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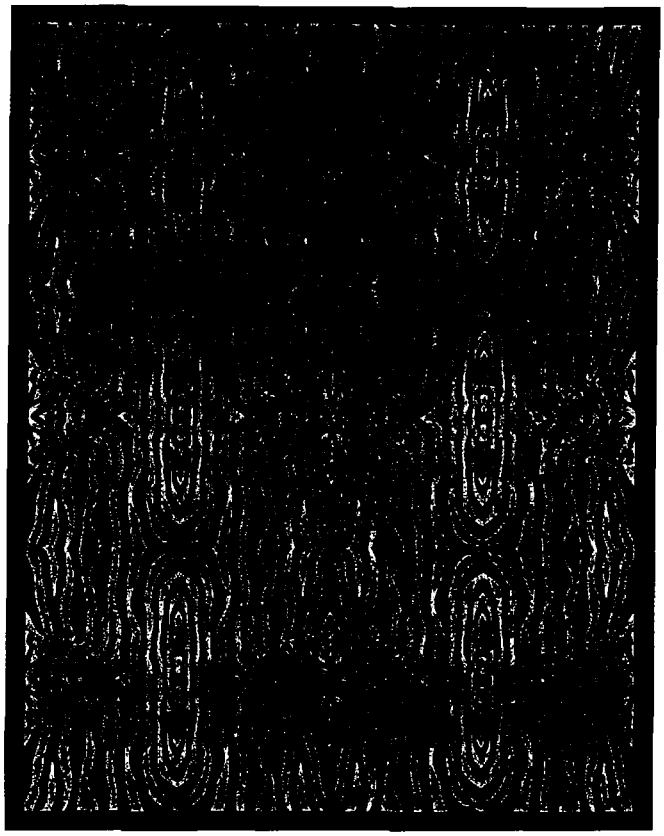
Applying Environmental Economics in Africa

Frank J. Convery



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FOREWORD

In 1993 the World Bank launched a Capacity Building in Environmental Economics Program to support the National Environmental Action Plans (NEAPs) that are emerging across sub-Saharan Africa. With financial support from Norway and Sweden, the World Bank has initiated three activities: (1) short-term training for NEAP economists, (2) grants to fund applied studies and (3) the development of texts for training in environmental economics.

This publication is a part of the program's efforts to channel the rapidly expanding theory and practice of environmental economics into an accessible format. The document is based on both the author's in-depth knowledge of the state of the art of environmental theory and practical field experience working in support of NEAPs across Africa. The text has been subject to internal and external review at several stages.

Environmental economics can contribute to environmentally sustainable development in several ways. First, it can analyze the links between macroeconomic and sectoral policies and the environment. Second, environmental economics can enhance a System of National Accounts to better reflect the costs and benefits of economic growth to the environment. Third, it is essential to the rational choice of environmental policy instruments. Finally, environmental economics allows for the inclusion of environmental values in project appraisal and evaluation.

As the author remarks, economics is "the science of choice." This text's broad coverage of environmental economics is offered as a contribution to the NEAP process at a stage when general policy declarations have to be confronted with the reality of scarce resources.

KEVIN CLEAVER
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ABSTRACT

Environmental concerns must be integrated into the development process, but African countries still face many challenges as they work to achieve development that is economically, socially, and environmentally sustainable.

Many countries have already launched National Environmental Action Plans (NEAPs) and National Conservation Strategies; however, in preparing and implementing them, economics was used sparingly because techniques and skills available to do so were in short supply.

This paper was written to fill this gap, to show how environmental economics could and should be used to improve the quality of decision making in the NEAP process. The paper is written for the practitioner in the field who needs to make immediate decisions and cannot wait for more data. After presenting the theory of environmental economics, the text goes on to show its practical application in Africa.

PREFACE

The necessity of integrating environmental concerns into the heart of the development process is now recognized; without such integration, the danger exists that impressive-looking growth, as estimated by measured per capita Gross Domestic Product (GDP), will be achieved at the cost of the health of the citizenry and assets that are not valued in markets, thereby prejudicing future well-being.

But African countries face a myriad of challenges as they work to achieve development that is economically, socially, and environmentally sustainable. To integrate environmental considerations into the development process, a number of countries have launched a process to prepare National Environmental Action Plans (NEAPs) and National Conservation Strategies. In preparing and implementing the first NEAPs, economics was used sparingly because the techniques and the skills available to do so were in short supply. This paper grew out of the desire to fill this gap—to show how environmental economics could and should be used to improve the quality of decision making.

I have written the piece for the practitioner in the field—the decision maker or analyst who cannot wait for more data and research and needs to shape decisions being made today.

The text is drafted in an easy-to-read style, accessible to noneconomists with a minimum use of mathematics and graphs. At the same time, I have recognized the importance of basing practice on well-articulated theory; where relevant, I first present the theoretical, followed by practical case studies showing its application in the African context.

Applying economics usefully in the field is as much art as science. This encourages readers to develop their creative instincts and to cultivate a sense of intellectual adventure that will yield new insights, thereby enriching the quality of decisions.

I have spent a few weeks each with the National Environmental Action Plan teams in Ghana, Madagascar, Mauritius, and Uganda, attempting to apply economic concepts to their endeavors. In each case, I was given every support, encouragement, and assistance in my work, not just by the teams themselves but by numerous civil servants and executives in their national administrations, who provided data and advice unstintingly. Perhaps more important, they ignored the hubris implied in aspiring to analyze such large issues in so a short time and indulged me. In Ghana, Dr. Kwadwo Tutu of the University of Ghana provided valuable linkage to the work of professional economists in the field.

When the commitment of government is substantive, the NEAP teams do remarkable work with limited resources. They inspired this paper, which is designed in part to allow them to embrace the rich insights that economics can offer and to do so in practical ways.

At the World Bank, numerous individuals have supported this concept in word and deed. These include François Falloux, who gave me my first opportunity to apply environmental economics in Africa, Cynthia Cook, who was the World Bank facilitator of the NEAP process in Ghana when I began work there, Jonathan Brown and Michael Rathnam, who brought me into contact with the NEAP process in Mauritius, and Brian Falconer, who was the link to my work in Uganda. These individuals were not merely conduits to the job. They encouraged, stimulated, criticized, and at times provoked, but always they were positive and useful. Some of the ideas were tested in courses; I am grateful to Patrice Harou and Del Fitchett of the Economic Development Institute, who organized them and who also acted as *animateurs* and critics.

A number of reviewers provided very useful feedback on earlier drafts. These include Noreen Beg, Robert Clement-Jones, Jose Furtado, and

Monika Huppi—all of the World Bank—and Sylviane Gastaldo (INSEE, France) and Grant R. Milne (Zimbabwe Natural Resources Management Programme).

Finally, this volume would not have seen the light of day without the constant practical and psychological support of Jan Bojö, who orchestrated internal arrangements with the World Bank and ensured that an easily distracted author gave the manuscript timely attention. Pam Cubberly deserves special mention for her editorial and layout work.

I am deeply grateful to all of the above, The usual disclaimer applies.

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Chapter 1

Introduction

1.1 The National Environmental Action Plan (NEAP) Concept

In 1987 a few African countries began the process of National Environmental Action Planning (NEAP).[1] By August 1994, 38 countries were so involved. The Rio Earth Summit in June 1992 called in its "Agenda 21" for the preparation of "country-driven sustainable development strategies." A number of countries have adopted the NEAP process as their means of responding to this call. The salient features of the NEAP process and the lessons yielded by experience thus far are presented by Falloux, Talbot, and Larson (1991). A much more complete treatment of the philosophy, development, and practice in this domain in Africa is provided by Falloux and Talbot (1992) and Talbot and Falloux (1993). As a complement to the African experience, it is worth reviewing recent developments in applying the NEAP concept in Central and Eastern Europe. A ministerial conference in April 1993 approved an Environmental Action Program for this region. Economic analysis is used throughout that document to indicate how to set priorities, how to identify and evaluate policy reforms, how to build better institutions, and how to establish priorities for environmental expenditure (Environment for Europe 1994).

The essence of the process is captured by the word "action." A country begins the process of identifying its environmental assets, issues, and problems and the causes of environmental degradation. The latter typically embrace poor information, inadequate assignment of property rights, deficiencies in institutions and laws, insufficient indigenous capacities in management and technical areas, and environmentally perverse incentives. Solutions, embracing institutional development, changes in laws and regulations, investment in information, infrastructure, education, and changes in incentives, are identified, as are needs in those cases where the causalities and solutions are not known. Action to address these solutions proceeds incrementally as part of a rolling program, which can be modified as learning proceeds. Some countries prepared National Conservation Strategies, which can form the basis for a NEAP.

Preparing a NEAP that commands popular and effective political support is difficult and time- and resource-consuming. Achieving action and implementation is even more demanding. Notably, the list below shows relatively few completions; full implementation is still confined to a few countries.

Central to the success of the process is the ownership and control of the process by the countries participating and involvement of a wide range of interests. These should include nongovernmental organizations (NGOs), local communities, and the general public, which provide both information on issues, choices, values, and possible solutions and on popular backing, which encourages implementation.

The interest of prospective donors is typically engaged early on. This facilitates getting their support once financial needs can be identified. In December 1990, following the inaugural meeting in Dublin of those involved in the NEAP process in Africa, the Network for Environment and Sustainable Development in Africa (NESDA) was formed as an informal *animateur* for the process

[1] NEAP is an acronym that is used frequently throughout this book. It can refer to the plan itself or to the planning process, depending on the context.

Box 1.1: African Countries Involved in the NEAP Process

As of August 1994 the following countries were involved:

Country	*Status*
Benin	Completed
Botswana	National Conservation Strategy completed in 1990.
Burkina Faso	Completed
Burundi	Completed
Cameroon	NEAP well advanced
Cape Verde	Completion expected before July 1995
CAR	Completion expected before July 1996
Comoros	Completion expected before July 1995
Congo	Completion expected before July 1995
Côte d'Ivoire	NEAP well advanced
Djibouti	Completion expected before July 1995
Ethiopia	National Conservation Strategy completed
The Gambia	NEAP completed, implementation under way
Ghana	NEAP completed, implementation under way
Guinea	Draft NEAP completed
Guinea-Bissau	Completed
Kenya	Completed
Lesotho	Completed
Madagascar	Completed, implementation under way
Malawi	Completed
Mali	Completion expected before July 1995
Mauritania	Completion expected before July 1995
Mauritius	Completed, implementation proceeding
Mozambique	First phase completed
Namibia	Green Plan completed
Niger	Completion expected before July 1996
Nigeria	Completed
Republic of South Africa	Definition stage
Rwanda	Completed
Sao Tome and Principe	Completed
Senegal	Under way
Seychelles	Completed, implementation proceeding
Sierra Leone	NEAP well advanced
Tanzania	National Conservation Strategy completed
Togo	Completion expected before July 1996
Uganda	Completed
Zambia	Completed
Zimbabwe	In progress, NEAP conference in November 1992

to help those centrally involved to meet their needs, to exchange ideas, and more. NESDA is based in Abidjan.

Some countries, notably Ghana, Madagascar, Mauritius, Nigeria, and the Seychelles, have applied some economic analysis in the NEAP process. In the case of many countries, however, such analysis is absent and, when undertaken, it has been partial, led externally, and not a continuing part of the implementation process.

1.2 Evolution of Environmental Economics

Economics can be defined as the science of choice. Not everything can be done; choices have to be made. Economics helps explain the choices that are made and helps in the evaluation of choices in investment and consumption. Market prices are the signals that drive many decisions. This concept of incentives, reflected in prices and otherwise, is central to the contribution that economics makes to the understanding of behavior. The systemic response to prices of goods, services, capital, labor, and so on makes possible the prediction of outcomes to changes at the levels of the firm, consumer, and nation.

Macroeconomics addresses national aggregates: rates of employment, the money supply, inflation, and level and growth rate of national output.

Microeconomics addresses the level of the firm and the individual consumer, dealing with such things as the responsiveness of consumption and production to price changes, identification of the optimum level of production and consumption, handling of risk and uncertainty, determination of equilibrium, and analysis of imperfect competition.

Welfare economics focuses on the aspects of choice that are relevant for societal well-being; it defines the conditions that must be met if markets are to produce outcomes in production and consumption that are consistent with the maximization of well-being. The area is fraught with difficulty, because it perforce involves addressing individual and collective values, which are difficult to define and quantify in a universally acceptable fashion.

Our environmental endowment can be defined as those aspects of the universe held in common: the air we breathe, the seas we share, the groundwater we draw from, and the vistas and wildlife we enjoy. But, this commonality provides the primary rationale for environmental economics. A key tenet of welfare economics is that, if markets are to behave in a fashion consistent with the maximization of societal welfare, resources have to be owned.

1.2.1 Environmental Economics

Environmental economics concerns ensuring that the manner in which this shared environmental endowment is used is consistent with achieving the best for our economic and social well-being. Environmental economics, although intellectually rooted in the traditions of microeconomics and welfare economics, is perforce also central to macroeconomic management, because the effectiveness with which the environmental endowment is managed will significantly influence the performance of the economy overall.

Pigou (1920) was the first modern economist to focus attention on the rights of future generations in relation to those of the present. He was concerned that our telescopic faculty would result in the rights of our posterity being compromised by the actions of the current generation and by the incidental damage that producers could impose on others in the course of production. He recommended that adjustments be made in taxes, legislation, and incentives generally to encourage saving and to protect natural resources. Coase (1960) disputed the need for action defined by Pigou, demonstrating that, regardless of who has property rights, if negotiations and transactions can take place between those polluting and those affected by pollution, a solution is likely to emerge that accords with the interests of society as a whole.

Over the past three decades, a sustained effort has been made to develop the insights provided by Pigou and Coase and apply the findings to real problems. Led initially by economists at Resources for the Future in Washington, D.C., this work focused on explaining environmental degradation as a consequence of malfunctioning economic signals and articulating the policy changes that would correct for such malfunctions, emphasizing market-oriented solutions, such as charging polluters for emissions to the air and water. Work also addressed the evaluation of environmental (including irreplaceable) assets in the context of project and policy evaluation, focusing on problems typical of developed economies. Only in the past decade has a substantial body of literature appeared that addressed the environmental problems of developing countries; this comprises the literature cited throughout this book.

The development of the field has been informed by the Laws of Thermodynamics. The First Law states that matter can neither be created nor destroyed; it can only be transformed. The environmental challenge then is not to dispose of matter in any final sense, but to order the ways in which matter is used so that the effects are benign now and in the future. The role of economics is to provide insight on how best to achieve such an ordering. The Second Law tells us that, as energy and materials are used, loss occurs because the products of such use cannot be fully recaptured and reused; the perpetual motion machine and 100 percent recycling are chimeras. In his article "The Coming Spaceship Earth," Kenneth Boulding (1966) made an important contribution to our understanding that environmental (and other) frontiers are finally closed on the planet; the "cowboy economy"—in which the environment can be used to dispose of waste and, if one place is degraded, there is another place to go—has had its day. This powerful insight has subsequently been reinforced by the images of "spaceship Earth" provided by space travel and by the problems we face now in managing the upper atmosphere—the ultimate frontier.

The strengths of environmental economics are: that it does indeed provide a powerful model for explaining why degradation takes place and that it also provides pointers on what are likely to be the most effective policies for addressing these problems. But it also suffers limitations: in spite of recent developments, much of the literature is of most relevance in situations in which markets are well developed, where taxing and charging systems function effectively and honestly, and where point sources of pollution are an important component of the total environmental problem. In most African countries, most output remains part of the subsistence economy and so is not readily amenable to the use of traditional price-incentive mechanisms. Most of the problems are diffuse and do not derive from a few readily identifiable polluters who can be targeted for action. To these limitations may be added deficiencies in the availability and quality of data and the complex problems that arise when attempting to place a value on life. The latter is an important issue in Africa, where many of the environmental challenges to be met have implications for health.

This book has been written to help practitioners meet these difficult challenges in Africa.

1.3 Objectives

This book is designed to encourage and facilitate the application of economics in the design and implementation of environmental policies in African countries. As is the case with NEAPs, the perspective taken is that of the country as nation-state. The primary audience consists of those analysts who have the task of applying economics in the NEAP process, but it is hoped that this book may also be of general interest. It is not a step-by-step manual or cookbook. It is designed to show the following:

- Even where data are few and time is short, the economist can make a useful contribution in formulating a National Environmental Action Plan and in its effective implementation.
- Techniques and methods exist that can be brought to bear in this regard.
- These have already been used to good effect in environmental planning in Africa. The prospective analyst need not be intimidated or depressed at the prospect of applying them in his or her country.
- Practical skills can be acquired, but at least as important is the acquisition of a way of thinking about choices.

The book elaborates some techniques but allows plenty of scope for individual analytical initiative. As with the NEAP process itself, the use of economics in this context is in part an exercise in learning by doing. A future volume will be produced that incorporates the fruits of experience from several analysts.

It is hoped that this book will be a useful companion for anyone attempting to apply environmental economics in the field, where data are weak, time is short, skills in economics and allied fields are scarce or nonexistent, and the application of sophisticated techniques is operationally impossible. It is assumed that the overriding con-

Box 1.2: Three Applications of Environmental Economics

I. Cost-Benefit Analysis of Land Improvement in Lesotho by Bojö (1991)

Study Objective: To evaluate the Farm Improvement with Soil Conservation (FISC) project (funded by the Swedish International Development Authority [SIDA]) in Southern Lesotho.

Methodology: The financial costs and benefits accruing to farmers were first estimated. These were then adjusted to account for the fact that the costs and benefits to society as a whole differ in some situations from those accruing to individuals. The costs and benefits were compared using conventional discounting techniques.

Results: The project makes a loss to society that is significant relative to the resources invested.

Implication: The project should not be replicated.

II. Economics and the Environment: A Contribution to the National Conservation Strategy for Botswana, by Perrings, Opschoor, and Pearce (1988).

Study Objective: Integrate economic considerations into the National Conservation Strategy of Botswana.

Methodology: The existing assignment of property rights and the incentive effects of prices and taxes were evaluated qualitatively.

Results: Recommend changes in incentives (taxes, subsidies, charges, and property rights) in project planning and in macroeconomic planning to ensure that the objectives of Botswana's National Conservation Strategy (NCS) are met.

Implication: Change the taxation, grants, and subsidy system to encourage conservation; give communities exclusive use of defined rangeland areas; introduce formal project appraisal; and shift national planning from sectoral to area-based analysis.

III. The Manicaland Health, Water, and Sanitation Program in Zimbabwe: A Social Cost-Benefit Analysis (Fredriksson and Persson 1989).

Study Objective: To evaluate the benefits and costs of a program for the supply of water, provision of latrines, and health education in a region of Zimbabwe.

Methodology: The benefits in improved health were estimated as follows: the benefits of water supply were evaluated as the aggregate difference between what it cost (in time and energy) to get water before the scheme and what it cost after the scheme. The health benefits were based on the estimated reduction in treatment costs, the value of loss of production prevented, and the transportation costs avoided. Input costs of labor and productivity benefits were adjusted ("shadow-priced") to reflect differences between the real and the nominal exchange rates in the economy.

Results: These are very sensitive to the assumptions concerning health benefits but indicate that the program is likely to yield net benefits.

Implication: The project should proceed.

straint in the short term is the scarcity of analytical skill. This imposes a preoccupation, reflected throughout this text, with the establishment of priorities in the effective use of such skills.

The need to make progress should not be associated with any downgrading of the need for an appropriate theoretical structure. The power of the economics discipline flows in part from the adherence of practitioners to such a theoretical structure. The challenge that all economists face when operating in developing countries is how to maintain the necessary theoretical rigor in a working situation where markets are weak or nonexistent and data are poor.

Some economists, especially those from industrial countries, suffer from intellectual grid-lock when faced with the intimidating realities of field application and fall back on a recounting of theory and the general insights that such can yield in the absence of data. This can become a circle of timidity, whereby economists keep to this safe road, repeating the same irrefutable verities; intellectual chastity is preserved, but no specific in-country advance is achieved. This is better than no analysis, but I believe that it is much better to make a first attempt to develop and confront real data, however tentatively. The data-free circle must somehow be broken. I hope that this book will give some insights on how to meet this challenge. NEAP economists are encouraged to pose the following: "If you disagree with my analysis and conclusions, show that you can do better." I hope that the first step will act as an intellectual catalyst, generating responses that lead to more data and analysis in a way that is mutually reinforcing.

1.4 How to Use This Book

An understanding of the sequence, content, structure, and style of the book will help readers to use it efficiently.

1.4.1 Sequence and Content

The underlying philosophy of this book is that the economist has a vital role to play in bringing a consideration of environmental policy and management to the center of a nation's agenda. The economist must meet two imperatives if he or she is to play such a role. The first is technical: to ensure that analysis is as rigorous and as well presented as possible, given limitations of data, time, and other factors. The second is strategic: to ensure that the economist and his or her work is positioned in the policy to be effective. Because the former (analytical rigor) without the latter (strategic positioning) will waste scarce intellectual resources, the content and sequence are designed to help the reader address these two imperatives. The book is organized as follows:

- **Chapter 2: Theory reviewed.** Economics provides a powerful theory on why environmental assets are degraded. This theoretical framework also provides powerful insights on what are likely to be the most effective policies for addressing these problems.

