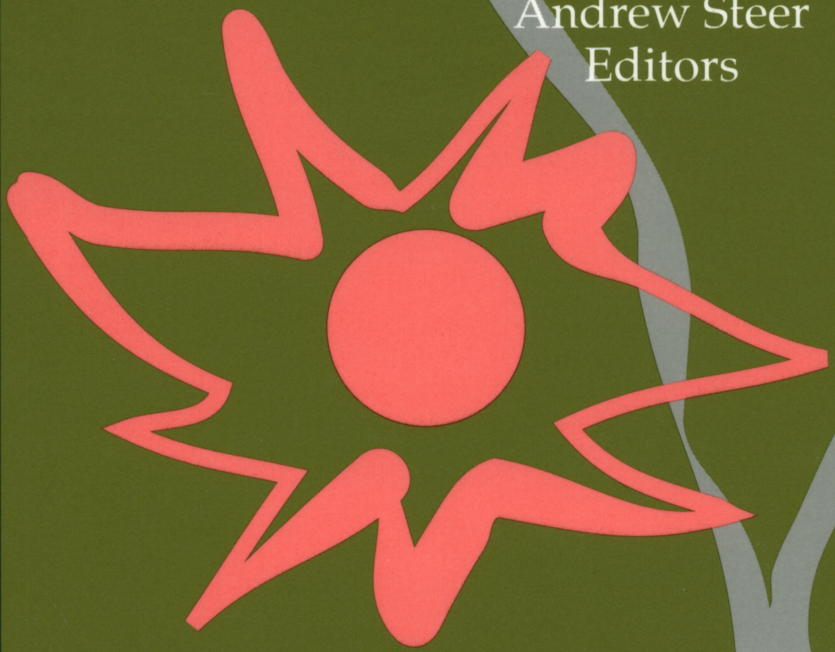
Valuing the Environment

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

ESD

Environmentally Sustainable Development Proceedings Series No. 2

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Alicia Hetzner
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

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 mainstreaming 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 interprovincial 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 deed 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 counties, 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.

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 them 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 globed 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 $C0_2$ 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 concerned 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 smallholder 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 services—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 Modem 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 community 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 comer 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. Naneth), *Making Democracy Work: Civic Traditions in Modem Italy* (Princeton: Princeton University Press, 1993).

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 interconnectedness 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 economics. 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.[3] 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 them 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 zoealth

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:

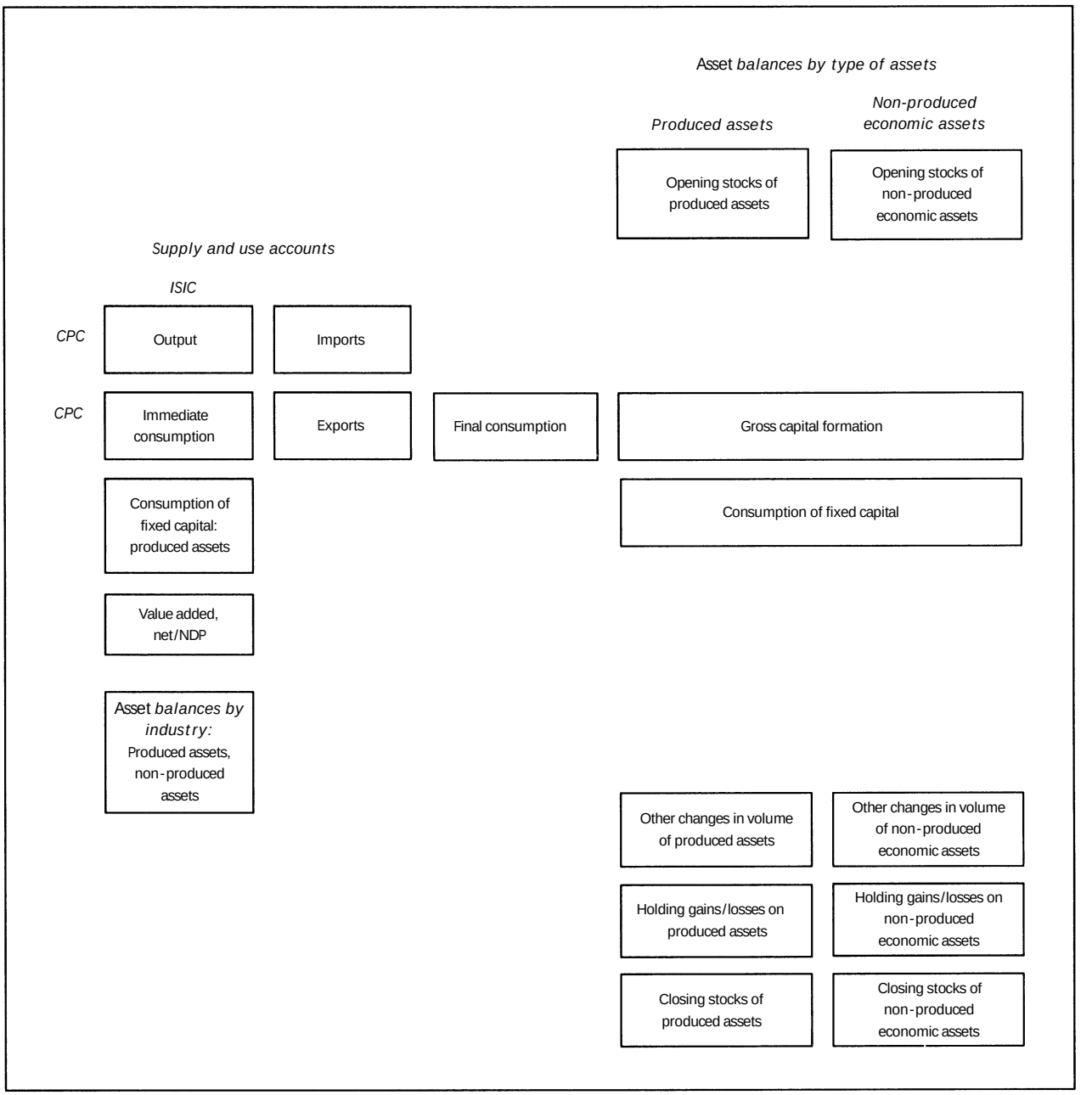
- The supply-use identity:
  - output + imports = intermediate consumption + exports + final consumption + gross capital formation
- The value added identity:
  - value added = output - intermediate consumption - consumption of fixed capital
- The domestic-product identity, which only holds for the economy as a whole:
  - net domestic product (NDP) = final consumption + gross capital formation + (exports - imports).

