	94%	87%	—	92-99%	90-97%
C/NDP	83%	88%	96%	89-100%	93-106%	95-109%
Δ CAP (net)	4.6 billion P	2.4 billion P	-0.7 billion P	463 million K ^f	282 million K ^f	228 million K ^f
Δ CAP/NDP	11%	6%	-2%	12-20%	5-17%	3-16%
NDP/CAP	37%	10%	—	59%	—	—

Explanations:

- NDP = Net Domestic Product
 EDP = Environmentally-adjusted net Domestic Product
 C = Final Consumption
 Δ CAP = Capital formation/accumulation
 CAP = Capital stock

a. Lowest and highest percentage (during 1986-1990).

b. Accounting for oil depletion, deforestation (including forest fires) and land use (excluding fish and other species depletion); net-price valuation.

c. Accounting additionally for air and water pollution, soil erosion, ground water use, and solid waste disposal; avoidance cost valuation.

d. Net-price valuation of mineral resources depletion.

e. Potential damage restoration or avoidance cost valuation in the case of waste water discharge (from mining); compensation cost for environmental impacts of forest clearing and dam construction.

f. For 1990.

Source: Mexico: Jan van Tongeren and others, "Integrated Environmental and Economic Accounting: A Case Study for Mexico." Environment Working Paper no. 50 (Environment Department, World Bank, Washington, D.C., 1991); Papua New Guinea: Peter Bartelmus, Ernst Lutz, and S. Schweinfest, "Integrated Environmental and Economic Accounting: A Case Study for Papua New Guinea." Environment Working Paper no. 54 (Environment Department, World Bank, Washington, D.C., 1992).

reached, each, levels of almost half their value added. Together (in the mining sector), environmental costs can be as high as three-quarters of value added. This would indeed call for changing the technological and sectoral structure of the economy, and shifting to resource-saving and low-waste production and consumption patterns.

C. Outlook: Limits and Prospects of Green Accounting

Monetary valuation and economic analysis reach their limits at the point that such valuation becomes arbitrary with increasing remoteness of the results of (non-economic) human activities and natural processes from economic output. Development goals of equity, cultural aspirations, or political stability are difficult to quantify, even in physical terms, and quite impossible to value in monetary terms. An attempt to push monetary valuation further into the realm of non-economic (dis)amenities is the application of the above-mentioned "contingent valuation" to environmental effects on human health and welfare. Well-known difficulties of declared willingness-to-pay in project-oriented cost/benefit analyses seem to disqualify this approach from use in routine accounting at the national level.

A comprehensive concept of development would have to cover all these amenities. The policy focus on monetary measures of economic growth therefore has been criticized by advocates of multi-objective development. Such development should address a variety of social concerns or human needs and aspirations as part of the overall goal of improving the quality of human life. There is growing recognition that long-term planning and policies are needed at the national level to take into account non-economic social, demographic, and environmental variables for achieving sustained development.²⁸

Systems of (environment) statistics and indicators aim at measuring these variables in an integrative, or at least comparable, fashion, providing a synthetic picture of the state and trend of the environment and its links to human socioeconomic activities. For example, UNSTAT is promoting the application of methodologies of environment statistics, organized in *A Framework for the Development of Environment Statistics* (FDES). The framework links social, demographic, and economic statistics of human activities with data on environmental impacts and social responses.²⁹ A substantial program of work in this area also has been set up by the World Bank.³⁰

Box 12. Capital accumulation and productivity in Mexico and Papua New Guinea

Environmental costs are mirrored in the SEEA in volume changes of capital (dis)accumulation. Table 4 shows that the depletion of natural resources (as reflected in an "EDP1" calculation) reduced their value, that is, lowered net capital formation (Δ CAP, net), to nearly half its value, in Mexico (60 percent in PNG). If all environmental costs (reflected in an "EDP2" calculation) are taken into account an actual "disinvestment" was observed in Mexico, while capital accumulation was reduced to less than half in PNG.

Corresponding increases of the share of final consumption indicate patterns of living off the physical (natural) capital base. There are, however, other criteria to measure "living," notably income, which is closer to the measurement of human welfare than production and can be affected by transboundary financial flows. Before coming to any conclusions about sustainable consumption levels those financial aspects of income and its distribution would have to be analysed.