- **Chapter 3: Environmental management as development strategy.** It is all too easy to become obsessed by environment as a problem rather than a dynamic for positive development. Every country in Africa and many elsewhere are grappling with the twin challenges of bringing government expenditure into line with receipts and providing a set of economic, social, and environmental policies that will generate a sustainable development path. The agglomeration of policies addressed to these challenges is called "stabilization and structural adjustment" or simply "structural adjustment." There is considerable debate on the effectiveness of such policies; in practice, they have been implemented with little formal advertence to the environmental dimensions. This chapter introduces the reader to the issues and how to begin the process of linking the environmental dimension to the adjustment process. It also provides insights on how to introduce a positive, developmental perspective.

- **Chapter 4: Underlying causes of environmental degradation: identifying perverse and positive incentives.** The behavior of most individuals, companies, and organizations is shaped by the incentives they face. Inducing changes in such behavior will typically require changes in these incentives. This chapter addresses this issue as it affects environmental performance with particular attention to price incentives.

- **Chapter 5: Nonprice incentives.** Economists can sometimes become obsessed with prices to the exclusion of other influences on behavior. This chapter is designed to introduce some of these other incentive categories, including taxes, public investment, and rent.

- **Chapter 6: Property rights and tenure systems.** How the property rights are allocated gets to the core of every society's political, economic, and social life. But the manner in which property rights are assigned also determines to a large extent how effectively a country's environmental endowment is managed. This chapter introduces this concept and outlines how it can be addressed in the NEAP context.

- **Chapter 7: Focusing on costs: general issues.** It is typically difficult to identify and evaluate benefits. Costs tend to be easier to address, and their analysis can yield powerful and useful insights. This chapter develops this idea and presents some examples of cost analysis.

- **Chapter 8: Estimating gross costs of environmental degradation: a Ghana case study.** It can be useful to estimate the gross costs that environmental degradation imposes on an economy. This chapter illustrates this process for Ghana and in particular emphasizes the compromises and challenges that must be addressed when such an exercise is undertaken over a short time period with limited data.

- **Chapter 9: Evaluation of benefits.** A range of methods exist for valuing benefits when market information is defective or absent. These include: direct valuation (change in productivity, loss of earnings, and defensive expenditures), surrogate market values, replacement cost, and contingent valuation. The strengths and limitations of these are discussed with an emphasis on applications.

- **Chapter 10: Comparing benefits and costs.** To make a recommendation on whether a policy, program, or project should be undertaken, an explicit or implicit determination must be made on whether the benefits exceed the costs. This chapter shows how to make such comparisons.

- **Chapter 11: Institutional development and cultural dimensions.** Every NEAP involves recommendations for institutional changes or the provision of capacity building. Indeed, these are often the central proposals. This chapter presents some criteria for evaluating such proposals, together with indications on the significance of cultural dimensions in the work of a NEAP economist.

- **Appendix A: Key literature and data sources.** Every NEAP economist should have access to certain key sources of data and a number of working paper series. Relevant background, citations, and addresses are provided. A few of the leading books in the field are also summarized.

- **Appendix B: Choices for the African farmer.** A short, hypothetical case study of the thought processes that an African farmer (male) might go through in making his choices concerning development and conservation.

1.4.2 Structure and Style

The book draws its primary inspiration from brief assignments by the author in Ghana (6 weeks) Madagascar (3 weeks), Mauritius (3 weeks), and Uganda (3 weeks) in which I attempted to apply economics to facets of the NEAP process in those countries. I draw on this experience as my primary source of insight but also on the experiences of others to the extent they have been documented. I cite literature I have found especially relevant from a theoretical or practical perspective or both, but I do not attempt in any sense to be inclusive in this regard. As such, my experience is inevitably limited, as is the book, being in a sense the fruits of a personal odyssey. Throughout the text, practical applications of environmental economics to issues in Africa are cited to show what has been and can be done.

For many economists, the technical material will be familiar, but it is hoped that combining pragmatism and theory to arrive within realistic time scales at useful answers will provide some insights not commonly found in conventional texts. I have made a conscious effort to make the material explicable to noneconomists: I have used equations sparingly to encourage the faint-hearted

Box 1.3: The Economic Value of Elephants

Methodology: Travel cost and contingent valuation methods were used to estimate willingness to pay for the maintenance of elephant populations on the part of safari participants in Kenya.

Results: The sample was small (53 tourists and 22 tour operators), but the results seem plausible. A median willingness to pay of $100 a visitor or $25–30 million annually, representing about 3 percent of total cost of safaris, to conserve elephant stocks. Visitors estimated that visits would drop to half the existing levels if the population of elephants fell by 50 percent below existing levels.

Implications: A special surcharge on visitors could be imposed and earmarked for elephant conservation without incurring significant consumer resistance. If elephant numbers fall significantly, visitor numbers will fall off substantially; so species conservation has substantial payoffs.

Source: Brown and Henry (1989)

and made extensive use of graphs, because a picture can clarify the main message you wish to convey with a data set. Each chapter poses a few discussion questions at the end to help the reader reflect on the issues addressed; further reading material is suggested; and some guidelines are outlined for the NEAP economist on how to act on the insights provided in the chapter. The term "NEAP economist" is intended to embrace any individual or group applying economics in the NEAP process or applying environmental economics generally in Africa.

There is much talk today of sustainable development. This can be and is defined in various ways. Giving the concept operational expression means somehow taking into account the effects on future generations of actions we undertake today and arriving at processes of development that leave people in the future at least as well off as we are today. This concept is extended by some to include the biosphere as a whole, so that all life on the planet is not diminished over time. A rich and expanding literature exists on the adjustments needed in national accounting to incorporate consideration of sustainability. (The theoretical issues are nicely addressed by Dasgupta and Mäler 1994.)

This book provides little formal advertence to this concept, but its attainment is an underlying *leitmotif*. The central challenge for developing countries in Africa is to reverse the cycle of destruction—to change the decisions of producers and consumers so that they become environmentally constructive, not destructive. To effect this change of direction and to do so in a fashion that advances the economic and social well-being of the citizenry is at the heart of the NEAP process and of the roles that the environmental economist plays therein. To the extent that this accords with a definition of sustainability, this book is about the achievement thereof. The following are specific benefits of applying environmental economics that should be relevant in an African context.

1.5 Why Apply Environmental Economics? The Potential Payoff

A number of reasons exist for applying environmental economics. These include: getting the attention of the policy process, focusing on the key issues, making the link between environment and development, estimating the benefits and costs of options, maximizing the use of on-the-ground personnel, and fostering the use of prices.

1.5.1 Getting the Attention of the Policy Process: Identifying Large Environment-Related Losses

A number of studies indicate that the losses imposed on the economy in African countries as a consequence of the by-products of resource ex-

ploitation are substantial, equivalent to 2–7 percent of GDP a year. Because most economies have not grown at this rate over the past decade, this may imply a negative real growth after the environment-associated losses have been taken into account.

1.5.2 Focus on Key Issues

An infinite number of issues could be addressed in a NEAP. The economist can help identify and focus on priorities.

1.5.3 Linkage with Economic Development

In spite of much rhetoric and evidence to the contrary, the linkage between economic and social development and environmental degradation is often not made by the policy process in both developed and developing countries. The economist can help make this linkage.

1.5.4 Estimation of Benefits and Costs: Evaluation of Projects and Policies

Evaluation of choices is an essential dimension of the NEAP process. The economist brings a set of useful analytical techniques to the identification of costs and benefits and their comparison.

1.5.5 Designing Sectoral Policies

In many countries, studies are under way as part of the process of identifying key policy changes and investment requirements designed to improve economic efficiency and competitiveness or enhance social impact. If economic efficiency and sustainable development are to be advanced, such studies need to incorporate specific consideration of environmental dimensions. The NEAP economist can help in their formulation. A couple of examples follow:

A sectoral study of *forestry* should first see if any macroeconomic studies link macroeconomic policies to the environmental performance of forestry. Kahn and McDonald (1991) examined the association between debt and deforestation for all tropical countries over the 1981–85 period. These include Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Congo, Côte d'Ivoire, Ethiopia, Gabon, Gambia, Ghana, Guinea-Bissau, Kenya, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, Sudan, Tanzania, Togo, Uganda, Zaire, Zambia, and Zimbabwe. Using regression analysis, they found a strong positive association between the degree of national indebtedness and the extent of tropical forest clearance.

Their findings contrast with those of Capistrano and Kiker (1990), who examined the relation between tropical forest clearance and a range of variables, including real per capita income, rate of real currency devaluation, population growth, and international debt, in a number of countries, including 20 African countries, over the 1967–85 period. They concluded that the strongest positive associations between deforestation and the variables tested for were with the real rate of devaluation, growth in per capita income, and growth in the value of export logs (the latter is strongly associated with devaluation). In their analysis, debt was *not* associated with deforestation. It is difficult to explain the contrasting results. Capistrano and Kiker examined the data over 18 years (compared with five in the case of Kahn and McDonald), and they evaluated the association over a number of possible explanatory variables, so that their results are perhaps more credible. But it is clearly an issue deserving of further analysis.

Analysis should also address the microeconomic issues, including the sales methods (for example, concession, lease, or auction); the standing volumes and volumes being extracted; the prices (standing, export log, or retail); the price gap or the difference between prices obtained and those that would prevail under competitive market conditions; areas being logged over; losses caused by fire, harvest damage, or other factors; volumes and value of nontimber outputs; adequacy of personnel and institutional and legal arrangements; and the costs and returns to plantation forestry.

By improving the return per unit of area logged and by concentrating the latter on those areas where the wood return is greatest, it should be possible to release areas where the return from wood is relatively lower to help to sustain wildlife and to conserve biodiversity. Without the core forestry economics work, it is impossible to put

the conservation issues in an overall economic context and to identify the most cost-effective niche for its achievement.

In the analysis of costs of environmental degradation in Ghana, which are discussed later on, a recently completed sectoral study on forestry, which addressed most of the points noted above, was invaluable.

A sectoral study of *energy* should address the key constraints and opportunities for wood energy and arrive at a strategy, for example, for pricing the various forms of energy so waste is not encouraged and environmental destruction made more attractive, as well as assignment of tenure, provision of technical assistance, provision of stoves, and more. These would result in more efficient wood production and consumption, less pressure on existing forests, and associated benefits of wildlife and biodiversity conservation, regulation of water flows, mitigation of floods, and so on. An energy study would also examine the options for energy supply, including hydroelectric power and the problems of accelerated sedimentation arising from large-scale erosion.

1.5.6 Maximizing the Contribution of On-the-Ground Personnel

The application of environmental economics provides an ideal mechanism for integrating disciplinary and sectoral insights from a variety of existing agencies and sources.

1.5.7 Fostering the Use of Prices

In most African countries, there are great difficulties in applying the regulatory or command-control policy instrument. Thus, the usual economist's bias in favor of using prices and incentives would appear to be accentuated in the African case. The absence, however, of well-developed markets, caused by poor infrastructure, poor information, lack of competition, and lack of monetization, will also make this policy instrument difficult to implement effectively in some cases. The environmental economist has a strong vested interest in encouraging the emergence of real market prices and in their systematic collection and analysis.

The environmental economist, however, will also be aware that using prices to allocate scarce resources will often favor those with the means to acquire these assets and discriminate against those who do not. Thus, every policy prescription that involves the use of prices as an allocator should address the equity issue: where the implications are distributionally perverse, ameliorative policies should be an integral part of the policy prescription.

1.6 The NEAP Economist

The French use the word *animateur* to describe someone who gets things going, who animates ideas and action. You need to act as an economics *animateur*, identifying existing and potential sources of help and support and encouraging them to assist and become involved. Specifically, you should consider the following:

- Make sure that you have the key documents listed in appendix A under "core data" and that you receive updates as they appear.

- Get on the mailing lists for working papers and the like for the organizations listed in appendix A under "Issue and Topic-Specific Data and Analyses" and others as they emerge or you hear of them. It is important not to become intellectually isolated.

- Get to know the economists in your country in the sectoral agencies, for example, agriculture, forestry, and industry and resource-interested economists in planning and finance ministries; universities; international agencies such as the World Bank; and nongovernmental organizations (NGOs). Familiarize yourself with their ongoing and prospective work. You should consider having the NEAP team host a lunchtime seminar for these economists once a month to provide a forum for the exchange of views, the presentation of work in progress, report on meetings attended, the presentation of seminars by visiting economists, and so on.

- Get to know the other resource specialists involved—foresters, agronomists, hydrologists, ecologists, and wildlife managers—who all bring special skills of which you must avail if you are to be effective. When you are

attempting to identify the *production functions*—the relationships between action and environmental degradation, and action and environmental improvement—they are the people whose help you will need. When information gaps are identified in this regard, they are the ones who will know how to develop information at least cost.

- Encourage the undertaking of sectoral studies that will address some of the key issues of interest environmentally. Help design the terms of reference so that they do address your concerns. If you can help locate funding, do so. The more others do for you, the better.

- Through reading the main policy documents and discussion, find out what are the main policy preoccupations for the country in general and specifically what are the key issues that concern senior administrators and politicians.

- Make sure to participate in the design of information-gathering and research programs to ensure they reflect some of the key issues from the perspective of economics.

- Be cautious in allocating your time and resources. The menu of activities on which you could work is almost infinite. When considering such an investment in time and effort, ask yourself the following questions: Will this work help change decisions in a positive direction? How does it stack up with other possible uses of my scarce time? What is the minimum effort I can devote to arrive at a useful result? Is there anyone else I could persuade to take it on?

Discussion Questions

1. What opportunities for sustainable development does the preparation of a NEAP open up, that would not be available in its absence?
2. What preconditions need to be in place for a NEAP to succeed?
3. What are the main constraints that are likely to inhibit successful completion of the process, including implementation?
4. List in order of priority the benefits that you believe the application of environmental economics could bring to your country.

Further Reading

Falloux, François, Lee Talbot, and Jeri Larson. 1991. *Progress and Next Steps for National Environmental Action Plans in Africa.* Washington, D.C.: World Bank, AFTEN.

Falloux, François and Lee Talbot. 1992. *Crise et Opportunité: Environnement et Développement en Afrique.* Editions G–P. Paris: Maisonneuve & Larose, 15, rue Victor-Cousin, Paris (V^{e}), et Agence de Coopération Culturelle et Technique, 13, quai André-Citroèn Paris (XV^{e}). An English edition will be available shortly.

Talbot, Lee and François Falloux. 1993. *Crisis and Opportunity: Environment and Development in Africa.* London: Island Press.

Chapter 2

Theory and Its Policy Implications Reviewed

Every profession has its own *patois*—its own jargon for summarizing concepts that are sometimes complex. It can also act (inadvertently I hope) to exclude others from understanding some of the core ideas of the profession. In this chapter, I review some of the core ideas of economics as it is applied to the management of the environmental endowment. Jargon is indicated in italics; these terms are used subsequently in the book, usually without explanation.

2.1 Societal Welfare and Market Failure

Unambiguous assignment of property rights is essential to the functioning of markets in general and to the achievement of effective management of environmental assets in particular. The public goods/open access nature of environmental assets allows the imposition of external costs, which typically accrue to those producers and consumers who are off site.

2.1.1 The Centrality of Ownership

Welfare economics is that branch of economics that deals with how to define, maximize, or at least move toward attaining the well-being of society. It is concerned with the roles that markets play in this regard and specifically with the necessary preconditions for markets to be fully effective as agents promoting societal well-being.

It is one of the central tenets of welfare economics that all resources must be owned if markets are to work effectively. Ownership is here defined as the ability and willingness to limit use and access to resources and the ability to transfer them to others. It has no necessary association with the legal definitions. Thus, a resource may be legally owned by an absentee owner or a government, but if they lack the ability and willingness to limit access, if they are prohibited from selling or otherwise transferring it, the resources are not owned in economic terms. Conversely, a community may lack any legal title to land, but if they act to ration access and use, they do own the resource in economic terms.

The ownership issue is of interest because it can be argued that the lack of ownership of many environmental assets creates the preconditions for environmental degradation. The argument goes as follows: If ownership of an asset does not exist, this open access resource can be used by anyone, at any time, and for any purpose. So long as the uses and the technologies employed do not impinge adversely on each other or on the well-being of future generations, economic scarcity does not arise and no issue of management per se arises. Until recently, the upper atmosphere and the oceans comprised open access resources. Tall stacks could be used to dispose of airborne wastes into the upper atmosphere without limit and without apparent damage; sewage and other wastes could be absorbed by the oceans without noticeable problems. More generally, over hundreds of thousands of years, the numbers of people and their technologies and cultural attitudes were such that land and forests were relatively open access resources; they did not impinge on the welfare of existing users or of future generations.

The rationale for environmental management rests fundamentally on the point that for many assets economic scarcity now exists. The numbers of users and their value systems and technologies are such that, if these assets remain as open access resources, they will be destroyed, the

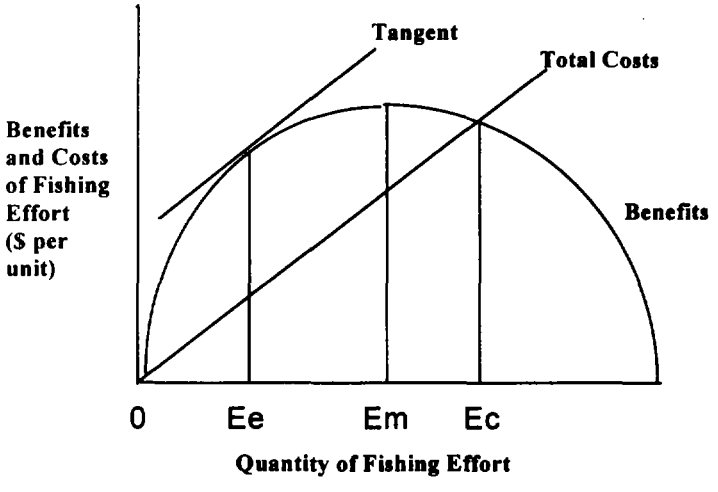
Box 2.1: Economic Efficiency and Fishing Effort

It can be shown that, under certain conditions, the level of fishing effort that is economically efficient is less than that which maximizes the sustained yield catch. Let us take the case of an open access marine fishery. Assume that:

- the additional effort required to catch a given unit of fish (marginal cost) stays the same as the size of the catch increases,
- the revenue per unit of fish caught stays constant, and
- in a given environment, the level of the fish stock increases at an increasing rate for a time and then, as the constraints to further growth become binding, the growth rate diminishes, until the growth rate eventually reaches zero at which point the stock level is maximized.

The benefits and costs of additional fishing effort under these assumptions are shown in figure 2.1. If the effort level (measured in number of ships, hours of fishing, or other measures) expands beyond level E_m, the total catch falls; E_m represents the maximum sustainable yield level of catch or effort. Net benefit is represented by the vertical distance between the total benefits and total costs at a catch level indicated by E_e below. Effort beyond this level is inefficient, because doing so reduces the net benefit; the additional costs are greater than the additional benefits. It is clear that, under the assumptions made, fishing at the maximum sustained-yield level is not economically efficient; greater net returns can be gained by reducing the effort to E_e. Under certain circumstances of open access, technology, discount rate, and biology, fishing effort will continue beyond the maximum sustained-yield level to E_c, at which point the costs and returns are such that all the net benefit has been squeezed out of the fishery.

Figure 2.1 The Optimum Level of Fishing Effort



Source: Tietenberg (1988, 258–264).

degree of destruction depending on their resilience and recuperative capacities.

In economic terms, we say that, under these conditions and by not being owned, the market mechanism does not work, the scarcity value of environmental assets is unrecognized, and *market failure* is manifest. The incentives that users face encourage an accelerated rate of destruction.

Take the case of a fisherman harvesting a species that is overfished in waters accessible—perhaps not by law—to anyone at any time to take whatever volumes of fish they can catch. He knows that the species is being overfished and that, if present trends continue, the fishery will be destroyed, perhaps forever. But his take is such a small proportion of the total that his individual actions to exploit or conserve will have negligible effect on the fate of the fishery. Knowing that destruction is going to happen anyway, his incentive is to take as much as he can while there is still something to be taken. When this realization occurs simultaneously to numerous users, accelerated destruction is likely. In this situation, the rent that the fishery could yield if it were rationed effectively gets dissipated in the catching effort by fishermen as they keep intensifying effort until their returns equal the costs of the effort expended.

2.1.2 Public Goods and Externalities

The concepts of public goods and externalities are useful as means of explaining and interpreting the phenomenon of market failure. An *externality* can be defined colloquially as an activity most of whose fruits are not captured by the provider (external benefits) or most of whose costs are not borne directly by the perpetrator (external costs). The user of a CFC aerosol spray depletes the ozone layer, thereby imposing an external cost; this action, taken in concert with similar actions by millions of individuals, exposes the residents of the globe to losses in health and other forms of welfare that are likely to be substantial. But the link between the action and the costs borne by the individual is not direct. Unless there is collective action, the sacrifice that an individual makes will not change the overall outcome.