The incorporation of the asset balances in figure 1 adds mother 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



Exp/anotions:

ISIC = International Standard Industrial Classification of All Economic Activities (United Nations, *International Standard Industrial Classification of All Economic Activities* (Sales no. E.90. XVII. I I) (New York: United Nations, 1990))

CPC = Provisional Central Product Classification (United Nations, *Provisional* Centra/ *Product Classification* (Sales no. E.91 .XVI 1.7) (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 IB). 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.l	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.ll	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.XVn.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 tire market, either directly or indirectly (see Section HI 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.

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)

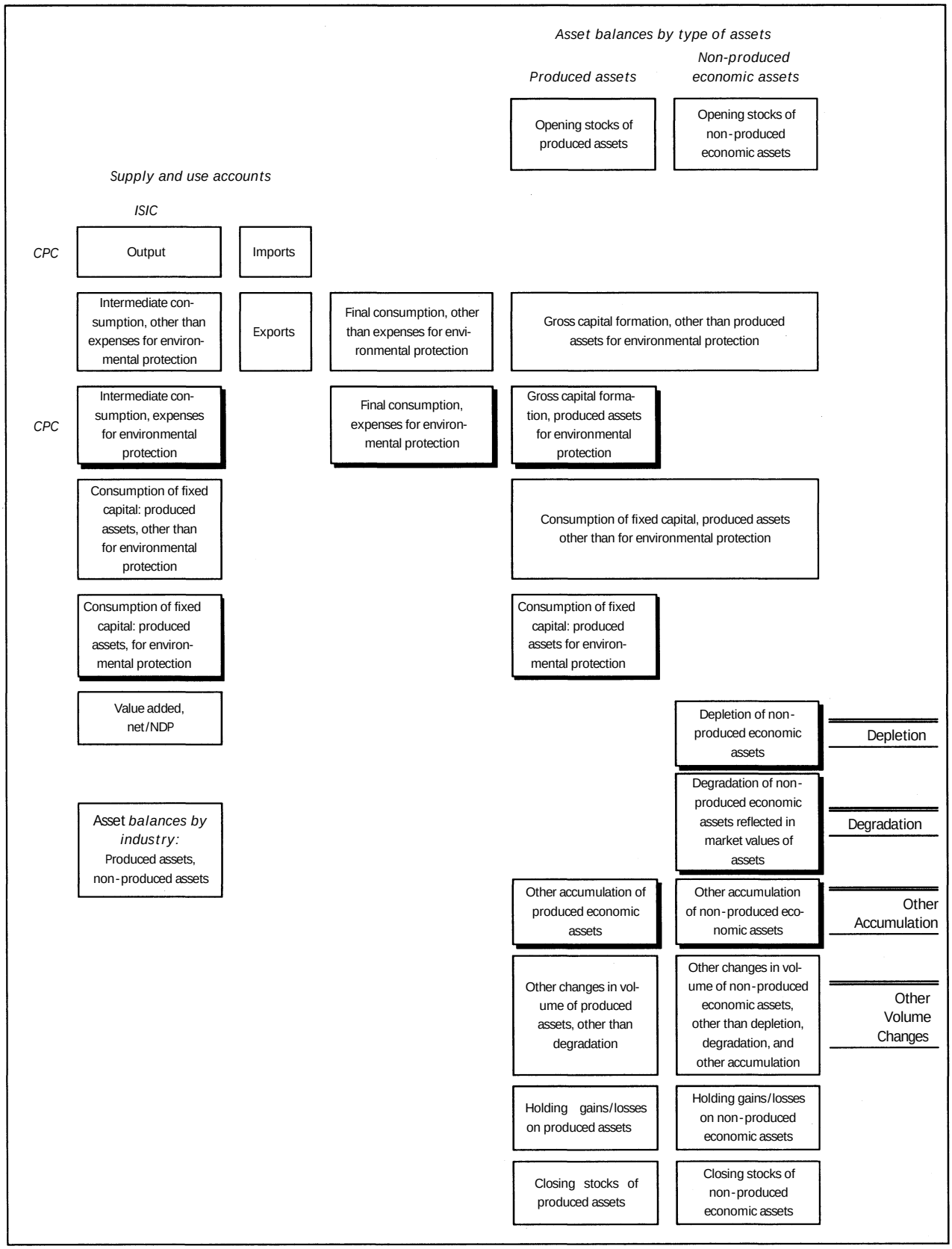