Reductions in capital productivity are reflected in the overall capital-output ratios (NDP or EDP over CAP). Data on total capital stocks were available in Mexico only. They indicated an overall reduction in capital efficiency from 37 percent to 10 percent resulting from natural resource depletion only. Considerable fluctuations among the different economic sectors indicated a quite different picture of capital efficiencies if natural capital is used and accounted for in different production processes.

The desire to obtain more aggregated indices of "development" that do not focus only on economic aggregates but also on other "human values" has prompted the estimation of a "Human Development Index."³¹ Apart from per capita GDP, the index accounts for literacy and life expectancy and can be adjusted for distributional aspects. It remains to be seen whether these efforts to assess integrated and sustainable development in non-monetary terms can prompt decisionmakers to formulate and implement consistent sustainable development policies, programs, and projects.

It took many years to develop the original SNA, and environmental accounting also probably will require many more years before a consensus on its concepts and methods can be reached. Some of the challenges facing the implementation of environmental accounts are the availability of environmental data in the accounting format, valuation of physical data, and the linkage of environmental data to socio-economic statistics and indicators. Thus, the SEEA, as presented in the interim version of *Integrated Accounting*, provides a flexible framework that can be modified according to national priorities, environmental conditions, and statistical capabilities.

High priority should be given to building national capacities for data collection and accounting, required for the implementation of one or the other version of the SEEA. Perhaps the greatest reward in carrying out national projects of integrated accounting may lie in the process of

implementation rather than the actual compilation of modified aggregates. Experience has shown that this process has a strong built-in capacity for data synthesis at different stages of the work, in physical and monetary terms. As a consequence, this process facilitates data interpretation and analysis, already at early stages of an integrated accounting program.

Notes

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Appendix 2

Biographies

Mahmoud Abu-Zeid is Chairman of the Water Research Center in Egypt, which has eleven Research Institutes working in different areas of water resources. Mr. Abu-Zeid received his Ph.D. from the University of California, in 1962. He is also the President of the International Water Resources Association (IWRA).

An educator, **Keith Bezanson** was appointed President of the International Development Research Center (IDRC), Ottawa, in 1991 for a five-year term. He was Administrative Manager of the Inter-American Development Bank, Washington, D.C., from 1988 to 1991 and Canadian Ambassador to Peru and Bolivia from 1981 to 1985. Mr. Bezanson served as Vice President, Americas Branch, of the Canadian International Development Authority (CIDA) from 1981 to 1985 after having been Director General, Multilateral Programs (1978-1981); Regional Director, East Africa Program (1977-1978); and Chief Planning Officer, Economic and Technical Cooperation in Anglophone Africa (1973-1977). From 1964 to 1970 he worked in primary and secondary education programs in Ghana and Nigeria. Mr. Bezanson has a Ph.D. from Stanford University (1972) and a Bachelor of Arts degree from Carleton University, Ottawa (1964). The author of numerous papers and publications, he was awarded the Medal of Bravery by the Governor-General of Canada (1981). He was also awarded an advanced Doctoral Fellowship under the Canada Council (1969-1970), a Ford Foundation Fellowship (1966-1968), and an Honour Award from Carleton University (1964).

Ivan Chéret has been Personal Advisor to the Chairman, Lyonnaise des Eaux-Dumez, Paris, since 1988. Prior to that he was Director of Gas, Electricity, and Coal in the Ministry of Industry (1970-1973); Chairman of Société industrielle de transports automobiles (SITA) (1974-1983); and Senior Vice President of Lyonnaise des Eaux, General Manager of Water Problems (1983-1988). He has been Chairman of the International Training Center for Water Resources Management since 1977. Mr. Chéret holds a degree as Chief Engineer of Bridges and Roadways from the Ecole Polytechnique, and a Groundworks diploma issued by the Office of Reclamation in Denver, Colorado.

Kamla Chowdhry is Chairman of the Centre for Science and Environment, New Delhi. She is also a member of the Technical Advisory Committee (TAC) of the Consultative Group on International Agricultural Research (CGIAR); Chairperson of the All India Council of Management Education; and Founder and former Chairperson of the National Wastelands Development Board in India. Ms. Chowdhry is a board member of several non-governmental organizations. She holds an M.A. in Philosophy and a Ph.D. in Social Psychology from the University of Michigan, Ann Arbor.