Likewise, the driver of a smoke-spewing taxi, the farmer whose soil losses silt up dams downstream, the timber harvester who destroys the bush meat and biodiversity potential of a forest, the industrialist who contaminates groundwater with toxic waste all impose external costs. They can do so because of the free nature of their access to environmental media. Such access is facilitated by the public goods nature of environmental resources in many situations: a *public good* can be defined as one that, if it is made available to one, is automatically available to all. Public goods are indivisible; the costs of exclusion are prohibitive. Thus, access to improved air quality is in effect impossible to limit. Benefits of access to a restocked marine fishery are difficult to limit, giving rise to what economists call the "free rider" problem: once the benefit (for example, clean air) is generated, all benefit, even if they have not contributed to the costs of clean-up.

A distinction is made between externalities that are *Pareto relevant* and those that are not. A Pareto relevant externality can be defined as one in which the costs of mitigation are less than the benefits; that is, the opportunity exists to eliminate the Pareto relevant externalities at a cost that is less than the resulting benefits, yielding a net improvement in welfare; this change is sometimes called a Pareto improvement. (Vilfredo Pareto was an Italian sociologist of the past century who articulated the concept, hence the name.) Take the case of a factory whose wastewater is damaging marine life to the extent that income from fishing and from coastal tourism is diminished. The pollution is imposing costs of $1 million[2] a year on the downstream users of the resource. It would cost the firm $0.5 million to remove the pollution. The textile factory's emissions are Pareto relevant as long as this pollution can be reduced for a cost less than the benefits that such reduction yields in reduced damage. (See box 2.3 for further development of this concept.) Much of the field of welfare economics, of which environmental economics is an application, addresses the conditions under which all the Pareto relevant externalities will be eliminated, that is, all the gains from exchange will be exhausted. When certain conditions of resource ownership and competitiveness are met,

[2] All dollar amounts in this book are U.S. dollars unless otherwise indicated.

an economy is said to achieve Pareto equilibrium; all the gains from exchange have been exhausted. For a given distribution of income, no one can be made better off without making someone else worse off. When some portion of what were formerly external costs are subsequently borne by the perpetrator, we say that they have been *internalized.* In theory, a polluter could be bribed to achieve the same effect, but practical financial and equity issues make it difficult to implement.

2.1.3 Financial and Economic Efficiency and On-Site and Off-Site Costs and Benefits

A distinction is often made between financial returns and *financial efficiency* and between returns to the economy and *economic efficiency.* In this context, financial returns are what accrue to the producer or consumer involved, based on the financial costs and rewards that they experience. Thus, farmers may use fertilizer that is subsidized and sell their output to markets where food prices are controlled. They make their decisions based on the financial costs and returns to them, attempting thereby to maximize financial efficiency. When distinguishing between financial and economic costs, one also uses *private costs* to connote the former and *social costs* to connote the latter. To judge economic returns requires that these financial prices be adjusted to remove the effects of the subsidy and the price controls. The prices after such adjustment are called *shadow prices.* Thus, the terminology of economics varies from the everyday. The prospective investor asks, "Is this an economic proposition?" The economist responds, "You mean, 'Is this a financially efficient investment?' "

Related to the concept of externalities are *on-site* and *off-site* costs and benefits. On-site costs are, in the case of a farmer, those that accrue to him or her on the site of production. Off-site costs include the siltation of dams and wells downstream; the loss of biological diversity, which reduces habitat for wildlife; and the potential of the area as a gene pool and a tourist attraction. The share of the financial and other costs borne by the farmer are sometimes called *private costs;* when to these are added the off-site costs, the total (private plus off-site) are called *social costs.*

In recent years, the concept of *government failure* has been introduced as an analogue to market failure. It lacks precise analytical definition but generally is taken to comprise negative acts of commission and positive acts of omission. An example of the former is when a parastatal with monopoly powers is set up to market an internationally traded good and ends up through some combination of inefficiency and corruption in absorbing much of the value of the output that could accrue to the producers and the government. An example of the latter is when the government fails to provide good price and other market information that is needed if efficient production and consumption decisions are to be made. Bojö (1991, 53–72) following Krueger (1990) provides a well-organized discussion of this issue.

The economic challenge regarding management of scarce environmental assets can be defined as contriving to arrive at a set of incentives and institutional arrangements so that (1) users ration their use by considering its scarcity value in making their utilization decisions and (2) aggregate use is such that the net benefits yielded by the environmental assets in question are maximized.

A distinction has been made between economic property rights, which reflect reality on the ground and may or may not be reflected in formal or even customary law, and legal property rights, which convey legal title. Another distinction worth making is between *open access resources,* which are available to whoever wishes to use them, and *common property resources,* which belong to a defined group and which may or may not be owned—in the sense of having the ability and willingness to limit access but generally some regulations govern access, use, and transfer.

In practice, a variety of tenure arrangements typically exist in which the degree to which access is or can be controlled varies, as does the degree to which the property can be transferred in markets.

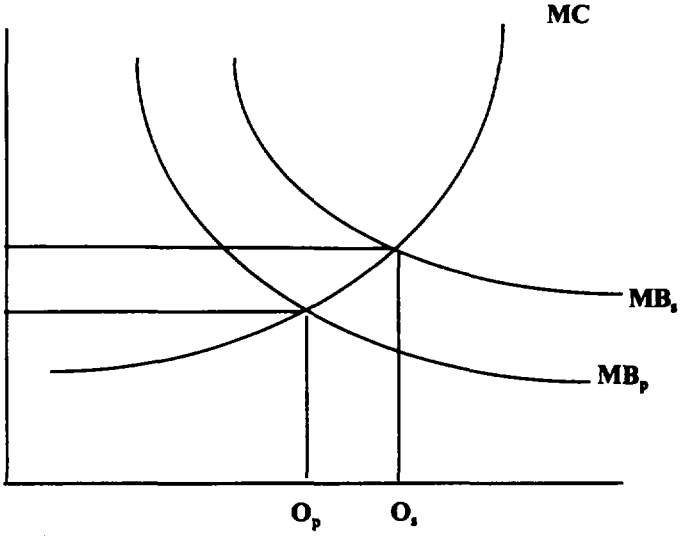
2.2 Market Failure and Policy Instruments

Once resource scarcity is manifest, ownership in the economic sense needs to be asserted. Management should be designed to reflect scarcity,

Box 2.2: The Optimum Level of Pollution

Take the case of a river that is grossly polluted. Simple, relatively cheap physical processes can be used to reduce the pollution in the early stages of clean-up. As the gross pollution is reduced, however, more sophisticated and expensive biological and chemical means need to be marshaled to continue the clean-up; the incremental or marginal costs per unit of clean-up rise rapidly as relative pristineness is approached. The marginal benefits go in the other direction. There is a substantial benefit payoff early on, as gross pollution is eliminated, but, once people can use the water safely and there are no negative aesthetic effects, the additional benefits per unit of reduction fall off. Taking only private costs and benefits into account, it can be seen from figure 2.2 that the optimum level of pollution is O_p, where the marginal costs equal the private marginal benefits (MB_p). To stop clean-up before that point would be irrational, because, the returns to additional effort at the margin exceed the costs. Beyond that point, the incremental costs at the margin exceed the ensuing benefits. If now the off-site benefits are added to the private (on-site) benefits, to yield marginal social benefits (MB_s), it is clear that the optimum level of clean-up rises, increasing from O_p to O_s.

Figure 2.2: The Optimum Level of Pollution



and the intervention should operate as efficiently as possible. Where market distortions abound, as in those cases in which property rights are inadequately defined, a lack of information exists and government failures of various kinds prevail; intervention can be called for.

There are a variety of relevant strategies in this regard. These strategies are often styled *policy instruments*, defined as combinations of actions designed to influence behavior. In evaluating options, the concept of cost-effectiveness is frequently invoked. A strategy or policy instrument is said to be *cost-effective* to the extent that it meets a predetermined objective at least cost. It carries no implication that the objective is worth

attaining. The following policy instruments are relevant for environmental economics.

2.2.1 Information, Education, and Research and Development

As already noted, adequate information is a necessary prerequisite for the effective operation of markets. Where it is lacking, markets cannot play their essential role of reflecting relative scarcity. The provision of information comprises an important policy instrument. The economist can help design an information and education process that is cost-effective in meeting information needs. In the United States, a provision mandating an inventory of toxic releases by plant must be made available to the public is regarded as among the most successful stimuli to improved environmental performance in that country. Effective research and development provides some combination of expanding output per unit of input; solving a problem to which there was previously no solution; and creating new opportunities.

2.2.2 Adequate Tenure and Facilitation of Negotiation

It follows from the discussion on property rights above that at the stage of economic development, population, and technology that most African NEAP countries find themselves, assignment of effective property rights is an essential prerequisite for effective economic and environmental management.

If property rights are assigned and only a few firms or individuals are involved, for example, a river basin with one large industrial user of the water for assimilative capacity and one authority representing the citizens, establishing a framework in which the potential polluter(s) negotiate(s) with those affected or vice versa should result in internalization of the external costs up to the point where the gains equal the costs of so doing; that is, the gains from exchange are captured and the Pareto relevant externalities are eliminated. (Ronald Coase [1960] was the first formal expositor of this potential solution [see box 2.3].)

2.2.3 Charges and the Use of Graduated Incentives

Charging for the use of environmental resources to reflect their scarcity value is a method that has obvious appeal for economists. It creates an incentive to conserve; it provides for a graduated response that allows users of environmental assets to choose the least costly mix of reduction measures; it provides a continuing incentive to conserve and to develop technologies that improve environmental performance; and it allows environmental costs to be reflected in end-product prices. The expression *graduated incentive*, for example, emission charges, is used to distinguish this type of policy instrument from a once-off fine, which a court might impose for noncompliance. Such incentives may be directly imposed on the emission, as in the case, of a tax on sulfur emissions, or indirectly, as in the case of a differential tax favoring lead-free petrol. The OECD (1993) analyzed the merits of direct compared with indirect systems of taxation and concluded that the tradeoff was between environmental effectiveness (greater with direct charges) and administrative convenience and cost (greater feasibility and lower cost with indirect taxes). *Tradable permits* allow an emitter to release up to a certain amount per unit of time from a given source or set of sources. These emission rights are tradable, that is, they can be bought and sold among the emitters in the zone to which the permits apply. NGOs can and do enter the market to buy out pollution in a modified debt-for-nature swap. The Nordic countries are among the most advanced in the use of taxes and charges, whereas the United States is a leader in the development and use of tradable permits.

2.2.4 Regulation or Command and Control

Regulatory methods will be relevant in cases where charging and other graduated incentives are ineffective and the assignment of property rights and mechanisms and negotiated settlements are insufficient. They can also be used to complement charging schemes. Regulatory methods typically involve government in defining forms of activity: for example, cultivation techniques, types of trees that can be harvested and planted, use of production techniques and treatment tech-

Box 2.3: Example of Coasian Solution

Take the case of the owner of a dye factory upstream ("Polluter Up") that emits pollution imposing clean-up costs downstream on the owner of a food factory ("Pollutee Down") amounting to $2 million annually. If the costs of clean-up by Polluter Up amounts to $1 million, an opportunity exists for mutually beneficial trade: if Pollutee Down negotiates with Polluter Up, he can afford to pay up to slightly less than $2 million and be better off. Likewise, if Polluter Up receives anything in excess of $1 million, he will be better off than before. If policy encourages and facilitates negotiation, mutual interest should lead them to strike a mutually beneficial bargain in which an amount somewhere between $1 million and $2 million will be transferred from Down to Up; they will both be better off, and the pollution will have been eliminated. Where the balance lies between these two amounts will depend on their relative negotiating strengths and skills.

Note that the outcome does not depend on who holds the property rights to the river. If Polluter Up has the right to pollute, the outcome will be as outlined. If Pollutee Down has the right to clean water, Polluter Up will offer up to $1 million to accept the pollution; however, Pollutee Down will refuse, because the costs imposed exceed this amount. Polluter Up will have to clean up.

This method is only effective, however, if a framework facilitates negotiation, if the numbers of actors involved allow effective negotiation and if each agent knows the cost and benefit functions of the others. If numerous agents are involved, the costs of negotiation—the *transaction costs*—can become so large that they act as a wedge inhibiting the internalization of the relevant external costs. In the case above, if the costs of negotiation exceeded $1 million, the trade will not take place; the opportunity for a Pareto improvement will not be realized. Government can help overcome the problem of transaction costs by allowing a representative group to act on behalf of a large number of affected citizens or by gathering or disseminating information or both.

A variant on the negotiated settlement between the affected parties is the negotiation of a *performance contract* between the polluters and the environmental management agency, in which the former agrees to meet certain performance standards and in return receives a license to produce. To work, the contract must only deal with information that can be verified. This may also be accompanied by grants toward the costs of meeting these standards and the imposition of sanctions if they are not observed.

nologies, and the extent and nature of emissions that are allowable, with noncompliance enforced by law.

2.2.5 Institutional and Procedural Developments

To initiate, formulate, and carry out policy requires that institutions exist to do the same. The provision of such institutions is a policy instrument. Procedural requirements, such as requiring Environmental Impact Assessments, are also policy instruments; they simultaneously (but at a cost) generate information on the implications of options and help ensure that the preferences of affected individuals are reflected in the decision-making process. To ensure that such institutions and procedures are cost-effective in their design and operation is a concern of the NEAP economist, as is ensuring that such institutions have internalized the ability to subject options to economic analysis.

2.2.6 Investment

Government undertakes investment programs that can have significant environmental implications. Investments specifically designed to address environmental problems are also undertaken. The economist can have a significant role in evaluating such investments and in advising on their net impacts.

2.3 Fundamentals on Prices

Prices are so central to the application of environmental economics that it is useful here to identify some practical issues involving their use.

2.3.1 Price Elasticities

One of the central tenets of economics is that producers and consumers respond to changes in real price. A *real price* is the price with the effects of general inflation netted out. A *nominal price* is the price unadjusted for inflation, that is, the price actually paid. The means for converting from nominal to real are described later on in this chapter. (Hereafter, whenever a change in price is discussed, the reader should impute that it is a real not a nominal change that is being discussed, unless otherwise noted.) Other things being equal, if a price rises, consumers will consume less, and suppliers will supply more. The demand curve represents the quantities that consumers will purchase at various prices; it slopes downward to the right. The supply curve represents the quantities that producers will supply at various prices; it curves upward to the right. The price that emerges from the interplay of demand and supply is the market price. If prices are not administratively controlled, this price will be a *market-clearing price*, defined as a price at which all who want to buy at that price can do so and all who want to sell at that price can do so. No demand is unsatisfied.

Much effort in econometrics—the application of statistics to economic analysis—is devoted to the identification of the responsiveness of demand and supply to price changes. In the case of demand, this responsiveness is called the price elasticity of demand, or demand elasticity, and comprises the percent change in quantity resulting from a given percent change in price. In the case of supply, the responsiveness is called the price elasticity of supply and comprises the percent change in quantity for a given percent change in price.

A concept parallel to that of price elasticity is that of income elasticity, which indicates the responsiveness of demand to changes in income and comprises the percent change in quantity demanded for a given percent change in income.

A distinction is often made between short-term and long-term responsiveness. Thus, if real energy prices increase, the short-term response in consumption reduction may well be modest, because consumers are locked into given technologies. In the long term, when everything can be varied, the option of replacing technologies with those that are more energy-efficient becomes feasible. Gasoline consumption by a car owner comprises a useful typical example of likely short-term and long-term effects: in the short term, the response to real petrol price increases is likely to be fewer miles driven and perhaps better engine maintenance. But in the long run, if the real price increase is expected to be maintained or even to increase in the future, replacing the car with a more efficient model will be considered. Thus, in general, responsiveness to prices in the long run will be greater than it will be in the short run.

An example for electricity consumption:

Period Price	Elasticity of Demand Income	Elasticity of Demand
Short-Term	-0.1	0.4
Long-Term	-0.3	0.6

This tells us that a 10 percent increase in price will result in a 1 percent fall in consumption in the short run and 3 percent in the long run, whereas a 10 percent increase in income will result in a 4 percent increase in the short run and a 6 percent increase in the long run.

The price and income effects are interrelated. Other confounding factors make it difficult in practice to derive elasticities; relatively sophisticated analysis of soundly based, cross-sectional and time series data will typically be needed to derive credible elasticities.

In general, it will not be justified to undertake such analysis as part of the NEAP process, assuming that the data were of sufficient quality to allow it.

The better the general quality of data and analysis available, however, the better the NEAP analysis can be. Thus, there is a strong vested interest on the part of NEAP staff in improving the overall quality of data and related economic analysis. Specifically, if credible price and income elasticities have been computed for the main outputs of relevance for environmental management, the NEAP economist then has valuable information with regard to the implications of policy choices. In the typical situation, however, such information will not be available; the analyst will be fortunate to have a few relatively short time series, which he or she can convert into real terms.

Let us explore the uses to which such data can be put to use. Although it will typically not be possible to quantify the magnitudes of change to be expected with individual policy initiatives or situations, it will be possible to predict the direction of change associated with it. This is a far more powerful insight than is commonly imagined. If NEAPs succeed in changing the direction of behavior from destructive to constructive, they will have succeeded.

Therefore, the ability to characterize policy with regard to its destructive or constructive potential is both useful and necessary.

2.3.2 Constant Price Trends

"Constant" or "real" in the sense used here means net of general inflation. Prices from which inflation has not been netted out are called "nominal" or "current" prices. On their own, few phenomena in this world are more useless than a nominal price series. If you are told that the nominal price of a barrel of oil has increased from $3.25 in 1962 to $22.00 in 1991, you know nothing that is useful. If you draw the conclusion that prices have increased over this period, the information will be positively misleading. Thus, always express price series in constant terms.

The objective in expressing prices in constant terms is to compare the price trends in the outputs or inputs of interest with price trends in general. The definition of "in general" will vary depending on what you are discussing. Many different types of price indexes exist: you should apply the one that is most relevant to your discussion. In many cases, you will be discussing the real price effects on consumers and farmers in relation to their overall living standards and purchasing power. For such situations, use the Consumer Price Index (CPI) to convert from nominal to real terms. Sometimes, the CPI is computed separately for urban and rural, for the capital, and for indigenous residents and expatriates.

It is computed monthly for each product group, typically including food, beverages and tobacco, clothing and footwear, rent, fuel and power, furnishing, medical health, transport and communication, recreation, and miscellaneous.

If you are discussing the trend in the price of a particular input relative to inputs in general, an index of all farm inputs, if available, would be the basis for adjustment and comparison. Likewise, the trends in the price of a particular energy source might be compared with an energy price index comprising a basket of energy goods, weighted appropriately.

Price indexes will be expressed for a particular base year, which is revised from time to time. Typically, a series will be computed for a number of base years. Table 2.1 shows a hypothetical firewood market. The prices are expressed for the most current year, that is, 1990. The choice of base year will not change the analysis of real prices. Any year could have been chosen, the multiplier computed for that year, and the prices expressed in constant AF$[3] for the year in question.

2.3.3 Energy, Pricing, and Incentives

Perhaps because it is computationally easy to do, prices are often expressed for the base year. If this convention were followed in this example, prices would be expressed in 1982 AF$. It is easier, however, for decision makers to relate to a series when expressed in the most current year, that is, "today's" prices. This convention should be fol-

[3] In this text, AF$ refers to an imaginary currency, African dollars.

Table 2.1: Hypothetical Current and Real Price Trend for Firewood

Year	Price Current	CPI 1982 = 100	CPI Multiplier 1990 = 1.00	Constant 1990 AF$
1980	42	77	3.64	153
1981	53	86	3.26	173
1982	112	100	2.80	314
1983	125	125	2.24	280
1984	145	140	2.00	290
1985	180	160	1.75	315
1986	200	180	1.56	312
1987	210	200	1.40	294
1988	240	240	1.17	280
1989	295	265	1.06	313
1990	330	280	1.00	330

Notes:

1. An imaginary currency, African dollars (AF$), is used to price the firewood.
2. The CPI multiplier is derived by dividing the CPI for 1990 by that for the relevant year. Thus, the multiplier for 1988 is equal to 280/240 = 1.17.
3. The constant or real price per ton—in 1990 AF$—is derived by multiplying the retail price in column (i) by the equivalent multiplier from column (iv). Thus, the real price—in 1990 AF$—of firewood in 1987 is equal to 210 multiplied by 1.4 or 294.

lowed unless there are reasons for doing otherwise.

Figure 2.3 plots the real price over time. It shows the two bursts of real growth: over the 1980–82 and the 1989–91 periods. Figure 2.4 shows a scatter diagram of the real price, and a linear curve fitted to it. This format can be useful if you want to say something about future real prices. But bear in mind that trend is not destiny. It is tempting to say that the fit in the above historical series seems to be quite good and that, therefore, it is likely to continue. But a change in underlying policy might make the historical trend misleading as a guide to the future, so you need to invest effort in examining the policy context that is likely to shape the future.[4]

The prices are expressed in the local currency. Should one convert these into internationally traded currencies such as U.S. dollars? My recommendation is: only do so if it clarifies a policy issue or choice. In any event, only do so for those years for which the official exchange rate approximates the market clearing rate or for which you have a parallel market rate, which reflects the realities of the market for the currency. (See World Bank [1992a] for a series of parallel market values.) Such will be the case for those countries that have adopted structural adjustment, in which a realistic exchange rate that reflects market realities generally obtains.