Source: Inter-Secretariat Working Group on National Accounts, *System of National Accounts* (Sales no. E.94.XVn.4) (New York: United Nations, 1993); and United Nations, *Integrated Environmental and Economic Accounting* (Sales no. E.93.XVII.12) (New York: United Nations, 1993), Annex IV.

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 categories 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 I.

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 "extemalization," 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.

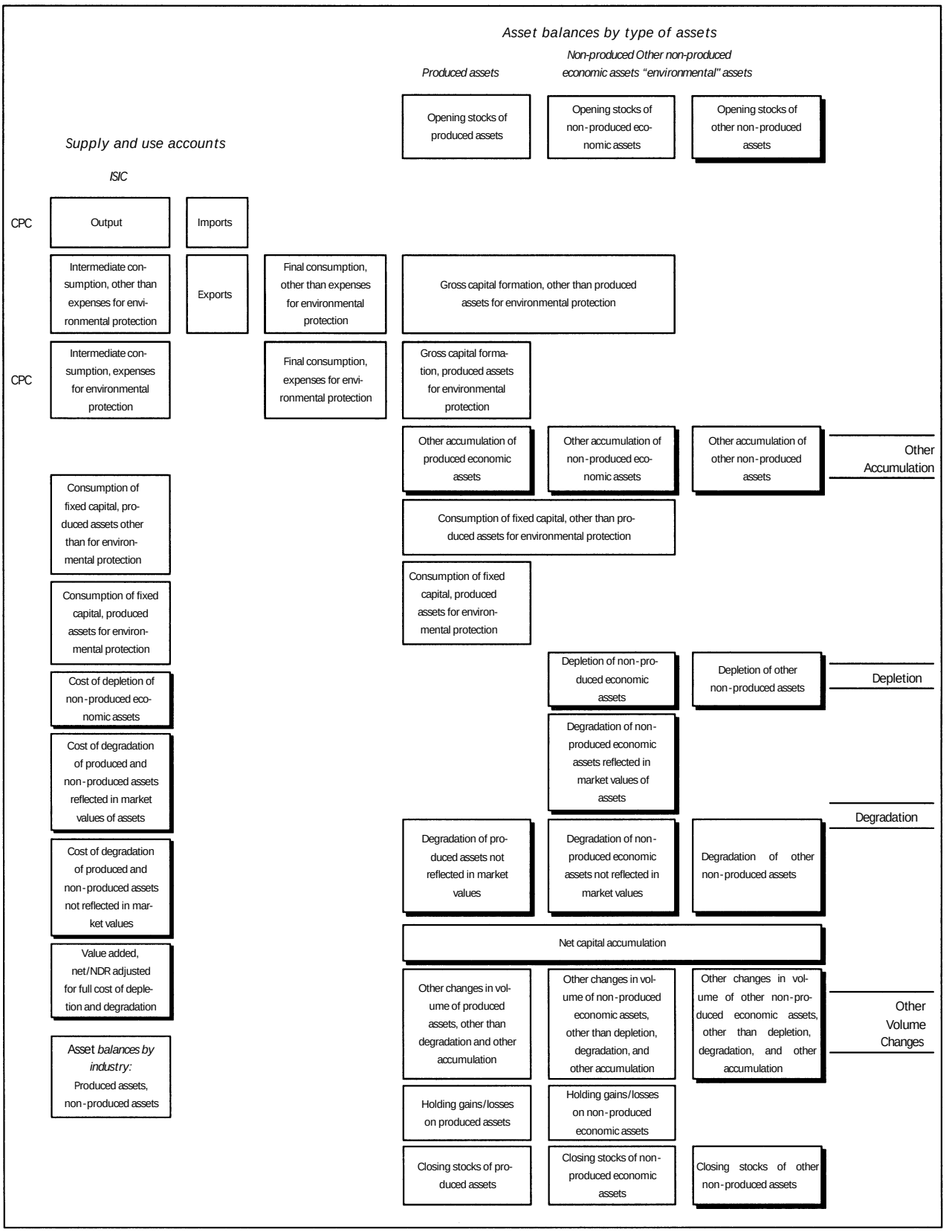
E)epletion of non-produced economic assets refers to the depletion of natural resources. Degradation of those assets (part of K6 in SNA; see box 3) includes quality changes (including restoration of quality) and degradation of land and other non-produced natural assets due to economic uses or due to 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 pretreatment 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 I.