For more than fifty years, **Jacques-Yves Cousteau** has explored the earth and been a leading spokesperson for the protection of the global environment and the underwater world. In 1943 he and Emile Gagnan conceived and built the Aqua-Lung,

which gave humanity the possibility of truly exploring the sea. In 1973 he created the Cousteau Society dedicated to the protection and improvement of the quality of life for present and future generations. The Cousteau Society addresses world environmental, economic, and social issues, drawing on Captain Cousteau's status as global witness, conscience, and catalyst. An Emmy Award-winning director, Jacques Cousteau has produced over seventy films for television as well as the Oscar-winning feature films, "The Silent World" and "World without Sun." Captain Cousteau has written or co-written more than fifty books, published in more than a dozen languages. A member of the U.S. National Academy of Sciences, Captain Cousteau has been awarded Honorary Doctor of Science degrees by the University of California at Berkeley, Brandeis University, Rensselaer Polytechnic Institute, and Harvard University. In 1977 he was the co-recipient of the United Nations International Environmental Prize, and in 1985 he was awarded the U.S. Presidential Medal of Freedom. In 1988 he was placed on the United Nations Environment Programme's (UNEP) Global 500 Roll of Honor for Environmental Achievement and in 1989 was inducted into the Académie Française. At the UN Conference on Environment and Development (UNCED) in 1992, he spoke on population and environment issues. He gave the Rafael Salas lecture, sponsored by the UN Family Planning Association, at the UN in 1992. In mid-1993, the President of France named Captain Cousteau the first Chairman of the Council on the Rights of Future Generations, and in 1993 he was named to the High Level Advisory Board of the UN Secretary-General. In addition to planning and directing ongoing expeditions, Captain Cousteau is committed to strengthening the role of the UN in global stewardship and international stability and to raising public awareness of the importance of addressing growing economic disparities between developed and developing countries.

Herman E. Daly is Senior Research Scholar in the School of Public Affairs at the University of Maryland, College Park. Before leaving the World Bank in 1994, Mr. Daly was Senior Economist, Environmental Economics and Pollution Division, in the Environment Department. Prior to joining the Bank in 1988, he was Alumni

Professor of Economics at Louisiana State University. He has taught in Brazil as a Ford Foundation Visiting Professor and as a Senior Fulbright Scholar. He also served as Research Associate at Yale University and as a Visiting Fellow at the Australian National University. Co-founder and Associate Editor of the journal, *Ecological Economics*, Mr. Daly has written many articles and several books, which include *Steady State Economics* (second edition, 1991); *Economics, Ecology, Ethics* (1980); and, with co-author John Cobb, Jr., *For the Common Good: Redirecting the Economy toward Community, the Environment, and a Sustainable Future* (1989). He holds a Bachelor of Arts degree from Rice University and a Ph.D. from Vanderbilt.

Partha Dasgupta is Professor of Economics at the University of Cambridge and a Fellow of St. John's College, Cambridge. From 1989 to 1992 he was also Professor of Economics, Professor of Philosophy, and Director of the Program in Ethics in Society at Stanford University. He has worked in the fields of capital and growth theory, social cost-benefit analysis, resource and environmental economics, industrial organization theory, the theory of incentives, the theory of games, population economics, and the economics of destitution. His most recent book is *An Inquiry into Well-Being and Destitution* (1993). He is a Research Advisor to the United Nations University's World Institute for Development Economics Research, Chairman of the Board of Directors of the Beijer International Institute of Ecological Economics, and Senior Research Fellow of the Institute for Policy Reform. Professor Dasgupta is a Fellow of the Econometric Society, Fellow of the British Academy, Foreign Honorary Member of the American Academy of Arts and Sciences, and Foreign Member of the Royal Swedish Academy of Sciences. He was educated in Varanasi, Delhi, and Cambridge, United Kingdom.

Nitin Desai, a national of India, is Under-Secretary-General for Policy Coordination and Sustainable Development at the United Nations. Before joining the UN, Mr. Desai was Secretary and Chief Economic Adviser in India's Ministry of Finance. Most recently, he served as Deputy Secretary-General of the United Nations Conference on Environment and Development (UNCED),

to which he was appointed in June 1990. Mr. Desai began his government career in 1973 when he joined the Planning Commission of the Government of India. From 1983 to 1985 he served as Secretary of the Economic Advisory Council to the Prime Minister of India. From 1985 to 1987, he served as Senior Economic Adviser for the World Commission on Environment and Development. He has also served as Special Secretary of the Planning Commission of the Government of India. Prior to entering government service, Mr. Desai worked as a consultant for Tata Economic Consultancy Services and lectured in economics at the Universities of Southampton and Liverpool in the United Kingdom. He was a member of the Commonwealth Secretariat Expert Group on Climatic Change and has published on development planning, regional economics, industry, energy, and international economic relations. Mr. Desai received a bachelor's degree from the University of Bombay in 1962 and, in 1965, earned a Master's Degree in Economics from the London School of Economics and Political Science.