In the hypothetical example in figure 2.4, over the 1980–90 period, the nominal price has increased 330/42 = 7.80 times; the price in constant terms has increased 330/153 = 2.16 times.

The real price over the period has sharply varied, with a doubling from 1980 to 1982, and then some decline and oscillation, before the recent rise from 1989 to 1990 brings it to just above the 1982 level.

It can be of interest to compute the average annual rate of real price growth over the period. The real price increase (in 1990 AF$) from 153 to 330 represents an annual average compound rise in real terms of 7.99 percent over the 1980–90 period.

The hypothetical example noted in figure 2.4 indicated rapid real growth in the price of firewood in the urban market. This trend is thought to reflect the reality of many urban markets, but see an example to the contrary below. (For details regarding the specifics of forestry, firewood, and economics, readers are referred to Asibey [1991],

[4] I did the graphs in this book using the program Cricket Graph on an Apple Macintosh; it takes less than one minute to produce a graph and allows you to experiment with different strategies.

Gregersen, Draper, and Elz [1989], and Anderson [1987].) If the hypothetical time series were to reflect reality, it would yield a number of useful questions and possible insights for the NEAP process, including the following:

- For the typical African case, in which there has been little if any growth in real per capita income over the past decade, we can conclude that additional hardship is being imposed on urban dwellers, as an increasing proportion of a fixed income goes to meet fuel needs.
- The use of more efficient burning devices, for example, efficient charcoal-burning stoves, should have increased, as fuel has become more expensive. If it has not, why not? Does the appropriate technology not exist? Does

Figure 2.3: Hypothetical Real Firewood Prices per Ton, 1990 AF$

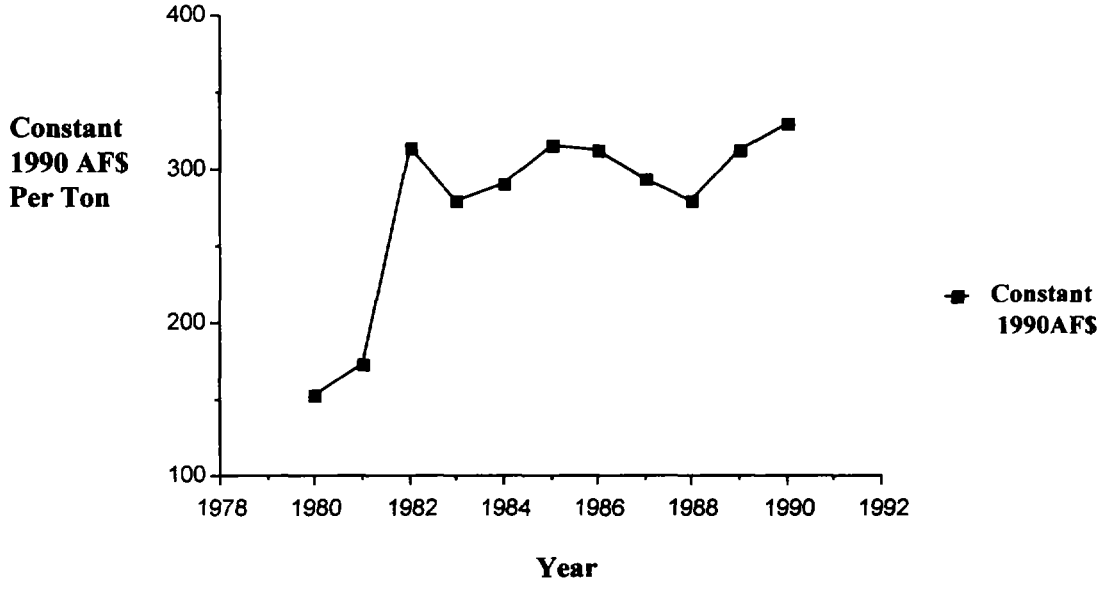


Figure 2.4: Linear Curve Fit to Real Firewood Prices Per Ton

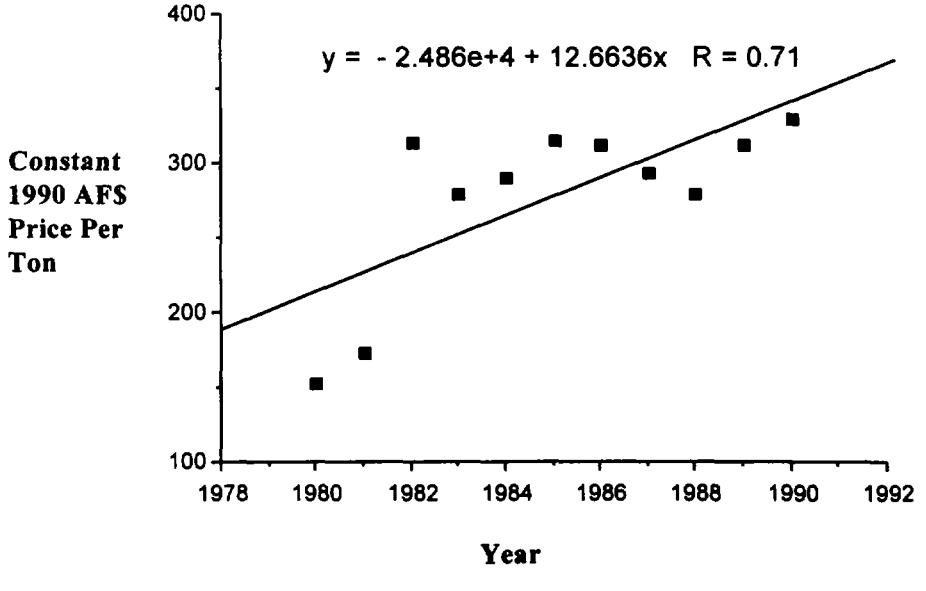


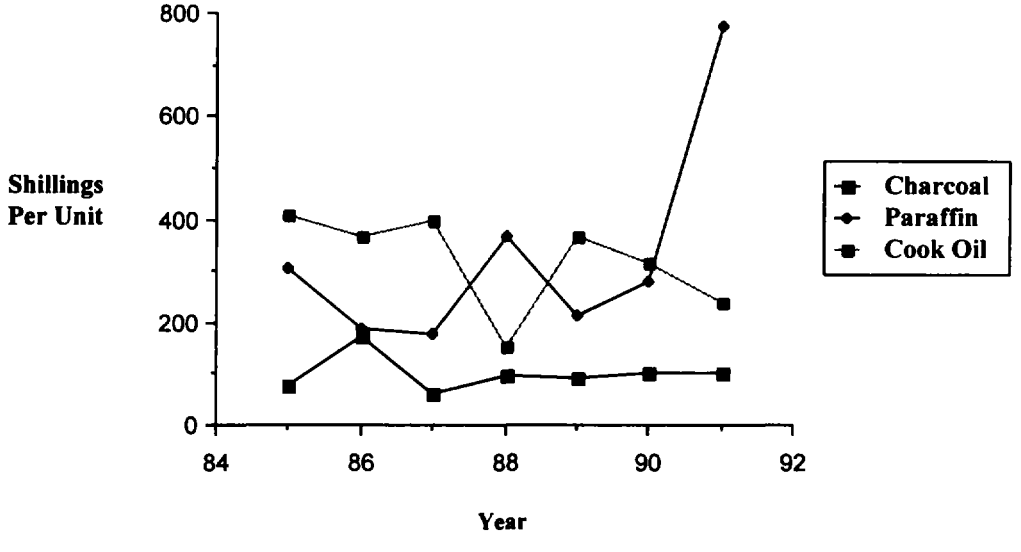
Table 2.2: Trends in Real Energy Prices to Consumers, Kampala, 1985–91

Year	CPI	Multiplier	Charcoal		Paraffin		Cooking Oil	
	1989/90 =100		Nominal	Real	Nominal	Real	Nominal	Real
1985	2.45	63.92	1.2	76.7	4.8	307	6.4	409
1986	6.41	24.43	7.1	173.0	7.6	186	15.0	366
1987	19.21	8.15	7.6	62.0	21.7	177	48.9	399
1988	56.90	2.75	35.5	98.0	133.3	367	56.3	155
1989	91.85	1.71	53.5	91.0	126.5	216	213.8	366
1990	122.31	1.28	79.0	101.0	220.0	282	245.0	314
1991	156.62	1.00	99.8	99.8	775.0	775	237.0	237

Source: Ministry of Finance and Economic Planning 1992, Table 18.

Note: The CPI multiplier is derived by dividing the coefficient for 1991—156.62—by the equivalent for each year; thus, for 1988, the multiplier is 156.62 ÷ 56.9 = 2.75. The nominal prices are converted into constant (1991) prices by multiplying the nominal price by the CPI multiplier

Figure 2.5: Real Price Per Unit of Fuels, Kampala
(1991 shillings)



the ability to manufacture competitively not exist? Are imports feasible? Do people need to be educated? Note that not everybody should be expected to respond; for those who are infrequent users or who have alternatives readily at hand, more efficient burning may still not be financially attractive.

- Switching to alternatives should have been encouraged. Has this happened, and, if so, to what extent? What are the environmental implications of, for example, increased paraffin use as a substitute?

Investment in tree growing for the firewood market should have been encouraged, as should

the marketing of wood by-products from industrial wood production. Is there any evidence that such is the case? If yes, what are the circumstances (for example, ownership, scale, technologies, tax provisions, subsidies, and so on) that bring forth this response? What is the magnitude of the supply response? If not, why not? Is the market failing to respond because of some combination of poorly defined property rights, lack of information, inadequacies of technology, inability to source appropriate inputs, including young plants/seedlings? Is there a threshold price that needs to be attained before any production response is warranted?

In the case of perceived lack of supply response to rapid escalation in firewood prices, it might be that the tenurial arrangements regarding land and firewood trees or inadequacies in the information available to prospective producers or both comprise key elements in the ingredients of failure. Information deficiencies have already been hypothesized as a possible explanation for the lack of an adequate conservation response, via charcoal stoves. If the local cultural attitude is that firewood is a free good, and that, therefore, no community support exists for protecting trees from theft, this comprises a monumental constraint on the ability and willingness of individuals, communities, or both to respond by expanding supply.

A time series can be invaluable as a way to prompt key policy questions, focused on implications for welfare and also on market responses. In the case where the latter are judged to be inadequate, the discussion then focuses on the direction of changes that will be needed if the markets are to fulfill their central function of responding effectively to scarcity.

Sometimes, concerns regarding firewood scarcity do not seem to be borne out by the data, as exemplified by the time series in table 2.2 of real energy prices to consumers in the Kampala market.

It is interesting to note that charcoal prices—with the exception of a sharp rise between 1985 and 1986—have stayed steady in real terms over the 1985–91 period; cooking oil has oscillated; whereas paraffin has shown real growth. This implies that suppliers of charcoal to the Kampala market were still managing in 1991 to get access to charcoal supplies without suffering the sharp, real cost increases that would be evident if there were an absolute scarcity. The relative price stability in charcoal may also be a function in part of a shift in demand toward paraffin, but volume consumption data were not available to the author.

2.4 The NEAP Economist

The NEAP economist should be mindful of the following points in his or her work:

- Always think through and provide a theoretical framework for your analyses, and review analytical work of others through the prism of such a framework.

- But keep your framework and associated jargon in the background when presenting reports for those in the policy process. It will intimidate and may annoy and confuse such readers, thereby reducing your effectiveness. This issue is taken up in more detail later on.

- Understand how the various policy instruments work or do not work in your country. Which have been shown to be at least partially effective and which are completely irrelevant?

- What price series are available to you, and how can you use them to highlight issues?

Discussion Questions

1. List the policy instruments available to shape environmental policy.
2. Identify the strengths and weaknesses of each instrument as a means of addressing the challenges of (1) soil degradation and (2) wildlife-based tourism development.
3. Given the following nominal or current price series for paraffin, and the Consumer Price Index, express paraffin prices in 1993 AF$:

Year	Price Per Unit *(current AF$)*	CPI 1975 = 100
1971	10	87
1973	12	92
1975	15	100
1977	22	130
1979	42	145
1981	52	160
1983	52	165
1985	53	180
1887	63	210
1989	65	220
1991	70	250
1993	75	280

What might these data imply for: (1) pressure on wood for energy, (2) trends in charcoal price, (3) disposable income in urban areas?

Further Reading

Bishop, Joshua, Bruce Aylward, and Edward B. Barbier. 1991. *Guidelines for Applying Environmental Economics in Developing Countries*. Gatekeeper Series No. LEEC 91-02. London: London Environmental Economics Centre, IIED.

There are a large (and growing) number of texts that provide a thorough treatment of the theory and application of environmental economics. The following are recognized as standard texts. Comments on each are provided in appendix A.

Pearce, David W. and R. Kerry Turner. 1990. *Economics of Natural Resources and the Environment.* Hertfordshire: Harvester Wheatsheaf.

Tietenberg, Tom. 1988. *Environmental and Natural Resource Economics* (second edition), Glenview, Ill.: Scott, Foresman, and Co.

Bojö, Jan, Karl-Göran Mäler, and Lena Unemo. 1992. *Environment and Development: An Economic Approach,* (second edition) Dordrecht, Netherlands: Kluwer Academic Publishers.

Chapter 3

Environmental Management as Development Strategy

Most cultures dominated by a rural ethos tend to view options in general as a zero sum game; if you win X, I must lose X. This can result in resentment becoming the dominant ethos of society. Where such is the case, development is difficult. It is vital that environmental policy not become viewed as either a reason to downgrade otherwise valuable development or as an excuse for inaction generally.

It is important, therefore, to get a sense of the key development priorities of the country involved and then begin to position environment in this context. The central strategy should be to identify the coincidence of interest between environmental management and development where it exists and convey the message that environment and development are not conflicting elements in a zero sum game, in which progress in one is at the expense of the other. Rather, the point needs to be emphasized that environment and development for the most part are elements in a mutually reinforcing, positive sum game; environmental policies need to encourage this symmetry of interest.

3.1 The Global Economic Context and the Implications of Trade Liberalization

In looking to the future, global trade prospects and especially changes that could alter a country's comparative advantage are relevant. A number of processes at the international level are particularly important in this regard: because more than half of sub-Saharan Africa's trade is with the European Community, the creation of the so-called Single Market in the European Community and the changes in prospect in the Common Agricultural Policy (CAP) will help shape the prospects for many African economies. Tovias (1990) outlines the implications of the Single Market for sub-Saharan Africa, and these issues are further developed by McAleese, Bourrinet, Davenport, Matthews and Stevens (1993). The North American Free Trade Agreement (NAFTA) will likewise shape the opportunities and constraints facing African countries.

Another external force shaping development prospects will be the implementation of the Uruguay round of the General Agreement on Tariffs and Trade (GATT). The implications of trade liberalization are outlined in Anderson and Blackhurst (1992). Such liberalization will have the effect of increasing the output of goods and services and increasing total income. The extent to which such an increase in output is environmentally deleterious or otherwise depends on the nature of the goods and services in which expansion takes place, who gets the increase in income and how they use it, and the environmental policies in place to shape producer and consumer behavior. We can get a sense of the issues by examining the situation in regard to the food sector. Developed industrial countries heavily subsidize agriculture. Reform in such countries will have the effect of reducing such subsidies (including subsidies for export to world markets); the effect, if the reform is confined to the developed world, will be to reduce supply and raise world prices. Developing countries by contrast discriminate against agriculture; prices in many countries have been below world prices as governments manipulate export taxes and currency rates to keep prices down. Under structural adjustment (discussed later), however, many of these interventions are being removed. The effects of liberalization on the food sector have been estimated for price and volume (see table 3.1).

Table 3.1: Effects on World Food Prices of Reform in Industrial and Developing Countries
(percent change, 1990)

Product	Reform in Advanced Industrial Economies Only	Reform in Industrial and Developing Economies
Wheat	15	0
Coarse Grain	5	-10
Rice	23	-3
Beef and Sheep Meat	48	6
Pork and poultry	9	-24
Dairy Products	109	84
Sugar	24	-15
Weighted Average	26	-1

Source: Anderson (1992, 157)

If the reform is confined to the developed world, world prices can be expected to increase, with the largest increase expected in dairy products, beef, and sheep meat and a weighted increase of 26 percent. If, however, the reform extends to the developing countries as well, the weighted change will be a reduction of 1 percent with only dairy products showing a real increase.

The change in volume and net economic welfare with reform in industrial and developing countries is estimated in table 3.2.

A substantial gain of almost $47 billion in economic welfare is predicted for the developed world, with a modest gain of $1.9 billion expected in Africa. Substantial reductions in global grain output are predicted, with reduction of about 72 million tons in the output of (now heavily subsidized) industrial countries. This reduction will be compensated in part by an expansion of more than 27 million tons in developing country output of which Africa is expected to account for 5.9 million tons. The same type of shift in production is expected in beef, sheep meat, and sugar, with modest growth in output expected in Africa.

Some environmental gain is likely in the industrial countries, as farming becomes less intensive and, therefore, consumes less artificial fertilizer and agricultural chemicals. The environmental implications for Africa depend on how the increased output is achieved. If it involves expansion into tropical high forest or expansion into

Table 3.2: Estimated Change in Output and Net Economic Welfare, with Trade Reform in the Industrial and Developing Economies, 1990

Product Change in Output *(millions of tons)*	Industrial Economies	Developing Countries	Sub-Saharan Africa	World
Grain	-71.5	27.5	5.9	-45.9
Beef and Sheep meat	-4.0	5.0	0.7	1.6
Sugar	-6.4	4.4	0.12	-2.0
Economic Welfare Change in Net Economic Welfare *(billions 1985 US$)*	46.6	16.6	1.9	62.4

Source: Anderson (1992, 158–159).

fragile uplands, the consequences are likely to be negative; if it involves a modest intensification of land already in production, the environmental effects will likewise be modest if environmental policies are appropriate. The potential for expansion into forest and uplands is itself a product of policies concerning tenure, the rates of return and revenue generated by forests, the nonmarketed goods and services provided as a result, and the extent that local communities participate in their production.

Concern has been widely expressed in industrial countries that manufacturing will "move south" under free trade, encouraged by lax environmental standards, which reduce the costs of production, enhancing the already significant production-cost advantage that developing countries are said to have in relation to the industrial countries. This concern has been used to attempt to impose industrial-country environmental standards on manufacturing capability in developing countries. Such initiatives have been variously supported by both environmental organizations and by protectionist interests in the developed world who fear that they will not be able to compete with the emerging capability in developing countries and who argue for a level playing field. This proposition gives rise to difficult issues and choices:

Case I: A developing country is producing waste of only local environmental significance, for example, organic waste, and the local river has plenty assimilative capacity for the waste produced.

In this case, the assimilative capacity is a factor of production. An attempt by the developed world to impose industrial-country emission standards is unjustified as it would yield little environmental benefit to the developing country but would damage its competitiveness in world markets. The emotive term "environmental imperialism" comes to mind in this context.

Case II: A developing country is producing waste or otherwise engaging in activities that damage the "global commons." The actions of the developing country are likely to diminish the well-being of the global community, for example, by the production of greenhouse gases from forest burning or development of a coal-fired plant or by reducing the biodiversity of the planet.

In such a situation, the global community has a basis for intervention, but a case can be made both in equity and economic efficiency that the global community should compensate the developing country for the conservation benefits yielded that are not captured by the country itself. The Global Environment Facility (GEF) has been established with precisely this rationale, to provide funding to developing countries to undertake initiatives designed to yield global benefits.

Case III: A developing country is engaging in activities that impose substantial local environmental costs, which it ignores, even if the costs of environmental degradation at the margin exceed the benefits of conservation.

This case poses an important sovereignty issue: does a country have the right to behave irrationally by destroying its local environment? Such choices can have ethnic and gender implications if the beneficiaries of destruction belong to an elite or dominant group and the costs are passed on to those lacking power. Economic efficiency demands that the environmental costs somehow be reduced to the point where the costs of so doing exceed the benefits, but this must in practice must be a decision for the developing country itself.

Case IV: One or several industrial countries boycott the products of a developing country because they judge its behavior to be environmentally inappropriate, for example, forest harvest practices or hunting of threatened species.

A boycott can be a potent weapon, because it is asymmetric; the developing country cannot retaliate because it lacks the purchasing power of the industrial country. If the conservation behavior is transparent and easily monitored, for example, a ban on whaling, it can be environmentally effective in the short run but may fail in the long run if the incentives created are perverse. This type of boycott can be both economically and environmentally destructive, if the management task is relatively complex. An industrial country ban on log imports, for example, will re-

duce the value of logs in the forest. This in turn will reduce the return to investment in tree planting, silviculture, and forest management and may simply reduce the return to the forest owners, while endowing local processors with windfall gains with no benefit for the forest or its residents.

A useful overview of the various issues involved in the trade debate is provided in Low (1992) and by Finger and Olechowski (1987).

Although it is not necessary for the NEAP economist to know the minutiae of the implications of these external forces on the country's economy, it is important that he or she understand the broad implications and notes those especially relevant to environmental resource management—for example, prospective changes in incentives for particular crops, for tourism, and so on.