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 HI. 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 ID 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 nation—are also accounted for in the SEEA according to cost-caused or cost-borne principles (by residents or die "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. in).

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. E)eduction 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 IB, 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.

Box 6. Capital accumulation in EDP calculation

SNA defines Net Domestic Product as:

$$NDP = C + J + (X - M).$$

If net capital accumulation in produced and non-produced economic assets ($A_{p\,ec} + A_{np.ec} - A\wedge\wedge J$) replaces net capital formation (I), the identity becomes:

$$EDP = C + (A_{pec} + A_{np.ec} - A \setminus + (X_{np.env} - M)$$

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
Anpec = Net capital accumulation in non-produced assets.
Atrpen∇~ 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 ($-A_{np.}\wedge$ 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:

$$EDP + V- = C + (V + A_{np.ec}) + (x\text{-Ag-}$$

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 HI 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 accounting 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.

2. *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_Q of a natural resource is the sum of the expected net revenue flows N_tQ_t, discounted at nominal or real interest rates r for the life T of the asset:

$$V_0 = \sum_{t=0}^{T} \frac{N_tQ_t}{(1+r)^t}$$

where N_f 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 LQ_f 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:

$$V_t = (P_t - C_t)R_t = N_tR_t$$

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.® 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. Bom, *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, die 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 ihe 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 ťin 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 I. Measurement and valuation in natural resource accounts

	Forests	*Minerals/oik*	*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[6]	Discoveries, upward revisions		
3. Reductions (depletion and part of other volume changes in the SEEA)	Harvesting, deforestation (forest conversion[6]), logging damage (waste[6]), fire damage, stand mortality[1]	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*[1]	Rer-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[1]	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 onfy*-[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 Bom, 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. Sol6rzano 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	NA
Closing stocks	2,648.7	3,683.7	1,584.4	-154.7*	NA

Note: The data presented reflect vanous 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:*

- 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.