Elizabeth Dowdeswell is Under-Secretary-General of the United Nations, Executive Director of the United Nations Environment Programme (UNEP), and Officer-in-charge of the United Nations Centre for Human Settlements (Habitat). Ms. Dowdeswell began her post with UNEP in early 1993. Under her leadership UNEP and Habitat are emerging as leaders among United Nations bodies in restructuring to improve transparency, cost-effectiveness, and accountability, as recommended by the Earth Summit's Agenda 21. She has introduced a results-oriented management approach to shift the focus of staff and programs from accomplishment of tasks to the achievement of results and to instill a client-service ethic. Ms. Dowdeswell intends to promote close collaboration between UNEP, Habitat, and other UN bodies. Before joining the United Nations, Ms. Dowdeswell was Assistant Deputy Minister at Environment Canada and Head of the Canadian Atmospheric Environment Service.

Mohamed T. El-Ashry was appointed Chief Executive Officer and Chairman of the Global Environment Facility (GEF) in July 1994. Formerly, he was Chief Environmental Adviser

to the President and Director of Environment at the World Bank. Prior to joining the World Bank, he served as Senior Vice President of the World Resources Institute (WRI) and as Director of Environmental Quality with the Tennessee Valley Authority. Mr. El-Ashry also served as Senior Environmental Adviser to the United Nations Development Programme (UNDP) and as Special Adviser to the Director General of the 1992 UN Conference on Environment and Development (UNCED).

Roberto Messias Franco is Senior Programme Officer at the United Nations Environment Programme, based in the Regional Office for Latin America and the Caribbean, Mexico City. From 1991 to 1994 he served as President of Brazil's environmental agency, Fundação Estadual do Meio Ambiente de Minas Gerais, Belo Horizonte. Previously, he was Brazil's Secretary for the Environment (1986-88) and Superintendent of Meio Ambiente de Minas Gerais (1983-86). Mr. Messias Franco has been a Professor at the Universidade Federal de Minas Gerais-Instituto de Geo-Ciências (Institute of Earth Sciences) since 1976. He received the Diplôme d'Ecologie et d'aménagement du Milieu Naturel (DGRST/UNES) in Paris in 1972. Prior to that in 1969 he was a Geographer at the Universidade de Minas Gerais, Brazil.

Anne Harrison is the Principal Administrator in the Transition Economies Division of the Statistics Directorate of the Organization for Economic Co-operation and Development in Paris. She has been working in the fields of economic statistics and national accounts for many years, including from 1983 to 1987 in the World Bank. Accounting for the environment has been of particular interest to her, and she has a number of publications in this field including articles in the two compendia prepared by the World Bank on this subject, *Environmental Accounting for Sustainable Development* and *Toward Improved Accounting for the Environment*.

Saad Ibrahim is Professor of Sociology at the American University in Cairo. He is also President of Cairo's Union of Social Professions, Board Member of Al-Ahram Center for Political and Strategic Studies, Trustee of the Arab Thought Forum (Amman), Member of the Club of

Rome, Chairman of the Board of the Ibn Kahldoun Center for Developmental Studies, and President of S. Al-Sabah Publishing House. Mr. Ibrahim was formerly Director of the Center for Arab Unity Studies in Cairo, Secretary-General of the Arab Organization for Human Rights, Secretary-General of the Arab Thought Forum, Secretary-General of the Arab Council of Childhood and Development, and Master Juror of the Aga Khan Award for Islamic Architecture. He has taught at Cairo University, the American University of Beirut, Indiana-Purdue University, DePauw University, University of California, Los Angeles, and the University of Washington. Saad Ibrahim is the author of 15 books and over 100 scholarly articles in Arabic and English periodicals, some of which have been translated into as many as 13 languages. His books include *Sociology of the Arab-Israeli Conflict*, *Kissinger and the Middle East Conflict*, *American Presidential Elections and the Middle East*, *Arabism in Egypt*, *Population and Urbanization in Morocco*, *Bridging the Gap: Intellectuals and Decision Makers in the Arab World*, *The New Arab Social Order*, and *Minorities of the Arab World*. Mr. Ibrahim received the Kuwait Award in Social and Economic Sciences in 1985 and the Jordanian Order of Independence in 1990. He holds a Bachelor of Arts with Honors from Cairo University (1960) and a Ph.D. from the University of Washington (1968).