3.2 The Question of Country Economic Scale

If we compare the Gross Domestic Product (the total value of goods and services produced) of the 45 sub-Saharan African country economies, if they were classified as companies, with the sales volume of the world's 100 largest corporations, we find that only Nigeria and Cameroon (just barely) would make it into the top 100 corporations. Indeed, only 14 of the 45 would make it into the top 500 (*Fortune International*, July 29, 1991: 71–72). Many NEAP countries have a total GDP that does not exceed the value of output of a single medium-size company in an industrial country.

Small economic scale imposes disadvantages:

- As the NEAP countries make the transition from cash crop and subsistence economies to the industrial stage of development, the lack of a significant domestic market makes it difficult to develop, because export markets are by definition extremely demanding in regard to quality and quantity, even assuming one is accessible.

- It makes it difficult to achieve economies of scale based on local markets and to have a sufficient number of enterprises to provide competition on domestic markets. This in turn poses challenges to privatization, because in many cases it will involve replacing an inefficient public monopoly with a private monopoly. In the absence of competition (and a benchmark for comparison) the new situation may prove in the long run to be at least as inefficient as a public monopoly.

- The absolute level of resources available to do anything is limited. The opportunity costs—what is being foregone—if a mistake is made are typically much higher for a poor country than a rich one, for example, building an expensive, advanced waste treatment plant that does not work will represent a relatively greater burden on the citizenry than if it is undertaken in a relatively rich country. The resources will not be available to replicate the types of institutional arrangements that rich countries can afford or to invest in advanced waste treatment processes that involve large initial capital costs and substantial operating costs.

The diseconomies of scale emphasize the necessity of the effective use of scarce resources. Indeed, this parsimony of resources in a sense makes the case for the NEAP process. Creativity in effective institutional design, in ensuring that environmental management is a net contributor to well-being, and in the design and implementation of cost-effective solutions is an important part of the NEAP process.

The one potential advantage that small scale provides is a certain social intimacy that allows decisions to be made expeditiously and consistently, involving key centers of influence, addressed to an agreed-on economic and social strategy. The NEAP provides the opportunity to ensure that environmental assets are part of this effort to overcome diseconomies of scale by thinking and acting strategically. Mauritius and the Seychelles, two modestly sized economies, have been successful in carrying the NEAP process through to implementation.

If the NEAP process is marginalized and is not included as an integral part of the development process, the main benefit of small scale will be lost; under such circumstances, it likely to comprise a waste of time, effort, and resources.

3.3 Identifying Development Priorities

Development priorities can be identified in a number of ways:

- The investment plan, often called the *Public Investment Program (PIP)*

This is a key source, as it defines spending priorities. By identifying the share of the total investment proposed that is allocated to various activities each year, it is possible to develop a sense of existing and proposed priorities. The National Plan will likewise be valuable in this regard.

- The structural adjustment program (SAP)

For many countries, this will capture the essence of the priorities that will drive the economy over the next five to ten years. Structural adjustment is addressed in detail below.

- Presidential statements, ministerial pronouncements, government policy statements

The policy preoccupations of the policy process can be discerned in part from such statements. Bear in mind, however, that actions speak louder than words; what government does is a better guide to policy priorities than what it says.

Having identified national development priorities in a global context, it is important to begin the process of shaping those priorities so that they reflect the centrality of environmental assets in the development process. The forms that such shaping can take will be the subject of most of the rest of this book. A number of methods can be adopted to position environmental assets and their management at the heart of the development process. These can be illustrated by reference to macroeconomic policies and sectoral development.

3.4 Macroeconomic Policies

Macroeconomic policies are those policies established at the national level that shape prices, access to imports, rate of inflation, and so on. The policies established in this regard can have positive or negative effects on environmental assets. Specifically:

- **Donor financial support:** The NEAP experience shows that well-designed environmental policies with realistic implementation schedules can attract substantial donor funding; and this will help relax the constraints on foreign exchange. If a country achieves a reputation for effective management of its environmental endowment, a positive image is likely to transfer to other areas.

- **Input pricing:** In many African (and other) countries, inputs have been underpriced. (Underpricing is here defined as pricing below the level that would prevail if the conditions for competitive markets was obtained.) Such subsidization has in the past been applied to fertilizers, water, electricity, pesticides, and herbicides.

  Underpricing resources leads to waste at the margin, in this sense: Producers and consumers will use the resources in question up to the point where the value yielded equals the price that they pay. If the latter is less than the competitive market value of the resource, they will overuse the resource in question, and underuse complementary inputs that are available at competitive market prices. Net economic output would be increased if resources were reallocated from the subsidized or free goods to those that are competitively priced.

  What are the implications for the environment? If the subsidized inputs have polluting effects, the negative environmental effects will be greater than in the absence of the subsidy. The opposite also holds true: if the subsidized inputs have positive environmental effects, the environment will gain from such subvention.

- **Output pricing:** In many African countries, the price of some crop outputs have been controlled below that which would be obtained under competitive market conditions, for example, the price of food sold domestically and cash crops exported and the prices of some mineral outputs, for example, gold. In other instances, prices have been supported above market levels. Such price control/support is economically inefficient. The

price control below the market-clearing level will yield an output level below what is economically most efficient, whereas the price support above the market clearing level will induce a level of output that exceeds *what is economically efficient.*

What are the implications for the environmental endowment? If the outputs being reduced in volume as a consequence of pricing policy are environmentally positive in effect, the pricing policy will be environmentally negative in effect. If subvention supports crops that protect the environment, the policy intervention will, other things being equal, be environmentally positive.

- **Employment policy:** Employment policy can support or not support activities that are environmentally positive/negative.

Correcting this asymmetry in the incentives facing producers and consumers is at the heart of the structural adjustment process. Pricing of environmental assets so that producers and consumers recognize their scarcity value and act on the implications is at the heart of the NEAP process. Therefore, a coincidence of interest can exist between environmental policies and development imperatives; this should be overtly recognized.

In an important study by Krueger, Schiff, and Valdés (1991), the influence on agriculture of direct sectoral interventions (mainly price intervention) and indirect (overvalued exchange rate and protection for domestic industry increasing cost of inputs) on a range of countries was assessed from the early 1960s to the mid-1980s. The study concluded that the percentage changes from border prices for the three countries—Côte d'Ivoire (cocoa, coffee, and rice), Ghana (cocoa, corn, and rice), and Zambia (corn, cotton, and tobacco)—comprising the African sample were a decrease of 28.6 percent due to indirect interventions and 23 percent due to direct interventions.

These numbers are no longer relevant, because the three countries analyzed have since embraced structural adjustment. It does, however, show the significant negative effects on the prices received by farmers, which can be exercised by sectoral and macroeconomic policies combined. This in turn influences crop combinations and environmental performance.

3.5 Stabilization and Structural Adjustment

Broadly defined, stabilization is a process of bringing government expenditure (especially current expenditure) into line with income, stabilizing and if possible reducing the rate of inflation and bringing the value of the currency closer to its market value. Of itself, stabilization will generally not be sufficient to achieve economic growth, but the latter is difficult to sustain without the former. For an economy running unsustainably large government budget deficits, printing money at a rate that leads to accelerating inflation, and operating an exchange rate for its currency that is substantially at variance with market value, it is a necessary but not sufficient condition of sustained development that stabilization be achieved. In its most simplistic terms, the International Monetary Fund has been working with a number of countries to achieve such stabilization, with widely varying degrees of success.

Structural adjustment is the process of helping an economy respond effectively to market signals, to reach the point at which producers and consumers confront prices that reflect resource scarcity and adjust their production and consumption decisions accordingly. Once this has been achieved, resources will be applied where their payoff is greatest and a country's competitiveness will be enhanced accordingly. Achieving a competitive response involves allowing market prices for inputs and outputs to prevail; eliminating those institutions, regulations, subsidies, and taxes that act as a wedge between producers, consumers, and market signals; and providing an exchange rate that reflects the market realities in relation to currency value and that allows imports of inputs for economic development as required by users, rather than being rationed.

Because stabilization and structural adjustment are typically closely related, in the discussion that follows, distinctions between the two will not be made. Structural adjustment can be taken generically to refer also to stabilization, when the sense of the text so implies.

Almost every country in Africa is going through a process of stabilization and structural adjustment, although this terminology may not be employed to describe it. Almost every dimension of economic and social policy is affected by such processes. It is impossible to conceive of an effective NEAP process that does not connect with these underlying policy changes and that can be environmentally positive or negative in their effects, depending on their nature and how they are implemented. To ensure that the NEAP is not irrelevant from the outset, this linkage must be recognized and the implications acted on, hence the treatment of this specific policy at this early stage in the book. Many of the issues raised here are addressed in more detail in later chapters.

The short-term costs of making these adjustments can be high. Structural adjustment loans (SALs) have been provided by the World Bank to help achieve these ends. When loans have been targeted at a particular sector, they are called sectoral adjustment loans (SECALs).

Sebastian and Alicbusan (1989) have reviewed the implications of stabilization and adjustment lending for the environment in general terms. Cruz and Repetto (1992) analyzed the environmental effects of stabilization and structural adjustment programs in the Philippines, whereas in Reed (1992) a World Wide Fund for Nature (WWF)-inspired review examined the history of stabilization and structural adjustment in general terms and with specific reference to the environmental implications in Côte d'Ivoire, Mexico, and Thailand.

3.5.1 Structural Adjustment Measures

The following can be recognized as some of the measures that characterize structural adjustment, although the precise package will vary from country to country:

- Devaluation of the currency to bring it closer to market value and the associated setting up of currency auction mechanisms. The effect generally is to increase sharply the price of imports and exports, thereby discouraging the former and encouraging the latter. The export of goods that have a low import content, such as logs, will be particularly encouraged.
- Removal or relaxation of price controls or subsidies of certain consumer products, such as fertilizers, kerosene, electricity, and some food products, or some combiniation of these.
- Removal of some or all monopoly power from parastatals to buy and sell particular inputs and commodities, for example, farm machinery and cotton. Freer access to local and, in some cases, international markets.
- Reduction in the proportion of total export revenue captured by government via excise duties or other means, thereby increasing the proportion captured by the producers. (This assumes that the provision of services by intermediaries between producer and market is reasonably competitive.)
- Reduction in subsidization of farm inputs, such as fertilizers, seeds, and irrigation water.
- Improved efficiency of resource allocation, involving redirection of resources to priority areas and reduction of administrative overhead, to allow an increase in the direct provision of goods and services. Such redirection of expenditure may occur between sectors, for example, less on military and more on education, or within sectors, for example, less on university education and more on primary education.
- Liquidation, restructuring, privatization of state-owned companies, or any combination of these.
- Institutional development in sectors favored by SECALs and cutbacks in other publicly funded areas and institutions. In the short run, health and education services may suffer as a result of the cutbacks.
- Particular attention to reform of financial institutions and budgetary and planning systems.
- Overall, the prevailing ethos of decision making will be based on performance, rather than possession.

Any reallocation of resources and effort of the magnitude and ambition that characterize most structural adjustment programs will entail winners and losers but should not be a zero sum game. The gains should far exceed the losses. But it is important that mechanisms be in place to compensate the losers. Social adjustment programs have been introduced in some places to compensate those most hard hit by the changes.

3.5.2 Effects of Structural Adjustment

If structural adjustment succeeds, it will result in a growing economy, typically based in the first instance on internationally competitive resource-based sectors, evolving into primary and secondary manufacturing and the provision of internationally competitive services. Government will be reduced in size, and its quality increased; in particular, decisions on the public investment program and its management will improve. The private sector will increase its share of total economic activity and operate in a competitive environment with government playing an enabling role.

Prices of inputs and outputs will reflect those that would prevail under competitive market conditions, and producers and consumers will respond accordingly.

Inevitably, *realpolitik* will enter in, as vested interests strive to protect their interests, as private entrepreneurs strive to establish local monopolies, and as the political process attempts to accommodate regional interests. But in the countries that succeed, the balance of advantage will shift to those individuals who perform and away from those who do not.

What does all this add up to in practice for the environment? The outcome for the environment in the short run seems to be mixed. For example, devaluing the currency and bringing it into line with market realities has the effect of making log and sawn timber exports more competitive. This in turn increases deforestation pressures unless tenurial arrangements and royalty charges are simultaneously improved, which they generally have not been, although work is ongoing in this regard. The competitiveness of tree crops (cocoa, tea, and oil palm) is improved. This is environmentally positive, because such crops protect the soil but may also justify encroachment into forest reserves.

3.6 Structural Adjustment and the NEAP Process

How is structural adjustment likely to affect the environment and, thereby, the NEAP process? It is important to apply the conventional "with/without" method: what would the situation in relation to the economy and environment be with structural adjustment and without it—the difference being attributable in some sense to structural adjustment. To get a sense of the "without structural adjustment" situation, to which the "with" situation should be compared, it is useful to review the trends in environmental performance before structural adjustment to provide a baseline. It can be hypothesized that the existing (that is, before structural adjustment) trends would continue in the absence of structural adjustment. In those cases, however, where government financial support was necessary to maintain the *status quo*, for example, in the case of fuel and food subsidies, it is likely that in the "without" situation the subsidies would be cut back anyway because a primary stimulus for structural adjustment is the ability of governments to pay their bills.

3.6.1 Growth, Development, Distribution, and Environmental Quality

If structural adjustment is successful, the main long-term effects will be the improvement of economic performance. A complex relationship exists among economic growth, development, income distribution, and environmental quality. For poor countries whose economies are based on natural resource exploitation, lack of income can plausibly be posited as an important contributing factor in environmental degradation. But, as we know from experience in Thailand, Mexico, and elsewhere, economic growth does not necessarily result in environmental improvement and may well result in the reverse. Unless the appropriate policies are in place and implemented—their achievement is the core rationale for the NEAP process—no necessary coincidence exists between economic growth and the conservation of environmental endowments in the short term. In

the long term, the destruction of environmental assets may well stymie the attainment of sustainable development. National debt and environmental degradation are also linked. To the extent that a country's resources are being used to pay back debt, less is available for current private consumption, investment, or government expenditure. To judge the net effects of, for example, reducing or eliminating the national debt on environmental quality, we would need to know the environmental effects, if any, of the manners in which the resources so released were used.

If the fruits of structural adjustment are captured mainly by a small elite who use the proceeds to purchase consumer imports, the long-run positive effect will be modest. To the extent that the fruits of such improvement are distributed among the populace and to the extent that poverty is regarded as a prime cause of environmental degradation, the environmental effects of structural adjustment in the long term will be positive. In the same vein, growing incomes will generate the means by which the private and public sectors invest in environmental protection. But growing incomes can be a cause of environmental degradation: almost all issues in environment are two-edged; income growth is no exception. If policies are appropriate, the net environmental impact of increasing income can be positive; if policies and their implementation are deficient, the opposite will be true.

Associated with improved economic performance will be an increased systematization in the evaluation of investment proposals. Environmental investment will have to compete for funds in an arena that increasingly will demand value for money and coherent justification for the allocation of scarce resources. With appropriate analysis, properly presented and appropriately communicated, environmental investment will be able to compete, but the NEAP economist will be central to the success of this endeavor. But, of course, the essence of the NEAP process is that in the long term no dichotomy can exist between environment and economic efficiency. If environmental assets are destroyed so that they cannot play their full part in the development process, the prospects of the latter will be blighted.

3.6.2 Some Examples

In their study of the Philippines, Cruz and Repetto (1992) concluded that the environmental implications had been significantly negative; a computable general equilibrium model of the economy was constructed to assay the effects of structural adjustment. The conventional wisdom had posited that structural adjustment would favor resource exploitation, notably deforestation. In fact, resource exploitation slowed down somewhat in comparison with the pre-adjustment situation, but the overall effect was nevertheless environmentally negative. As a consequence of adjustment-induced reduction in employment in the public sector, millions of individuals were released from the public sector who, in the absence of effective tenurial or other appropriate land and forest policy arrangements, had commenced environmentally destructive farming on fragile soils and in forest areas.

In three case studies (Mexico, Thailand, and Côte d'Ivoire) undertaken under the aegis of WWF, the environmental implications of stabilization and structural adjustment are assessed. They conclude that the results were somewhat ambiguous, with both positive and negative features (Reed 1992). These studies highlight the methodological difficulties in determining (1) what is and is not attributable to structural adjustment and (2) what are the environmental implications of price and other changes. In regard to Côte d'Ivoire, with or without structural adjustment, the lack of effective land and forest tenure arrangements and the use of prices for standing wood that are well below the market-clearing level have resulted in the destructive use of forest. In a review of case study analyses linking structural adjustment effects to the environment, Barton (1993) suggests that it is important to be explicit on the environmental impact variables used. Specifically, specifying flow variables (flow of materials into and out of the environment) is necessary in the modeling process to uncover linkages, tracking changes in environmental state variables back to the resource users, and ultimately macroeconomic policy.

Box 3.1:

Potential Environmentally Negative Effects of Market Pricing: Gum Arabic in Sudan

Barbier (1990) compares the financial and economic returns for a range of crops assessed for various regions of Sudan. The crops evaluated included the gum arabic tree (*Acacia senegal*), which produces gum, fodder, and fuel; sorghum; millet; groundnuts; and sesame. The gum arabic tree is more environmentally positive in its effects than the competing crops. The economic analyses incorporate adjustments in the currency to reflect market conditions and the use of prices that reflect world prices. These are the kinds of changes that characterize structural adjustment. They do not reflect the external benefits and costs that these crops generate. In particular, they do not reflect the fact that *Acacia senegal* plays a role in reducing soil erosion, fixing nitrogen, reducing wind erosion, and inhibiting desertification.

The financial and economic returns were summarized as follows in 1989 Sudanese pounds per unit area (feddan), using a discount rate of 10 percent:

	A. senegal	Sorghum	Millet	Groundnuts	Sesame
NPV (Financial)	152	-671	-357	-316	567
NPV (Economic)	2,065	2,412	2,329	9,461	9,468

The results indicate that under the controlled conditions obtaining in 1989 on prices and markets, gum arabic would be preferred by farmers over all crops except sesame. But after adjustments have been made to reflect real prices for crops and for the currency, gum arabic becomes the least attractive. The strong policy implication is that, as the economy brings the pricing of its outputs to better reflect market realities, environmental damage will ensue unless the positive externalities associated with gum arabic are reflected in policy and in the signals being received by farmers. Otherwise they will abandon gum arabic for more environmentally destructive crops. The objective is not to stop the adjustment process but to ensure that environmental assets are appropriately accommodated so that the long-term objectives are not confounded because the environmental foundation is too weak to sustain a dynamic economy.

Warford and others (1994) summarize the evolution of environmental concerns in structural adjustment lending from a World Bank perspective. The conclusions generally are the following:

- Models of national economy—computable general equilibrium models or input output models—are needed, together with linkage between macroeconomic changes and environmental change, to analyze environment-related impacts of structural adjustment comprehensively.
- With existing data and models, it is possible to give a qualitative sense of the likely direction of structural adjustment-induced environmental change.
- Complementary policies, especially having to do with improved security of tenure, distribution of benefits and costs, and institutional development, need to accompany traditional structural adjustment policies if the management of their environmental dimensions is to be economically efficient.

We have seen that the main effects in practice of structural adjustment at the level of firms and individuals will be to sharply change relative prices. How the price changes that are likely will affect behavior in relation to environment will depend on the incentives that are created in this regard for producers and consumers, a topic that is discussed at some length in chapter 5.

3.7 Sectoral Development

Every sector has its own characteristics. Policy needs to be customized to reflect this fact.

3.7.1 Development Path

Many African economies will pursue the following development path:

- The *first stage* will involve achieving the efficient production of natural resources, in which efficiency entails producing what consumers want at internationally competitive prices. The production and consumption of food and commercial crops will expand, as will mining output. Tourism based on a combination of unique biodiversity and coastal ambience will become important in those countries with the appropriate endowments and policies. But the dynamics of technology, subsidization of food production by the developed world, and protectionist policies generally will combine to make an exclusively resource-based economy an unsatisfactory long-term development strategy.

- The *second stage*, which will overlap with the first, will involve industrialization at relatively low skill levels with output expanding and becoming more capital intensive and skill-based as knowledge and capital accretes. Countries in sub-Saharan Africa have serious disabilities imposed by the exceptionally small size of domestic markets. The evolution in Mauritius, however, from a resource-based (sugar) to an industry- (textiles/garments) and service-based (tourism) economy shows that the absence of a large domestic market is not necessarily a barrier to a successful transition.

- A *third stage* will entail the emergence of higher value-added manufacturing and services.

The demographic transition: Associated with this evolution is a drop in the rate of population growth, which improves the prospects for *per capita* increase in output and income. In Africa this transition has been slow in coming. The total fertility rate (TFR)—the average number of children who would be born alive to a woman during her lifetime if she were to pass through her childbearing years conforming to the age-specific fertility rates of a given year—for sub-Saharan Africa as a whole has remained constant at about 6.5 to 6.6 for the past 25 years. (The replacement rate is 2.2 per woman.) There are signs of change, however, as is shown in table 3.3.

Table 3.3: Changes in Total Fertility Rates

Country	Recent Drop in TFR
Botswana	6.9 in the 1960s to 4.7 in 1989
Kenya	8.2 in 1977 to 6.5 in 1989
Mauritius	4.8 in the mid-1960s to 1.9 in 1990
Nigeria	Drop to 5.7 in 1990
Zimbabwe	8.0 in the 1960s to 5.3 in 1989

Source: Cleaver and Schreiber (1991, 28).