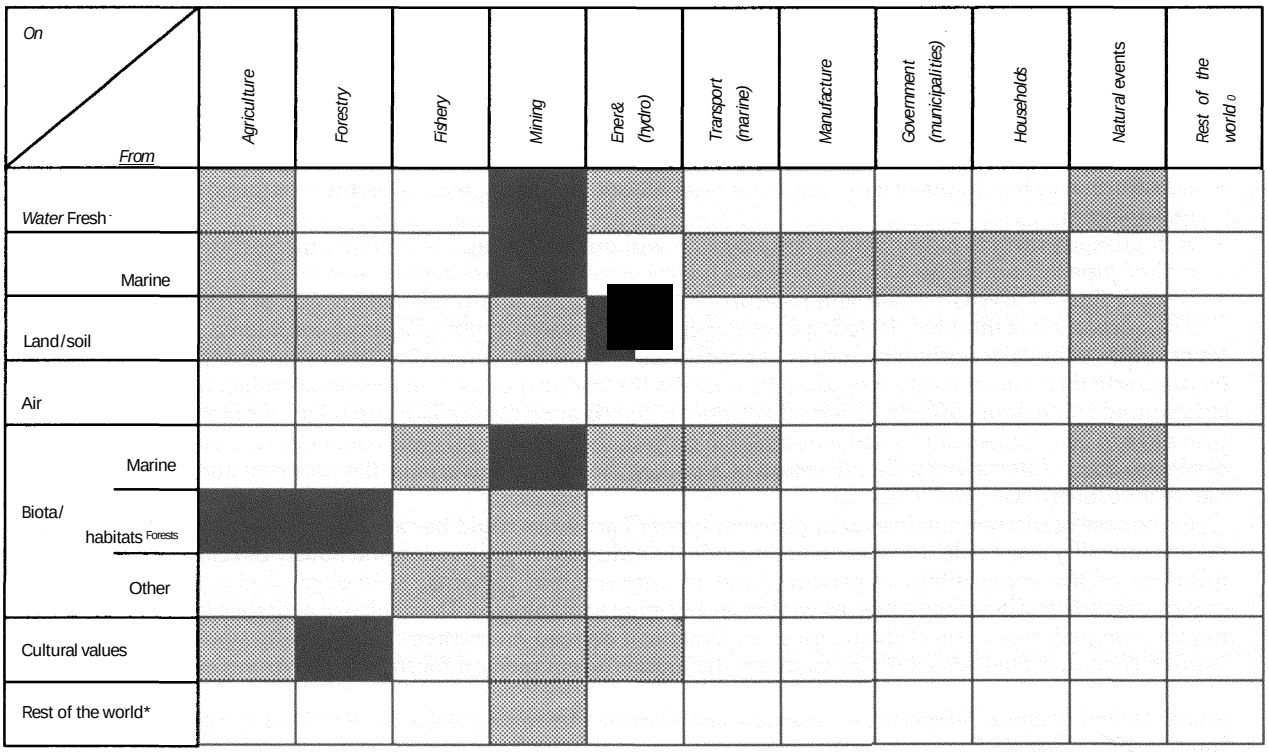
The maintenance-cost concept implies that uses of the environment that have no impacts on nature have a zero (monetary) value. If, for instance, water that, is available in sufficient quantities is used, water abstraction has no maintenance costs. The same holds for fishing and logging if natural growth 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 IIB.

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 socioeconomic 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



a. Imports/exports of residuals.

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 HI 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 die 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-

nomic 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 dismissed.

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 (ACAP). 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 allocation 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 Now Guinea (1986-1990)**		
		Integrated ("green") accounts			*Integrated ("green") accounts*	
	Conventional accounts	*EDP /[b]*	*EPD2[c]*	*Conventional accounts*	*EDP /[d]*	*EDP P*
NDP	42.1 billion P	39.7 billion P	36.4 billion P	2 760 million K*	2 580 million K?	2 580 million K*
EDP/NDP	–	94%	87%	–	92-99%	90-97%
C/NDP	83%	88%	96%	89-100%	93-106%	95-109%
A CAP (net)	4.6 billion P	2.4 billion P	-0.7 billion P	463 million Kf	282 million K*	228 million K
ACAP/NDP	1 1%	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
A 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. Fbtentia! damage restoration or avoidance cost valuation in the case of waste water discharge (from mining); compensation cost for environmental impacts of forest cleanng 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, Vtoshington. 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 (ACAP, 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 socioeconomic 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.

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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 (CGLAR); 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, Rensselear Polytechnic Institute, and Harvard University. In 1977he 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 Frarujaise. 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, Fundagao 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 Natural (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 Water Aid 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 PREPCOMIV 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 Dim 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 Appliqueés (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 Universite, 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 Chulalongkom 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 Pic. 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 bom 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 'Wee 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.

The World Bank

Headquarters
1818 H Street, N.W.
Washington, D.C. 20433, U.S.A.

Telephone: (202) 477-1234
Facsimile: 202) 477-6391
Telex: MCI 64145 WORLDBANK
MCI 248423 WORLDBANK
Cable address: INTBAFRAD
WASHINGTONDC

European Office
66, avenue d'leńa
75116 Paris, France

Telephone: (1)40.69.30.00
Facsimile: (1) 40.69.30.66
Telex: 842-640651

Tokyo Office
Kokusai Building
1-1, Marunouchi 3-chome
Chiyoda-ku, Tokyo 100, Japan

Telephone: (3) 3214-5001
Facsimile: (3) 3214-3657
Telex: 781-26838

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