Janusz Kindler is a Water Resource Planning Specialist in the Middle East and North Africa Technical Department at the World Bank. He joined the Bank in 1992 from his position as Professor of Water and Environmental Systems at Warsaw's University of Technology, Poland, and Director of the Institute of Environmental Engineering at the same university. From 1981 to 1992, he was invited to lecture on water resources management at the Universities of Kyoto, Lund, Budapest, Brussels, Perugia, and Wageningen. His expertise is in water resources and environmental policy analysis and formulation, water resources planning, and demand management. In the 1970s he was responsible for developing a comprehensive plan for the Vistula River system and in the 1990s participated in developing the new Polish river basin management system. Mr. Kindler has worked extensively outside Poland. He was the Chief Consulting Engineer for the

Amarah Irrigation Project in Iraq, worked on the long-term water resources planning in Skane, Southern Sweden, was responsible for the preparation of UNEP's Lake Chad Diagnostic Study and Action Plan, and was involved in preparing UNEP's Aral Sea Diagnostic Study. He co-chaired the task force that in the 1990s prepared the Baltic Sea Action Program and until recently was Chairman of the Board of Trustees of the Regional Environmental Center for Central and Eastern Europe, in Budapest. Currently, Mr. Kindler is working on water resources planning issues in the Aral Sea Basin, Albania, Belarus, and Russia.

David Kinnersley is Former Adviser to the Secretary of State for Environment, United Kingdom. He advises governments and water agencies on legislation and policy including organization and aspects of privatization and regulation in the water sector. His career posts in river basin functions and water utility services included Chief Executive of a regional authority serving a population of 7 million. After advising the UK Secretary of State on setting up the National Rivers Authority, he was an active board member for its early years. Mr. Kinnersley was closely associated with the formation of WaterAid in 1981 as a UK-based nongovernmental organization committed to self-help partnerships in water supply and sanitation in poorer parts of Africa and Asia. He has worked as an adviser in Australia, Eastern Europe, Latin America, Malaysia, and Thailand. He is a part-time consultant to the World Bank and has just completed a book to be published by Penguin in 1994.

Wangari Maathai is the Founder and Coordinator of The Green Belt Movement in Kenya. A native of Nyeri, Kenya, she has a Bachelor of Science Degree from Mount St. Scholastica College in Kansas and a Master of Science Degree from the University of Nairobi. Professor Maathai taught at the University of Nairobi for many years. She is the recipient of several international awards.

Jim MacNeill, President, MacNeill and Associates, Ottawa, is an international consultant and policy advisor on environment and sustainable development. He is also a Senior Advisor to the President of Canada's International Development Research Center and a member of the boards of the Woods

Hole Research Center, Woods Hole, Mass.; the World Environment Center, New York; the International Institute for Sustainable Development, Winnipeg; and the new Wuppertal Institute on Climate and Energy Policy in Germany. Mr. MacNeill was Secretary General and member of the World Commission on Environment and Development (the Brundtland Commission), headquartered in Geneva, and the principal architect and major author of its world-acclaimed report, *Our Common Future*, which sets out a new global agenda for sustainable development. Prior to joining the World Commission in 1984, he was for seven years Director of Environment for the Organization for Economic Co-operation and Development, (OECD), Paris. He was Canada's Ambassador and Commissioner General for the 1976 United Nations Conference on Human Settlements (Habitat), held in Vancouver. His most recent book, *Beyond Interdependence*, written with Pieter Winsemius and Taizo Yakushiji, was published in English by Oxford University Press of New York, in Japanese by Diamond Press of Tokyo, and in Portuguese by Jorge Zahar of Rio de Janeiro.