The interface between the development process and environmental policies can be addressed in the context of sectoral issues.

3.7.2 Tourism

The relation between environment and development is perhaps the most transparent in the tourism sector. The African countries are relatively remote from the primary tourist-originating markets. They have image problems in that prospective tourists regard their culinary offerings as limited and are concerned about diseases, such as malaria and AIDS. Transport services and basic facilities and infrastructure are weak. Civil disturbance creates apprehension. On the positive

Box 3.2:

Causes of High Birth Rates in Africa

Cleaver and Schreiber (1991) suggest the following factors are important:

- Most women live in rural areas, have little or no formal education, have few opportunities outside their traditional roles, and have limited legal rights.
- Childbearing enhances their status. Most women marry early, begin having children early, and continue having them throughout their fecund years.
- Among all women, desired fertility is far higher than elsewhere, but (1) younger women desire fewer children than older women, (2) urban women desire fewer children than rural women, and (3) educated women want far fewer children than uneducated women.
- Prolonged and nearly universal breast feeding has been the main factor in keeping fertility below a biological maximum.
- For women, the only means of securing adequate labor for their many tasks may be from their own children.
- Allocation of land on the basis of the ability to cultivate it may comprise an incentive to have children.
- Large families, by providing adequate farm labor and security for the parents in old age, tend to do better than small families.
- As soil fertility declines and distance to fuel and water increases, many rural women find that the only means of dealing with the situation is to increase the use of child labor.
- In many societies, women only have access to resources such as land and public services through male relatives, which increases the incentive to have as many male children as possible as a back-up in the event of the death of or divorce by her spouse.
- Total fertility rates are highest in those countries with a high rate of infant mortality.

All these forces combine to produce a culture that prizes large families and uses little contraception. Improving education, especially that of women, reducing the rate of infant mortality, and improving the quality of the environment are likely to lead to increased demand for birth control.

In an important study of successful adaptation to population pressure, English, Tiffen, and Mortimore (1994) show that in the Machakos District of Kenya, although population has increased from 227,000 in the 1930s to 1.4 million in 1989, food production per capita has increased, livestock numbers have increased, and the environment has not deteriorated. An individualistic (privatization) culture combined with the introduction of 45 technological innovations and good access to them explain the outcome.

side, countries have unique biota (both plants and animals), in some cases cultural artifacts of some significance, dramatically beautiful scenery, nice beach environments, warm winter weather, and friendly people.

To participate successfully in what is perhaps the most competitive business in the world, the right images must be lodged in prospective customers' minds. It must be as easy as possible for them to translate the image to reality by getting to the country in question. Then, the total experience on the ground must be sufficiently arresting so that they in effect advertise the destination to their friends when they return home.

It is clear that a high quality and diverse environment is central to the tourist appeal of all African countries. It will not be possible for them to develop sustained tourism unless key features of the environment—the coasts and the main wildlife features—are conserved. For resource-based economies, tourism, although small in absolute terms, will often provide the best prospects for growth. It follows that protection of the environmental base and its associated image is central to the prospects of such economies. This theme is developed further in chapter 10 regarding Mauritius.

Retaining options for future development is an important strategic point that needs to be made on a simple with-without basis. For example, wildlife conservation in Uganda provides the basis for an estimated $15 million tourism industry with considerable prospects for growth. (World Bank 1993).

3.7.3 Agriculture

The linkage between environment and development in this sector operates at a number of levels. As noted above in the discussion of input and output price distortions, where deficiencies in incentives lead to mining of the soil and extension of cultivation into marginal areas, removing such distortions can result in expansion of output on existing farmland and simultaneously improve the environment. A positive environmental image will in some cases be beneficial in the case of food for export; the contrary can be harmful to access to markets and the capturing of premium prices. In the case of industrial crops traded in bulk, however, no premium is likely to accrue to environmentally positive production.

Although a plausible linkage between sectoral policy and environment can be suggested, little empirical work validates such a linkage. In chapter 8, the gross costs incurred as a consequence of soil degradation and other forms of environmental loss are estimated for Ghana.

3.7.4 Forestry

Achieving the sustained management of indigenous tropical forests in a fashion that reconciles financial and ecological imperatives comprises one of the greatest environmental and economic challenges in Africa. The standing forest is a valuable storehouse of capital in the form of commercial wood and as a machine that, in addition to producing wood, also produces a variety of nonmarketed or only partially marketed goods and services, including meat, soil protection, water storage and filtration, a sink for carbon, genetic diversity, and so on.

From a country's point of view, the central economic problem arises from the fact that, although the capital value of the wood stored in the forest is high, it is difficult and often impossible to get a commercial return on this capital, while maintaining the forestry machine intact. First, the ecology of tropical forests is such that a significant reduction in the standing volume can impair the entire forest; a harvest of, for example, 10 percent of the standing volume is difficult to achieve, while maintaining the productive capability of the forest. Second, most of the other outputs either occur downstream or are not marketed and do not have a price that can be readily captured by the forest owners. The management difficulties that come from the nature of the endowment are typically exacerbated by the actions of the countries themselves: selling the wood at prices well below market prices and providing poor tenurial arrangements.

Development of a mix of strategies can encourage the maintenance of the indigenous forest base, including (1) designing and implementing incentives, which in effect pay local people to conserve the forest; (2) implementing wood sale and management systems, which pay the concessionaires and wood purchasers to harvest

Box 3.3:

Hypothetical Discussion of Rain-Fed Agriculture

Farmers can expect improved producer prices for internationally traded goods, especially tea, from devaluation of the currency, which is designed to approximate its market value, and changed government policy on excise duties. Although decontrolling fertilizer prices and currency changes will make these inputs much more expensive, the soils in most productive areas require few inputs; thus, farmers will have a strong incentive to expand tea production. Although food crops can be traded on the open market, the combination of poor infrastructure and high fertilizer costs will shift the balance in many areas to favor tea.

Replacing maize and other annual crops with tea will improve soil stabilization because tea protects the soil better than other crops under current management practices. Agricultural extension agents, however, expect most of the expansion in production to take place at the extensive margin where ostensibly state-owned forest can be cleared by fire and planted. Because the land is in effect free to the farmer and burning provides free nutrients, this is the least-cost option for cashing in on the opportunities opened up by currency changes and changes in government policies on pricing.

The forests likely to be destroyed are estimated to produce the equivalent of AF$5 million of meat alone a year. The accelerated loss of this area will cut this yield in at least half within five years, and the forests, which are expected to last for another 50 years under current policies, will disappear within 25 years. No one has really counted the species found in these forests, but experts regard them as an outstanding reservoir of biodiversity. Their destruction would impose two potential costs in addition to the meat losses. We have talked for the past five years of getting serious about tourism, which would have to be based in part on our wildlife and its habitat. So far we have done nothing effective for a number of reasons. We still have the option, however, to develop this sector; if the remaining forest areas go, this option is gone. Likewise, it is clear from the way in which the Global Environment Facility (GEF) is being administered as a pilot scheme that money will be available in the future for those countries that make a serious

(continued next page)

carefully; (3) using revised tenure, pricing, and other incentive mechanisms to encourage successful establishment and management of plantations; and (4) developing commercial markets for the sustainable outputs of the forest.

3.7.5 Mining

In the case of tourism, agriculture, and forestry, a long-term sectoral self-interest exists to accommodate environmental considerations in the development process. Indeed, unless the environmental dimensions are addressed appropriately, these assets will be destroyed. The policy challenge is to create the framework in which the inherent logic of this view is accepted and the incentives encourage its realization.

In the case of mining, although a strong national development interest exists to ensure that the sector does not damage development prospects elsewhere in the economy, the mining sector itself will not suffer in the short term if the environment is degraded. In the long term, environmental degradation may damage the sector's developmental prospects if the public associates mining with such degradation and the associated implications for health.

Encouraging and facilitating investment in this sector requires that prospective investors expect

effort to conserve their biodiversity. To cash in on this opportunity, however, requires that we have something unique to offer the world community and that we have at least some credibility in managing it. The costs of implementing structural adjustment without making a parallel effort to secure indigenous forests from intrusion may impose heavy costs within five to ten years.

It is important to maintain the incentive for farmers to expand output, but it is also important to ensure that, in so doing, the future economic potential of our society is not blighted. The following measures should be considered:

- Provide special extension services for farmers who can intensify production on existing cultivated land, for example, by restoring and rehabilitating existing plantations and so on. The cost of this, targeted at the most promising farmers for three years, is estimated at AF$0.25 million a year or AF$250 on average for each of the 10,000 farmers targeted.

- Provide incentives for the farmers living in the vicinity of the key biodiversity areas to protect the forests in their relatively pristine state. We could afford to spend about AF$0.5 million annually for the next five years on this and still end up ahead, in the sense that the total costs of extension and transfers to forest communities would not exceed the value of the bush meat lost if we take no action. What we want to do is in effect transfer to local communities effective ownership of these areas, to be exercised within parameters that will conserve their essential features. We have little experience with this type of program; however well we design it, we will learn much by doing it. A full analysis would require us to value the option of maintaining the tourism and GEF Mark II options on the benefit side of the column and the additional costs imposed on farmers who intensify rather than plant virgin land on the other.

Although doing so involves risks, I believe the issues are so important for our environment, our future economy, and our image abroad (especially with donors) that we should make the relatively small sacrifices needed to keep future options open. We will demonstrate that our commitment to sustainable development is more than rhetorical. The funding required should be built in as an integral component of the structural and sectoral package as a simple cost of doing business and as a prudent and cost-effective means to keep options open.

to achieve a competitive return on their investment, having adjusted for risk and uncertainty. The environmental management challenge is to ensure that potential environmental damage is reduced to an acceptable level, using means that minimize the reduction in the prospective rate of return for investors in the sector.

3.7.6 Industry

With regard to the sectoral self-interest in a high quality environment, industry falls midway between agriculture, forestry, and tourism, which have a high degree of self interest, and mining, in which the short-term sectoral benefits of a high quality environment are relatively low. Basic indigenous processing industries likewise have little vested interest in a high quality environment.

For firms producing consumer goods, however, image can be central to marketing success. In such cases, an association with a high quality environment can be important and the converse can be damaging. In the extreme case of the latter, the damage can be terminal.

Most large multinational firms are image sensitive; a reputation anywhere in the world for environmental fecklessness is likely to damage them in their main markets. Thus, for such companies, environmental management should in-

volve confronting them with clear policies that are consistent with what they experience at home and with an active local and international NGO presence, which will ensure that the costs of nonperformance are borne in the form of poor publicity. With indigenous industry, agreement to implement a program over time, using the various policy instruments noted earlier, comprises an effective means of improving environmental performance without threatening commercial viability.

3.8 The NEAP Economist

The NEAP economist should be mindful of the following points in his or her work:

- Develop as clear an understanding as possible of the economic development process and the roles of sectors in this regard.

- Plot the shares of the Public Investment Program over time, and assess the implications for policy priorities.

- Assess where growth is likely to come from in the short to medium term (one to five years) and get to know the key actors—in both the private and the public domains—in the sectors concerned.

- Identify the key *constraints and opportunities* implied by environmental management. For example, biodiversity conservation might represent an opportunity for tourism, whereas protection of water, air, and land might represent a constraint for mining.

- Develop a draft position paper with a topic such as "Environment as a Dynamic Force for Sustainable Development" to provide a basis for discussion and a point of contact and reference with colleagues.

- Understand the kinds of information on which decisions are made. Many cultures are predominantly oral and make decisions based on discussion rather than the digestion of briefing papers. However you communicate at the policy levels, in my view, it is always worth having something put on paper. The American author Flannery O'Connor said: "I do not know what I think until I see what I write." I feel that there is a lot of truth in that statement. Inconsistency and illogicalness become clearer as you attempt to weave a tapestry of your thoughts in writing. Nevertheless, you need also to use other media, if this is the basis on which decisions are made.

- Always bear in mind that those at the top of the decision-making process have several competing ideas and preoccupations for their time and attention. When you want a decision, prepare two documents; the first is short—one to three pages—and makes the key points and recommendations. The other is the background document, which provides the intellectual underpinning to justify the decisions you request.

Structural adjustment provides you as the NEAP economist with a great opportunity to connect with the policy process and to shape policies that are environmentally neutral or positive. Most analytical effort in both economic analysis and environmental assessment goes into projects rather than policies. The payoff of a marginal improvement in policies that influences thousands of decisions positively, however, is likely to be much greater than even substantial influence on a single project; this conclusion is dramatically reinforced if you can influence policy at the formulation stage and if the decisions on the character, scale, and location of projects are in practice already decided before your analysis is undertaken.

An economist's scarce time and effort should be allocated where it can do the most good, other things being equal, at the stage of policy rather than of projects. (This is not always true; a large project with substantial environmental effects may warrant more attention than policies of limited collective environmental impact.) The point is that scarce analytical effort should be allocated rationally.

Structural adjustment provides the window of opportunity for getting to the policy table. Make sure to go through it.

- Encourage the development of macroeconomic models of the national economy

Table 3.4: Sample Matrix for Likely Production and Environmental Impacts

Action	Sectoral Environmental Implications							
	Energy	Urban	Crops	Grazing	Forest	Wildlife	Mining	Industry
Currency Devaluation								
Remove Price Controls								
Reduce Excise Duties								
Increase Product Prices								
Free Market Access								
Reduce Subsidies for Farm Inputs								
Privatization of Parastatals								
Institution Strengthening								
Financial Reform								

that allow the integration of environmental impacts into their analytical framework.

- At the sectoral level, outline the likely production and environmental impacts—with regard to the direction of change, if quantitative analysis is impossible—of the measures proposed or those being implemented under structural adjustment if there is no environment-specific policy response. A matrix, such as that shown in table 3.4, can be used to organize the discussion: Neither row nor column is intended as a complete taxonomy. Where relevant, the short- to medium-term (up to five years) and medium- to long-term (five years plus) prospects need to be discussed.

- Indicate the policy responses that would help ensure that the structural adjustment effects were not economically inefficient and environmentally damaging.

- Discuss each sector. See box 3.3 for a hypothetical discussion of rain-fed agriculture.

This somewhat discursive discussion opens up a number of issues and options but in a fashion that does not threaten and does not define the choices as zero sum: either the environment or the farmers win. It does not say that nothing can be said because we have not done a substantial study; nor does it imply that success is inevitable. The objective is to ensure that the possible environmental implications get onto the agenda as quickly as possible, to help have specific, quantified options considered in as helpful a way as possible, and to arrive at affordable possible solutions. A similar kind of analysis can be done for the other boxes in the matrix, even though little can be said about many of them.

Discussion Questions

1. What are the implications of the Single European Market for the economic development prospects of your country? Are there prospective associated environmental impacts?
2. Fill in table 3.5 for your country, modifying the sector categories as appropriate: Do the same for current expenditure. Discuss the implications for the evolution in government priorities.
3. A farmer is considering expanding output with AF$80 he has saved. He can use either additional labor or fertilizer. Assume that the effects of these inputs are independent of each other and that these are the only investment choices he has. The additional output associated with additional inputs of labor

Table 3.5: Sample Matrix for a Public Investment Program

Sector	1983	1993
Agriculture		
Amount		
Percent of Total		
Transport		
Amount		
Percent of Total		
Energy		
Amount		
Percent of Total		
Industry		
Amount		
Percent of Total		
Tourism		
Amount		
Percent of Total		
Forestry and Wildlife		
Amount		
Percent of Total		
Environment		
Amount		
Percent of Total		
Education		
Amount		
Percent of Total		
Health		
Amount		
Percent of Total		
Social Welfare		
Amount		
Percent of Total		
Defense		
Amount		
Percent of Total		
Other		

Additional labor input	Additional output induced by labor	Additional fertilizer input	Additional output induced by fertilizer
20	30	20	28
20	25	20	23
20	23	20	22
20	15	20	21

and fertilizer are estimated to the left (all units in constant AF$).

a. How should he allocate his AF$80 between labor and fertilizer to maximize his additional output? (Hint: Try different combinations, bearing in mind that net output is maximized when returns to inputs at the margin are equal.)

b. If the money available to him doubled to AF$160, how would he use it?
c. If he needed funds quickly to provide for the health of his family, how is it likely to influence his decision?

Note: Show the additional output induced by different combinations of AF$80 of labor and fertilizer.

4. Take any sector in the economy, and:

a. describe trends with regard to *changes* (output composition, prices, volume, area, and so on).
b. identify the key elements of policy (prices, subsidies, regulations, property rights, and so on) that influence sectoral performance.

5. Identify the key elements of structural adjustment in your country. In what respects are policies likely to be different if structural adjustment had not been embraced? How has environmental performance been influenced?

Further Reading

Cleaver, Kevin M. and Götz A. Schreiber. 1991. *The Population, Agriculture, and Environment Nexus in Sub-Saharan Africa.* Washington, D.C.: World Bank, Africa Region.

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Reed, David, ed. 1992. *Structural Adjustment and the Environment.* Boulder and London: Westview Press.

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Chapter 4

Underlying Causes of Environmental Degradation: Identifying Perverse and Positive Price Incentives

This chapter focuses on the signals we get in our day-to-day production and consumption decisions. These signals have, in a sense, the effect of unconsciously influencing our behavior in an environmentally positive or negative fashion. Your role as a NEAP economist is to get under the skin of the economy to understand the incentives that encourage conservation and destruction. In this chapter, I will focus on how to address price incentives in particular. In chapter 5, I will address the use of taxation, grants, and regulatory incentives in this context.

Combining trends in prices of key inputs (for example, fertilizer in the Ghana case to be addressed later) with those of output prices, quantities, and land use changes allows us to see what is happening, why, and what the environmental implications are.

Because one of the *raison d'êtres* for NEAPs is to take the long view and anticipate as well as deal with current problems, it is important not to become obsessed with the environmental issues associated with existing production systems to the exclusion of considering future challenges. Environmental problems do not go away; they simply change their form. Most African countries will ultimately make the transition from extensive to intensive agriculture. This will take the pressure off the forests and fragile lands; indeed, contraction of the area under cultivation can ultimately be expected. The environmental management issue then will shift to how to intensify use of water, fertilizers, machinery, and so on in fashions that protect the environment.

In appendix B, I simulate the experience of a farmer to understand the incentives for the key individuals involved. I also use graphs to show how time-series data can provide insights. A word of caution: the time series used are so short in most cases that they do not lend themselves to statistical analyses from which clear inferences can be drawn. I do fit a few linear curves, which are provided by the Cricket Graph package, to show some possibilities in this regard.

4.1 The Centrality of Incentives

If the incentives facing producers and consumers encourage environmental degradation, it is difficult to reverse the cycle of environmental decline unless the incentives are changed. This is a rather trite and self-evident statement, but acting on it can have radical implications for environmental policy and management. It means that environmental policy must concern itself with the manner in which an economy is managed and with policies on taxation, exchange rates, price controls, subsidies, definitions, or otherwise of property rights, and so on. In a sense, the breadth of concern that must be addressed if environmental planning is to be effective provides the central rationale for the NEAP process; the process is the mechanism by which incentives facing users of the environment can be analyzed, the policy changes needed to alter the incentives in a more environmentally benign direction can be identified, and such changes can be incorporated into the NEAP and implemented.

This undertaking is so fundamental to successful environmental management that action on it comprises a test of the efficacy of the NEAP process. If the incentives are effectively ad-

dressed, the NEAP will likely achieve success in the long term; if not, the reverse is likely.

The centrality of incentives for the success or failure of environmental management also demands a commensurate application of resources on the part of the NEAP economist. In allocating your scarce and valuable time, you should favor spending time analyzing incentives and addressing their implications. This will require a conscious decision to go counter to the day-to-day demands on your time, which will direct your attention to project analysis. The bias in favor of project analysis arises from two sources. First, environmental management can be viewed as a series of projects. Because the effects of specific projects in the end prove politically beneficial or damaging, they drive the policy and management process; environmental managers have to respond to this reality. Thus, Environmental Impact Assessment procedures are project-based, licensing procedures are project-based, and so on. Second, the preponderance of intellectual contributions have likewise been project-based. A typical textbook on environmental management will focus most of its attention on projects rather than policies.

Incentives can and should be addressed in a number of ways. Two will be explored here: role playing and macroeconomic sectoral analysis.

Box 4.1:

Role of Smallholder Producer Prices in Land Degradation in Malawi

Barbier (1990) makes a distinction between erosive—maize, cassava, cotton, and tobacco—and nonerosive—pulse and groundnut—crops in Malawi. He develops an annual price index for nonerosive and erosive crops and estimates the ratio of these over the 1969–90 period. He plots this ratio over time. The ratio did not rise significantly but fluctuated significantly over the period, indicating no tendency over time for either erosive or nonerosive crops to be favored by price.