Shri Kamal Nath was inducted into the Union Council of Ministers and given charge of the Ministry of Environment and Forests in 1991. Mr. Nath joined the Indian National Congress in 1968 as a Youth Worker and was elected to Parliament from the Chhindwara constituency in January 1980. As a Member of Parliament, Mr. Nath represented India in the United Nations General Assembly in 1983 and 1983. He was also a Member of the Parliamentary Delegation to the International Parliamentary Union Conference in Nicaragua (1987), Guatemala (1988), and Cyprus (1990). Mr. Nath led the Indian Delegation to the World Forestry Conference in Paris in September 1991, the UNEP Governing Council meetings in Nairobi in February 1992 and May 1993, the PREPCOM IV discussions in New York in March 1992, and the Kuala Lumpur Conference in April 1992. Emerging as one of the chief spokespersons for developing countries at UNCED in Rio de Janeiro in June 1992, he led the Indian delegation to the first meeting of the UN Commission on Sustainable Development in New York in June 1993. Concurrently, he is President of the Board of Governors of the Institute of Management Technology, Ghaziabad; Chairman, Madhya Pradesh

Child Development Council; President, Delhi Council of Child Welfare; and Patron, Bharat Yuvak Samaj (Youth Wing of All India Bharat Seva Samaj). Mr. Nath was educated at Doon School in Dehra Dun and obtained his Bachelor's Degree in Commerce from St. Xavier's College, Calcutta.

David W. Pearce is Professor of Environmental Economics at University College, London. He has been Chair of University College since 1983. He is also Director of the Centre for Social and Economic Research on the Global Environment (CSERGE). He was Personal Advisor to the United Kingdom Secretary of State for Environment from 1989 to 1992, and is currently Chairman of the United Nations Economic Commission for Europe (ECE) Economics Group on Acid Rain, and Member of the Scientific and Advisory Panel of the Global Environment Facility (GEF). Mr. Pearce has consulted to the World Bank, European Commission, International Union for the Conservation of Nature, Arab Fund, UK Overseas Development Administration, United Nations Conference on Trade and Development, International Labour Organization, and World Health Organization. He has worked in many countries. He is author, co-author, or editor of over thirty books, including *Economics of Natural Resources and the Environment* (1990), *Blueprint for a Green Economy* (1989), *Blueprint 2* (1991), *Sustainable Development* (1990), and *Cost Benefit Analysis* (1972, 1983, 1986). He was educated at Oxford University (Lincoln College): Politics, Philosophy and Economics (1960-1963) and London School of Economics (1964).

Michel J. Petit was appointed Director, Agriculture Research, in the Office of the Vice President, Environmentally Sustainable Development, at the World Bank in July 1994. He had been Director of the Agriculture and Natural Resources Department since 1988. Prior to that Mr. Petit was Professor of Agricultural Economics at Ecole Nationale Supérieure des Sciences Agronomiques Appliquées (ENSSAA), Dijon, France (1968-1988). During that period he took leave to be Program Advisor, Agriculture and Rural Development, for the Ford Foundation in India (1975-1977) and Visiting Research Fellow at the International Food Policy Research Institute (IFPRI) in Washington, D.C. (1983-1984). Mr. Petit is Past President of the European Association of Agricultural Economists

(1978-1981) and of the International Association of Agricultural Economists (1985-1988). He was educated as an Agricultural Engineer at the Institut National Agronomique in Paris (1958); received the Certificat d'Aptitude from Institut Statistiques Université, Paris (1959); and earned a Ph.D., Phi Kappa Phi, from Michigan State University, East Lansing (1964).

Dhira Phantumvanit is President of the Thailand Environment Institute, Bangkok, a post he has held since 1993. Previously, he was Director, Natural Resources and Environment Program, Thailand Development Research Institute (TDRI) (1987-1993); Associate Director, Natural Resources and Environment Program, TDRI (1985-1987); Programme Officer, Industry and Environment Office, United Nations Environment Programme (UNEP), Paris (1983-1985); and Regional Advisor, Regional Office for Asia and Pacific, UNEP (1976-1983). Mr. Phantumvanit was Associate Faculty at the Asian Institute of Technology, Bangkok, with the Division of Environmental Engineering (1981-1983) and with the Division of Industrial Engineering and Management (1975-1983). He was Chief of the Environmental Impact Evaluation Division of the National Environment Board, Bangkok (1975-1976) and Chief of the Technology and Environment Planning Division of the National Economic and Social Development Board, Bangkok (1974-1975). He earned a Ph.D. in Engineering from Texas A&M University (1974) and has a Bachelor's degree in Engineering from Chulalongkorn University, Bangkok (1969).

Lewis T. Preston became President of the International Bank for Reconstruction and Development (IBRD), the International Development Association (IDA), the International Finance Corporation (IFC), and the Multilateral Investment Guarantee Agency (MIGA) on September 1, 1991. He retired on February 1, 1991, as Chairman of the Executive Committee of J.P. Morgan & Co. From January 1980 through 1990 he was Chairman of the Board and Chief Executive Officer, and was a member of the Corporate Office of the Board of Directors from 1976. Mr. Preston joined J.P. Morgan in 1951 and served clients in the southwestern United States and in the commodities industry. In 1966 he was appointed head of the London office and helped guide Morgan's

participation in the then-emerging Eurocurrency market. He was named Executive Vice President in charge of international banking in 1968. In 1976 he was elected Vice Chairman of the Board and a Director of both J.P. Morgan & Co. and Morgan Guaranty. He became President of both companies in 1978. On January 1, 1990 he stepped down as Chairman. Prior to joining the World Bank, Mr. Preston was Director of General Electric Co., Air Liquide, Paris, the Anheuser Busch Co., The Urban Foundation (USA) Inc., and British Petroleum Company Plc. On April 19, 1984, he was awarded the medal d'Officier de la Legion d'Honneur by the President of the Republic of France. On February 28, 1988, he was awarded "The Grand Cross" on behalf of the President of the Federal Republic of Germany (presented by His Excellency Dr. Juergen Ruhfus, Ambassador of the Federal Republic of Germany). He is a Trustee of the Alfred P. Sloan Foundation. Mr. Preston graduated from Harvard College in 1951. Before college he served in the U.S. Marine Corps.

Robert C. Repetto is Vice President and Director of the Program in Economics and Population at the World Resources Institute. He directs research projects on the impacts of structural adjustment on the environment, the economics of sustainable agriculture, incorporating natural resource depletion into national income accounts, environmental protection and the competitiveness of the U.S. Mr. Repetto is the author of numerous publications on economic development, population issues, and natural resource management for sustainable development. Before joining WRI in 1983, Mr. Repetto was an Associate Professor of Economics in the School of Public Health at Harvard University and a member of the economics faculty at Harvard's Center for Population Studies. Previously, he was a Staff Economist for the World Bank Resident Mission in Indonesia, Economic Advisor to the Planning and Development Board for the Government of East Pakistan, Staff Economist for the Ford Foundation in New Delhi and an economist for the Federal Reserve Bank of New York. He is a member of the Science Advisory Board under the U.S. Environmental Protection Agency; the National Advisory Committee to the Center for Tropical Ecology and Conservation, Duke University; and of the Advisory Board for the

Worldwide Fund for Nature program on tropical forests. Mr. Repetto received a Ph.D. in Economics from Harvard University in 1967 and a Master of Science degree in Mathematical Economics and Econometrics from the London School of Economics, and graduated from Harvard College in 1959.

Emil Salim is Former Minister of Environment of Indonesia and Member of the Brundtland Commission, Jakarta. Currently, in Jakarta, he is Teaching Professor at the Economic Faculty, University of Indonesia; Member of the Indonesian Academy of Sciences; Member of the Center for Policy and Implementation Studies (CPIS), Member of the People's Consultative Assembly; and Chairman of the Environmental Science Board at the Post Graduate Faculty, University of Indonesia. From 1978 to 1993 he was Indonesia's State Minister for Population and Environment. Mr. Salim has a Ph.D. in Economics from the University of California, Berkeley (1964).

Sven Sandström is a Managing Director of the World Bank. He oversees the Bank's financial, sectoral, and operational policies; its current programs to promote environmentally sustainable development; and its activities in Latin America and East Asia. Mr. Sandström was born in northern Sweden. He graduated from the Royal Institute of Technology in Stockholm (Dr. Sc. in Civil Engineering), Stockholm School of Economics (M.B.A.), and University of Stockholm (B.A.). He worked as a consultant in Sweden from 1966 to 1968 and as a Research Associate at MIT and Harvard Business School in the United States from 1969 to 1972. Mr. Sandström joined the World Bank in 1972. In the 1970s he worked as a Project Analyst in the Transport, Water and Sanitation, and Urban Development sectors. In the 1980s he held management positions with increasing responsibility for different aspects of the Bank's work, particularly in Africa and Asia. He was Director of the Bank's Southern Africa Department from 1987 to 1990 and Director of the Office of the President from 1990 to 1991. Mr. Sandström was appointed Managing Director in 1991.