4.2 The Uses of Role Playing

One way to explore incentives and their effects is to take each of the main categories environmental asset user and ask: if I were in this person's situation, how would I react to the choices that face me? A primary role of the NEAPs is to communicate as clearly as possible to policymakers and the citizenry the forces that result in environmental degradation and the most effective means likely to deal with them. Role playing can be useful in conveying insights in a fashion that is relatively nontechnocratic and relates to situations that the reader can understand. In appendix B, I outline hypothetically the likely reactions and reasoning of one such participant. An analogous exercise could be advantageously undertaken for other decision makers, such as a forester, a miner, an industrialist, an urban householder, a female farmer, and so on.

In most African countries, farmers, as the main users of the land, are the primary shapers of the environment. If they behave in a fashion that conserves soil, forest, and water, they will achieve the conservation of most of all environmental assets.

Looking at life from the point of view of key actors in the use of environmental assets yields some insights. Examining aggregate trends and prospects can also be useful and can be done in a number of ways. It is important to get as clear an understanding as possible on what drives the actions of the main actors in the system and identify the changes in their macroeconomic environment likely to change their behavior. It is useful to examine the role of prices, taxation, and subsidies as incentives.

4.3 Prices as Incentives

Perhaps the most fundamental signals we get every day are prices: those we pay as consumers and those we pay for inputs and receive for outputs as producers. Prices are significantly influenced by policies.

4.3.1 Energy Prices

One of the paradoxes of the development process is that the poorest countries are often among the least efficient users of energy (Kosmo 1989),

wasting scarce resources, thereby reducing net output, and damaging environmental assets. [5]

The causes of this inefficiency are many, but an important contributing factor in many countries is pricing energy supplies below their opportunity cost, that is, below what the economy pays to supply these resources.

Why is this important? The economic waste comes from a variety of sources with the common antecedent that consumers (households, industry, farmers, and services), by not paying the full costs, will not use energy as efficiently.

- Conservation will be underinvested, from less investment in more efficient charcoal-burning units to cars with better mileage.
- Relatively wasteful energy-using behavior will be encouraged. Energy will be substituted for labor, other materials, and capital at the margin.
- For countries that border countries that do not subsidize energy to the same extent, smuggling will take place, as the cheap fuel flows to capture the higher prices.
- Production of energy, from trees to natural gas development, will be discouraged.

Kosmo (1989) provides the most complete analysis available of such pricing. He shows that most oil-exporting developing countries subsidize petroleum products to domestic consumers. In consequence, often substantial foreign-exchange earnings are foregone because subsidies encourage domestic consumption, diminishing supplies available for export. The same applies in the case of coal and natural gas producers.

To assess the extent of subsidy or otherwise, Kosmo computes the ratio of retail to border prices. For net exporters, he defines the border price simply as the world price, whereas for net importers, it is the world price plus transport, landing, and insurance costs. Ratios above 1 indicate net taxation of petroleum products, whereas ratios below 1 depict net subsidies. The amount of the economic subsidy for each fuel is equal to the difference between border and retail prices multiplied by the level of domestic consumption.

The ratio data for a number of African countries are shown in table 4.1. The data indicate that, for the countries listed, in the early 1980s subsidization was not pervasive and the degree of taxation bore much more heavily on petrol relative to other fuels, especially kerosene. It is likely that these trends have continued and intensified as countries have embraced structural adjustment. (Note: Nigeria, which has substantial oil resources and would be expected to subsidize oil prices to consumers, was not included in this analysis.)

Kosmo also examined electricity pricing. For 12 countries surveyed, he finds the average prices charged for electricity substantially below long-run marginal costs of its provision. The long-run marginal cost in this context is the capital, fuel, and other operating costs per unit of output (kilowatt hour) of supplying additional electricity. The relevant data for the sub-Saharan African countries listed by Kosmo are shown in table 4.2. Note the antiquity of the data.

This is a striking example of a rationale for conserving electricity: the prices that consumers pay on average are substantially lower than the costs per unit of supplying new electricity at the margin. By cutting back consumption or at least by slowing the rate at which new capacity must be brought on stream, a country delays incurring high (relative to what consumers are now paying) additional costs at the margin.

Substantial environmental benefits also accrue from deferring capacity expansions. The nature and extent of these benefits will depend on a range of factors, including the location and forms of expansion envisaged. Such potential environmental benefits include:

- Preventing or slowing the expansion of hydroelectric power, which is likely to diminish adverse effects on the character of rivers and

[5] This section focuses on the environmental and economic inefficiency of inappropriate pricing of energy. Many other causes exist, however, including the lack of a regulatory framework allowing cogeneration by private producers, operating subsidies for monopoly electricity producers, corruption, and technical inefficiency. Munasinghe (1990a and 1990b) provides background and analysis of these general issues.

Table 4.1: Degree of Net Taxation and Net Subsidy of Selected Energy Sources in Some African Countries, 1981 and 1983.

Country	Year	Petrol	Kerosene	Diesel	Heavy Fuel Oil	Total
Ethiopia	1981	1.96	1.02	0.89	0.91	1.13
	1983	2.26	1.23	1.54	1.29	1.70
Ghana	1981	3.47	1.58	2.73	1.37	2.70
	1983	3.80	1.69	2.99	1.57	3.05
Kenya	1981	2.28	1.01	1.58	0.89	1.49
	1983	2.13	1.07	1.70	0.89	1.67
Uganda	1981	2.97	1.63	1.83	1.16	2.06
	1983	3.83	2.36	2.71	-	-

Source: Kosmo (1989, 247).

fisheries, and the conservation of biodiversity and may also reduce or eliminate the need to resettle displaced populations.

- Reducing the rate of expansion of fossil fuel-fired plants, which will diminish carbon dioxide emissions and may reduce the emission of other air pollutants and the thermal pollution of waters.

In the event of such a subsidy, that is, the ratios are less than 1, the case should be made that this is economically and environmentally wasteful.

Note, however, that there may be another reason why the long-run marginal cost is so high relative to average cost, namely, inefficiency in generation or transmission, or both. In such a situation, another solution is to increase generation and transmission efficiency to the point that the gap between long-run marginal cost and charges paid nears convergence.

Why do countries subsidize energy? They do so for a variety of reasons but mainly to indulge particular groups of the citizenry and improve the competitiveness of particular sectors, for example, industry. With the former, the case is often made that energy, being an essential good, should be kept as cheap as possible so that the poorest can afford some minimal comfort in this regard. But it is also true that those with the highest incomes consume the most energy so a subsidy based on all energy consumed will transfer more to the relatively rich. Targeted compensation in the form of direct income or energy transfers to those most in need comprise the most cost-effective means of meeting the objectives of equity, although not always feasible in practice.

The competitiveness argument can be rhetorically negated on the grounds that, in addition to the inefficiencies in energy use and supply engendered, the costs of the subsidy will have to be borne somewhere else in the economy. This will show up, in the form of poorer roads, education,

Table 4.2: Average Revenues and Long-Run Marginal Cost (LRMC) of Electricity Generation for Selected African Countries

(U.S. cents per kilowatt hour)

Country	Year	Average Revenues	LRMC	Average Revenue/LRMC
Ethiopia	1983	6.01	18.78	0.32
Senegal	1981	11.70	12.72	0.82
Tanzania	1983	7.79	8.20	0.95
Uganda	1982	1.20	8.00	0.15

Source: Kosmo (1989, 249)

or whatever, as a loss of competitiveness in other sectors.

A more subtle and, depending on the circumstances, convincing argument is sometimes advanced in those cases where a government-owned resource such as natural gas is concerned that underpricing of the resource at least ensures that consumers get the benefits; with full competitive pricing, the government captures the value. If the government is especially incompetent or corrupt or both this will result in dissipation of the asset in wasteful and perhaps even actively harmful ways. The solution is to reform the government. This is not always feasible; in such circumstances, low-cost pricing may be an appropriate interim second-best solution, but it implies both economic inefficiency and, as part of this inefficiency, environmental degradation.

It should also be noted that too high prices can also have perverse effects on decisions. In situations where poor households are purchasing small quantities of expensive (in relation to income) charcoal, it can put such a drain on disposable income that purchase of stoves, which are relatively expensive but yield a large payoff in efficiency and convenience, is impeded. This is a function of high rates of time preference (the rate at which future benefits are discounted) and perhaps also failure in the credit system.

4.3.2 Local and Foreign Exchange Value

Exchange rate policy will affect the prices of imports and exports. Table 4.3 on Ghana makes the point, showing that an exporter selling goods for U.S. dollars will have achieved a 2.37 times increase in real price over the 1984–89 period (36,990/15,624 = 2.37) with some decline occurring from 1989 to 1990. If the goods in question require few imported goods to produce, for example, roundwood logs, a substantial gain will accrue to the resource owner and extractor, depending on how rights to them are allocated. This is important, because, as we have seen in chapter 3, one of the intended effects of structural adjustment is to encourage and facilitate exports by allowing producers to capture the full value of exports.

Note, however, that I have used the official exchange rates, not the parallel rates prevailing in the free market. The implication is that our hypothetical exporter could only avail of the official exchange rate, which is not fully in accord with reality.

4.3.3 Use of Time Series in Mauritius

The incentive effects of tourism can be environmentally positive and negative. They can be positive if associated development is channeled in a fashion that is not environmentally destructive and if the need to attract tourists provides the ra-

Table 4.3: The Effects of Changing Exchange Rates and General Inflation in Ghana on the Value of US$100 in Constant Cedis of Imports or Exports.

Year	Cedis/US$	Cedis/$100	CPI 1977 = 100	CPI Multiplier	Constant Value of $100 in 1990 Cedis
	(ii)	(iii) (ii) x 100	(iv)	(v)	(vi) (iii) x (v)
1984	36	3,600	3,304.2	4.34	15,624
1985	54	5,400	3,647.2	3.93	21,222
1986	106	10,600	4,543.1	3.16	33,496
1987	162	16,200	6,352.0	2.26	36,612
1988	202	20,200	8,343.9	1.72	34,744
1989	270	27,000	10,449.3	1.37	36,990
1990	330	33,000	14,341.5	1.00	33,000
1991	375	37,500	n.a.	n.a.	n.a.

Sources: Exchange Rates: Personal communication with Robert Warner, Country Economist, Ghana, World Bank, Washington, D.C., August 1991.

Notes: CPI is the combined index for all products for Ghana and is taken from the World Bank (1991) p. 123. The multiplier for 1990 cedis is derived by dividing the CPI index for 1990 (14,341.5) in column (iv) by its equivalent for the years in question. The resulting numbers comprise the multipliers, which, when applied to the data in column (iii), adjusts the price to constant cedis and expresses the value of US$100 of exports or imports in real, 1990 cedis.

tionale and resources to protect environmental assets. It can be destructive if tourist sector developers are in effect allowed to mine the tourist base by intruding development into areas that cannot sustain it and by bringing visitors into habitats in numbers and in fashions that result in the loss of unique habitats. A key to reconciling tourism and environment is to keep the numbers at a level that is physically and culturally sustainable and to maximize the revenue per visitor. As the NEAP economist, you need to continually assess the sector to see to what extent its policies and their realization are consistent with sound environmental management.

The tourism sector in Mauritius is based on the premise of attracting the high-spending visitor by offering a quality environmental and social experience. Pristine environments, beautiful weather, lovely people, a culinary haven that is "away from it all" are the ingredients that has allowed the industry to prosper over the past decade. If the expenditure per visitor grows in real terms, it will be possible to maintain the growth of the sector without the necessity of increasing the numbers of visitors and associated development of additional hotel rooms, increasing congestion, rising sewage disposal problems, and so on.

A clear environmental interest exists in the success of this policy; more people means more buildings on the coast, more limitations on effective access, more sewage, litter, congestion, more potential for a cultural backlash. Maintaining a quality image is central to success for a destination that is remote from markets. Gresham's Law tells us that "bad money will drive out good." Likewise, bad tourism will over time drive out good tourism. If Mauritius were to get the reputation of being a mass tourist destination, it would in effect drive out the highly sensitive quality tourist and a cycle of decline would set in, in which more and more low-spending tourists would be needed to maintain expansion, this would accelerate the decline in the country's reputation as a quality destination, and the environment and ultimately the tourist economy would be destroyed.

Mauritian policy is designed explicitly to avoid this doomsday scenario by emphasizing quality over quantity. When we examine real trends in tourist expenditure (see figure 4.1), however, we observe the following: total tourism receipts in real terms grew rapidly up to 1988 and have since declined slightly; expenditure per tourist night in rupees has declined slightly since 1987; the decline is much sharper if the data are converted into U.S. dollars.

A flattening out when expenditure is expressed in Mauritian rupees per bed/night becomes more pronouncedly negative when the expenditure in translated into U.S. dollars.

These potentially adverse trends would not be obvious if the data were not converted from nominal to real; general price inflation has led to substantial nominal growth, masking the realities, unless the latter are identified using real rather than nominal data trends.

A strong symmetry of interest exists between Mauritian environmental policies and developments in tourism. The trends in real expenditure provide a warning signal that a gap may be opening up between rhetoric and reality. Although it is still early in the process and the situation may prove to be a blip on an otherwise healthy trend, the sooner potential problems are identified the better. The data on real expenditure should engender an examination of trends in building starts, capacity utilization, expenditure patterns and so on to see if supporting or confounding evidence indicates problems are emerging.

4.3.4 Some Price Series from Ghana

Examining price series for agricultural outputs and inputs in Ghana can provide useful insights.

The producer price for cocoa. Government policy on the tax take from export crops and the efficiency of tax administration will strongly influence producer incentives. In Ghana, the government has adopted a policy of passing back to farmers an increasing proportion of the export price of cocoa to encourage production.

Figure 4.1: Tourism Expenditure in Mauritius, per Arrival and per Bed/Night in Real 1989 US$

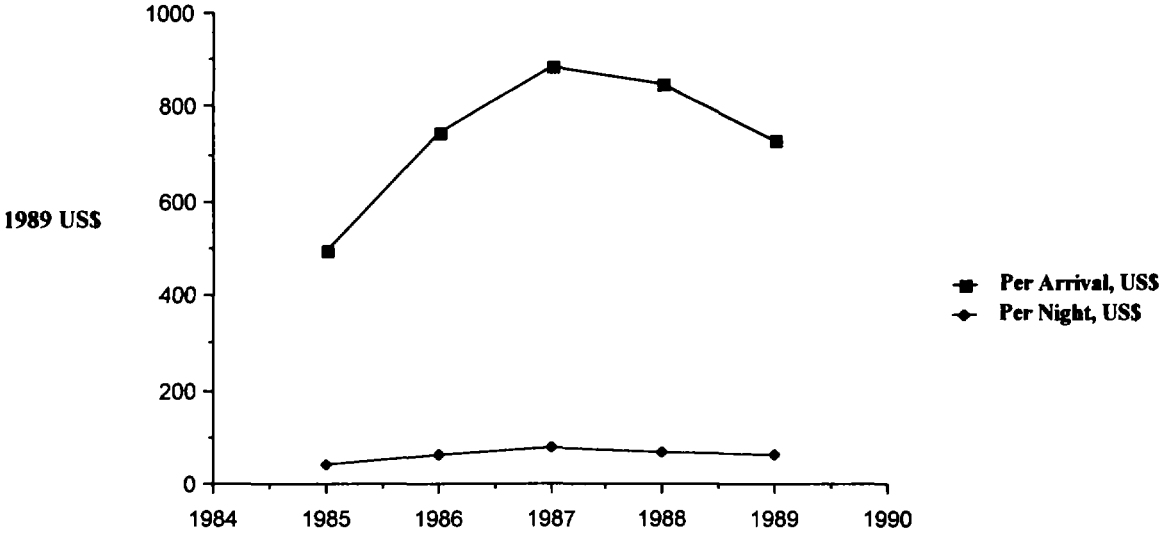
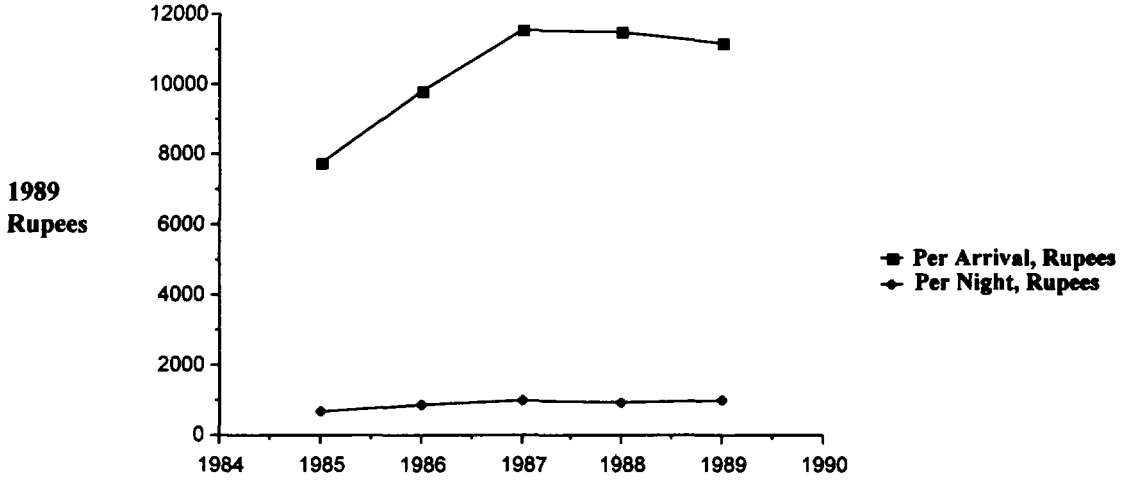


Figure 4.2: Tourism Expenditure per Arrival and per Bed/Night, Mauritius in 1989 Rupees



The producer price (the price that the producer gets paid), the share that it comprises of the foot on board (FOB) export price, and cocoa production are shown in table 4.4.

It is interesting to track the pattern of production and real prices. To do this, indexes for them need to be constructed (table 4.5). Indexes can be presented graphically (figure 4.3).

Rising production does seem to be associated with a rising real price. Since 1987 prices in real terms have fallen, in spite of the fact that the government has been allowing a higher proportion of the export price back to farmers (figure 4.4). The real price trend can be presented separately (figure 4.5). Note the low correlation coefficient R (where 1.0 indicates a perfect fit and 0.0 the converse), which indicates that there is not a good linear fit between time and price. Finally, we can plot the real price index against the production index for the following year (figure 4.6). The fit is again extremely poor but would have been better if a parabola had been fitted. It is important to only use graphs showing trends, relating to price in particular, as an association not a causation.

Table 4.4: Producer Price of Cocoa in Constant 1990 Cedis and as a Percent of Export Price and Production in 000s Tons, 1984–85/1990–91, Ghana

Year	Producer Price Current	CPI 1977 = 100	CPI Multiplier	Producer Price Constant 1990–91 cedis	Producer Price as Percent of Export Price	Output 000s Tons
1984–85	30,000	3,501	5.12	153,600	25	174.7
1985–86	56,600	4,245	4.22	238,852	24	218.8
1986–87	85,000	5,904	3.04	258,400	23	227.7
1987–88	140,000	7,865	2.28	319,200	33	188.2
1988–89	165,000	10,366	1.73	285,450	42	300.2
1989–90	174,400	13,061	1.37	238,928	42	295.0
1990–91	224,400	17,933	1.00	224,400	47	260.0

Source: Data compiled from the World Bank (1991, 22).

Table 4.5: Production and Price Indexes, Cocoa, Ghana

Year	Real Production Price Index 1990–91 = 100	Production Index 1990–91 = 100	Lagged Production Index
1984–85	68	67	84
1985–86	106	84	78
1986–87	115	78	72
1987–88	142	72	115
1988–89	127	115	113
1989–90	106	113	100
1990–91	100	100	

Table 4.6: Average Real Wholesale Prices for Crops, Ghana *(000s of 1988 cedis)*

Crop	1970	1978	1980	1983	1984	1985	1986	1987	1988
Maize	65	51	78	124	54	43	58	69	69
Cassava	29	22	29	53	22	19	27	45	29
Groundnut	192	178	161	234	175	283	152	166	143
Pepper	432	490	540	604	270	693	877	508	700
Millet	97	73	101	156	111	75	76	74	93
Sorghum	79	61	98	170	93	53	63	69	76
Rice	120	86	113	198	156	111	103	136	137
Yams	23	18	18	23	16	15	16	14	20
Cocoyam	54	42	40	99	52	24	40	62	51
Oil Palm	8	6	6	7	6	5	4	4	4
Cowpea	14	128	139	191	133	114	126	119	140

Source: Provided by the Statistical Division, Ministry of Agriculture, Ghana, in October 1989.

Table 4.7: Real Price of Fertilizer, in Cedis per 50 Kilograms in 1989 Prices

Year	Fertilizer Type		Subsidy
	Compound	Straight	Percent
1979	391	313	80
1980	391	313	65
1981	361	301	45
1982	295	246	45
1983	256	198	45
1984	1,390	932	-
1985	1,263	847	56/62
1986	1,794	1,127	36
1987	2,277	2,096	42
1988	2,875	2,000	30
1989	3,350	2,100	15

Source: World Bank (1990, 7).