Ismail Serageldin is Vice President for Environmentally Sustainable Development (ESD) and

Chairman of the Consultative Group on International Agricultural Research (CGIAR) at the World Bank. Since joining the Bank in 1972, he has designed and managed a broad array of poverty-focused projects in developing countries. Educated at Cairo University and Harvard University, where he earned a Ph.D., Mr. Serageldin is an internationally published author on economic development, human resource issues, the environment, architecture, urbanism, the Arab world, Islam, and culture. His most recent books include *Culture and Development in Africa: Proceedings of an International Conference*, co-edited with June Taboroff (1994); *Development Partners: Aid and Cooperation in the 1990s*, a monograph on the challenge of development assistance overall and the special case of Sub-Saharan Africa (1993); *Saving Africa's Rainforests*, second edition (1993); *Friday Morning Reflections at the World Bank: Essays on Values and Development* (1991); *Poverty, Adjustment and Growth in Africa* (1989); and *Space for Freedom: The Search for Architectural Excellence in Muslim Societies* (1989).

Andrew Steer assumed the responsibility of Director, Environment Department, in the Vice Presidency for Environmentally Sustainable Development at the World Bank in July 1994. He had been Deputy Director since 1992. Mr. Steer joined the Bank in 1978, and was Agriculture Project Officer in Nigeria (1978-1980). Between 1980 and 1984 he worked in the Bank's Resident Mission in Indonesia on economic and urban environmental issues. On return to headquarters he was appointed Senior Economist on Thailand and later Principal Economist on Bangladesh. In 1987 he was promoted to Chief of the Country Risk Division and in 1989 was appointed Senior Advisor to the Bank's Chief Economist and Vice President of Development Economics. He served as Staff Director of the *World Development Report 1992* on Development and the Environment. Before joining the Bank, Mr. Steer taught economics and worked in economic research at the UK Treasury. He holds an M.A. (First Class Honors) from St. Andrews University, Scotland; a Ph.D. in Economics from the University of Pennsylvania, United States; and was a Supervisor of Studies at Cambridge University. Mr. Steer is the World Bank's Representative to the United Nations Commission on Sustainable Development (CSD).

Shams ul Mulk was appointed Chairman of the Pakistan Water and Power Development Authority (WAPDA) in 1994. He graduated from Punjab University of Engineering and Technology in 1954 and started his professional career in the Irrigation Department of North West Frontier Province (NWFP). In 1959 he joined the newly established WAPDA. During his thirty-four-year career in WAPDA he has worked primarily on water resources development projects, including surface irrigation, drainage, and surface storages. His major assignments have been General Manager, Tarbela Dam Project (1979-81) and General Manager, Kalabagh Dam Project (1987-88). In 1988 Shams ul Mulk was appointed by the Government of Pakistan as Member (Water) on the Board of WAPDA, in which capacity he oversaw water sector development, his major responsibilities being irrigation, drainage, and hydroelectric projects. He has been President of the Pakistan Engineering Congress (1989-91) and Vice President of the International Commission on Irrigation and Drainage (1989-92). He attended the June 1991 and May 1992 World Bank workshops in

Washington on comprehensive water resources management policies.

Fernando J. González Villarreal is Director General, Comision Nacional del Agua, Mexico City. He was the Director for the Commission of the National Water Plan from 1976 to 1982. He also served as Deputy Secretary of Hydraulic Infrastructure in the Department of Agriculture and Hydraulic Resources from 1982 to 1988. He has been the Director General for the National Water Commission since 1989. There he directed the work for the formulation of the new national Waters Law, which was enacted in December 1992. Mr. Villarreal has been a teacher at the UNAM Engineering School since 1961 and was a consultant from 1968 to 1970. He also worked as a researcher at the Institute of Engineering at UNAM from 1972 to 1976. He completed his undergraduate studies at the Universidad Nacional Autonoma de Mexico (UNAM) in Civil Engineering and obtained his Master's and Ph.D. degrees from the University of California at Berkeley.

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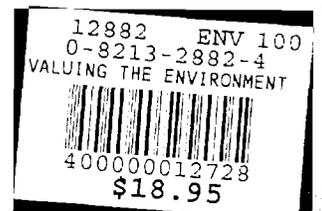
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