Table 4.8: Production and Area Cultivated and the Changes by Crop, Ghana, 1978–87

Crop	Output			Area		
	1978	1987	Percent Change	1978	1987	Percent Change
	(000s tons)			*(000s hectares)*		
Maize	269	598	123	257	548	132
Cassava	2,334	2,726	17	283	389	37
Groundnut	70	191	173	69	150	117
Pepper	74	158	114	24	55	129
Millet	121	173	43	204	235	15
Sorghum	137	206	50	184	272	48
Rice	61	81	33	59	72	22
Yams	517	1,185	129	94	204	117
Cocoyam	681	1,012	49	144	196	36
Plantain	902	1,078	20	152	170	118
Beans	8	18	125	88	160	82

Source: Ministry of Agriculture, (Statistical Division), Accra, Ghana, October 1989

Table 4.9: Estimates of Output per Hectare, Selected Crops, Ghana

Year	Maize *(tons)*	Cassava *(tons)*	Sorghum *(tons)*	Yams *(100 tubers)*	Cocoyams *(tons)*	Plantain *(nine bunches)*
1970	1.06	6.81	0.77	5.27	4.38	5.70
1978	1.05	8.25	0.75	5.50	4.73	5.93
1980	1.11	7.50	0.75	5.48	5.35	5.98
1983	0.50	5.68	0.50	4.70	4.24	5.36
1984	0.79	5.00	0.70	3.26	4.60	5.20
1985	0.98	8.64	0.74	5.05	4.50	5.00
1986	1.18	7.43	0.73	5.86	4.87	6.40
1987	1.09	7.00	0.75	5.80	5.15	9.03
1988	1.39	9.33	0.71	7.13	7.89	10.05

Source: Statistical Division, Ministry of Agriculture, Accra, Ghana.

Table 4.10: Erosion Potential Coefficients by Crop

Crop	Erosion Potential Coefficient
Rice (intensive culture)	0.1
Coffee	0.1
Manioc	0.2
Sweet Potatoes	0.2
Maize	0.3
Groundnuts	0.4
Cotton	0.5

Source: Derived from data presented in Repetto (1988).

Figure 4.3: Trends in Real Prices and Production of Cocoa, 1990–91=100

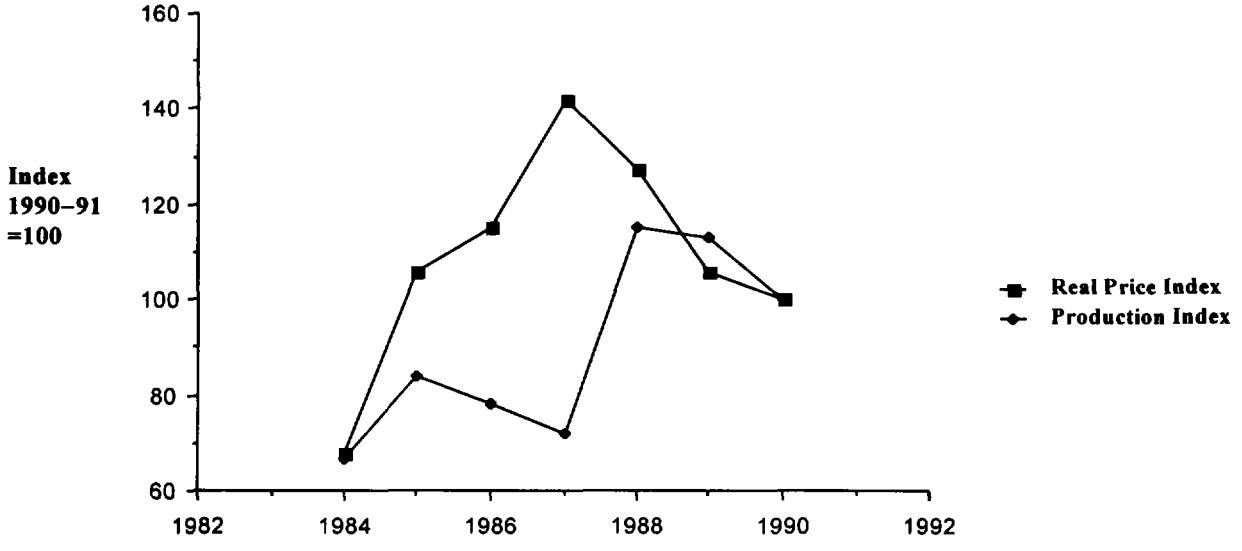


Figure 4.4: Producer Price of Cocoa as Percentage of Export Price, Ghana

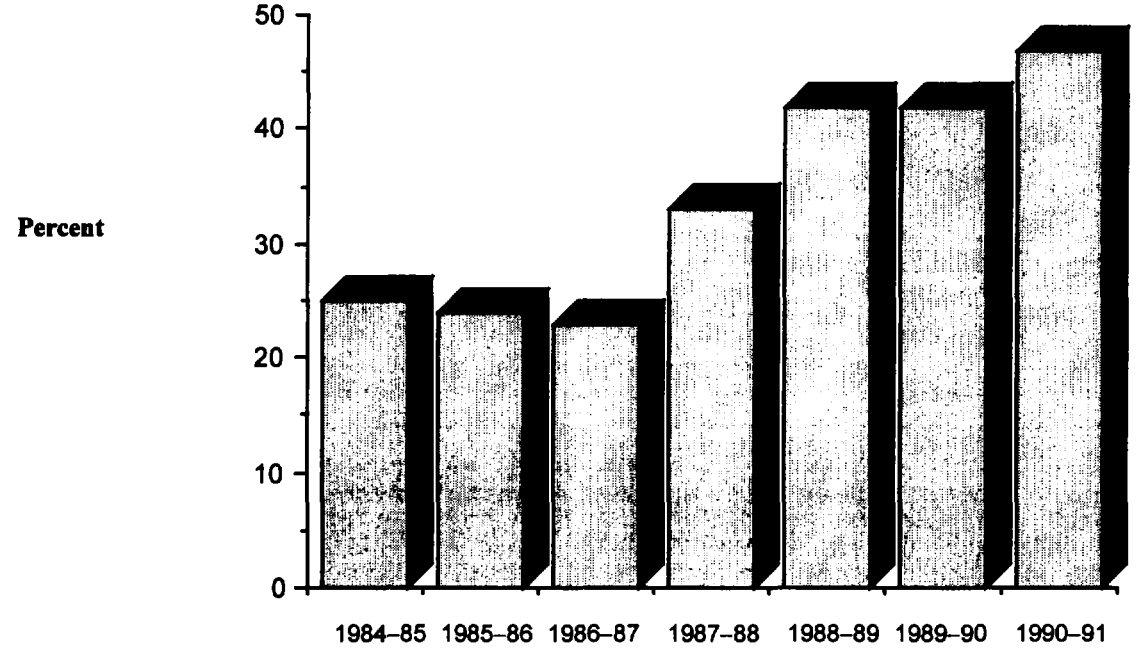


Figure 4.5: Real Producer Price, Cocoa, 1984/85–1990/91

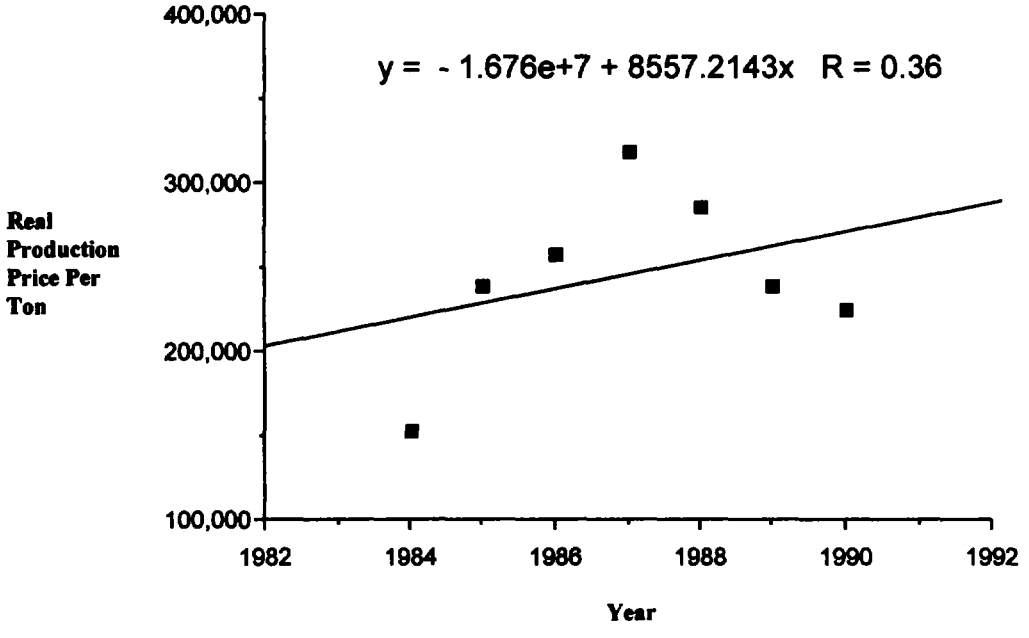


Figure 4.6: Price Index and Lagged Production Index, Cocoa, Ghana

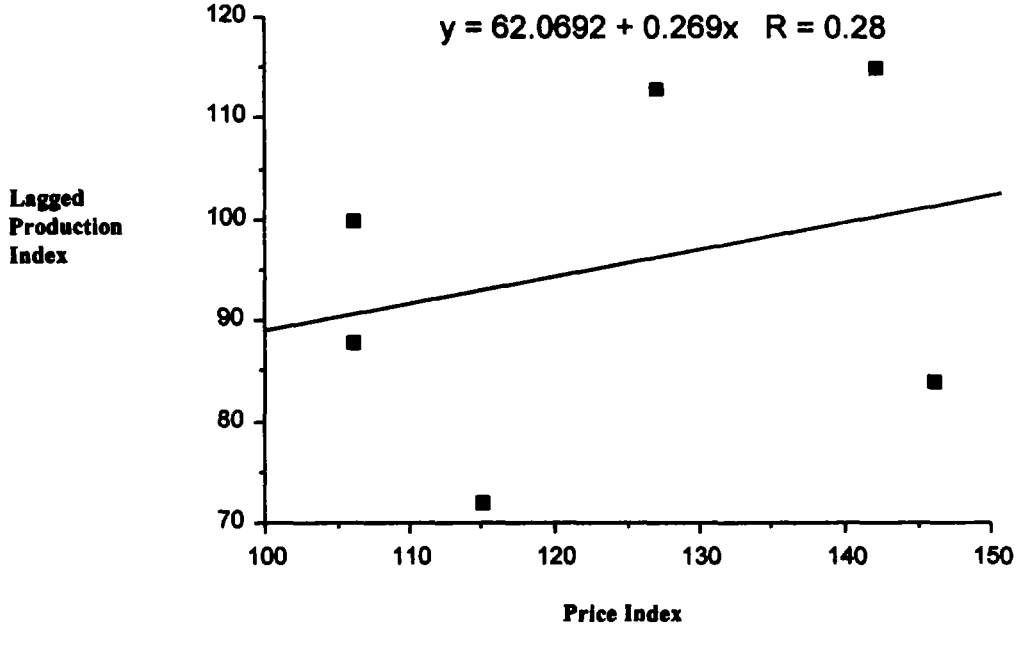


Figure 4.7: Trends in Wholesale Prices of Maize, Cassava, Groundnut, Ghana, 1988 Cedis

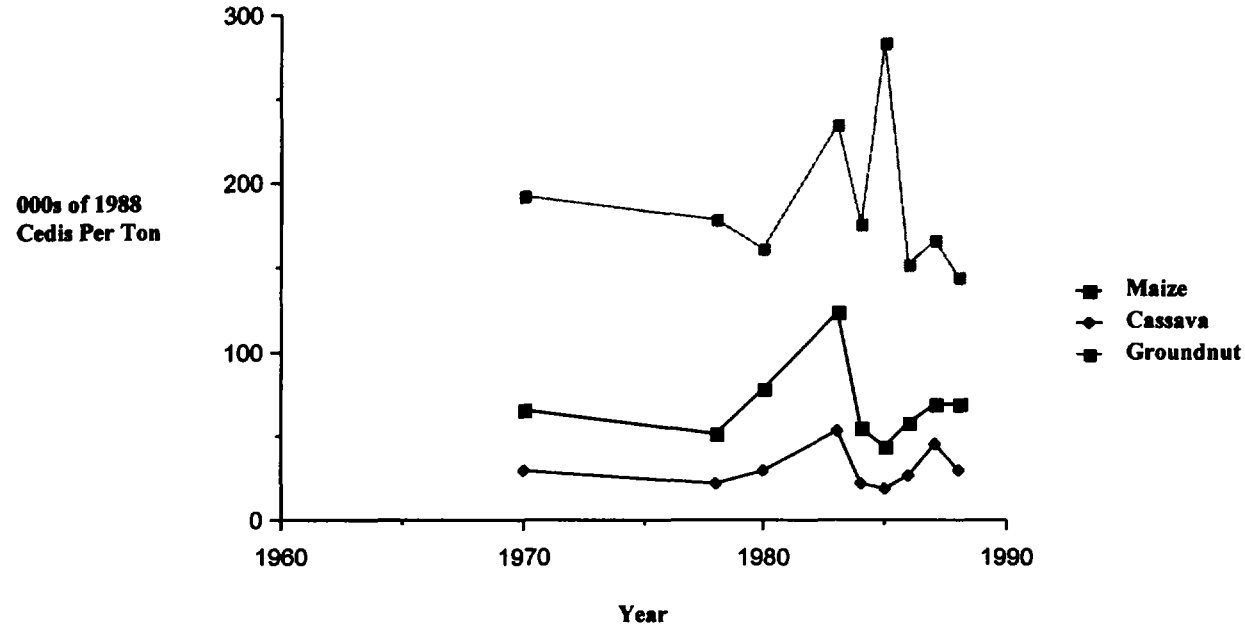


Figure 4.8: Real Price Trends for Pepper, Millet, Sorghum, and Rice, Ghana, 000s of 1988 Cedis Per Ton

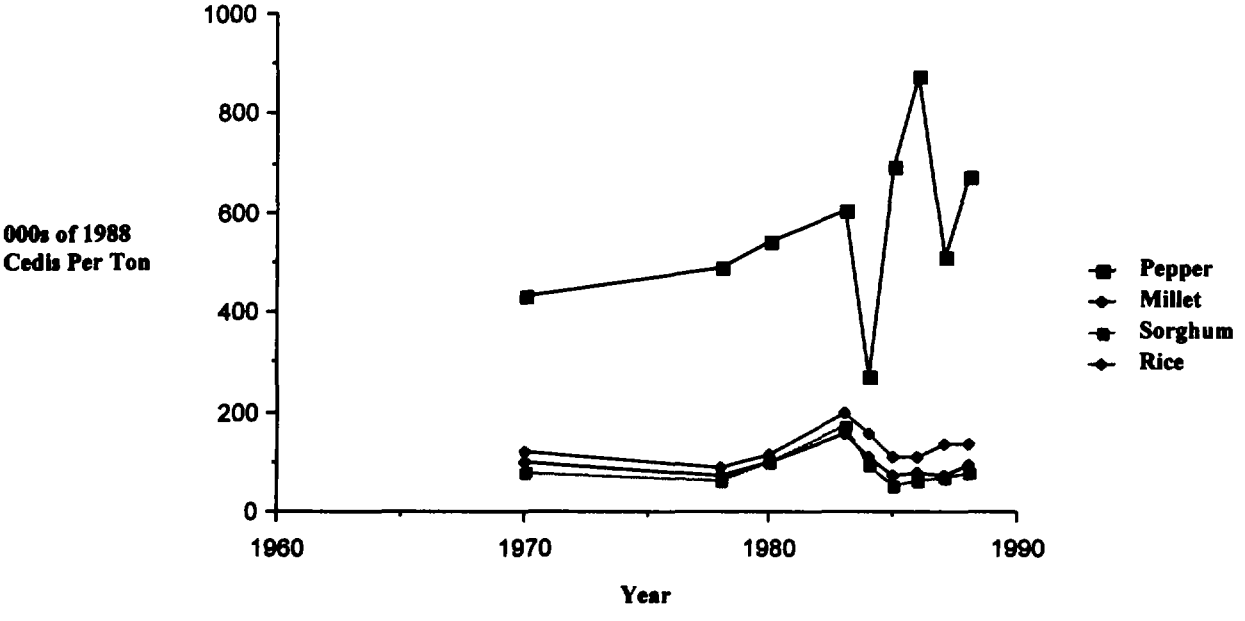


Figure 4.9: Percentage Change in Output and Area, by Crop, Ghana, from 1978 to 1987

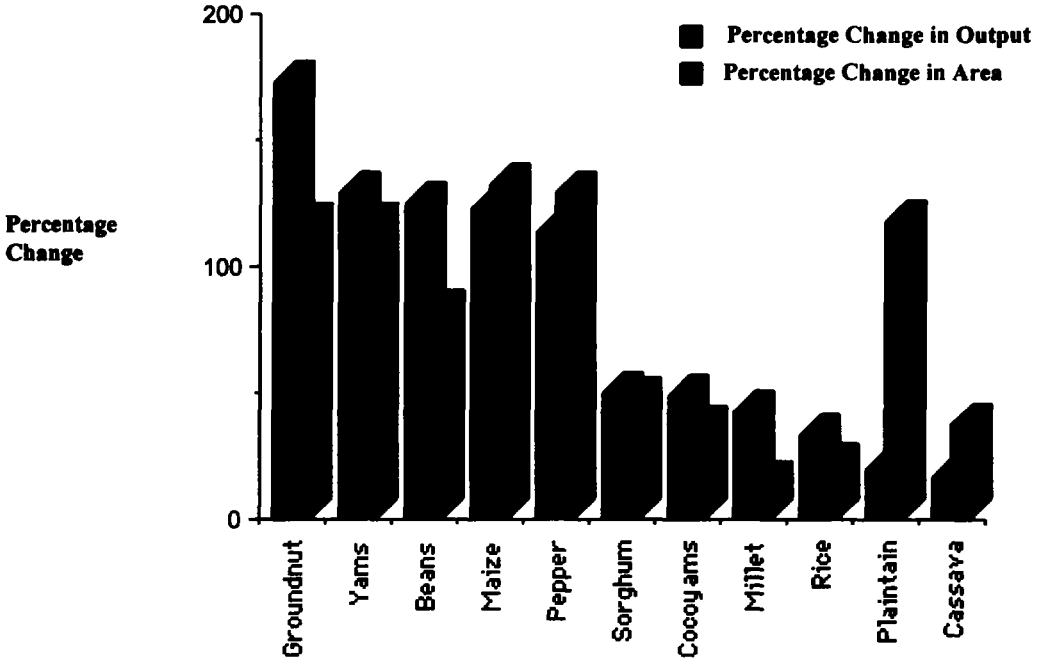


Figure 4.10: Output per Hectare, Crops, Ghana

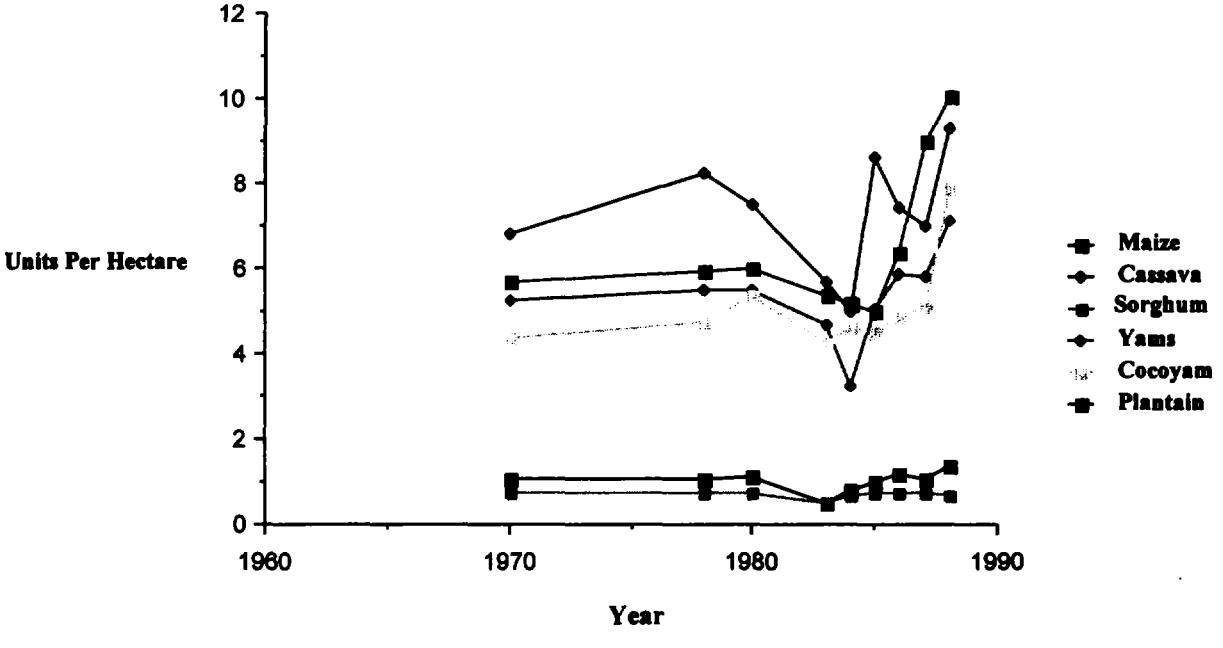
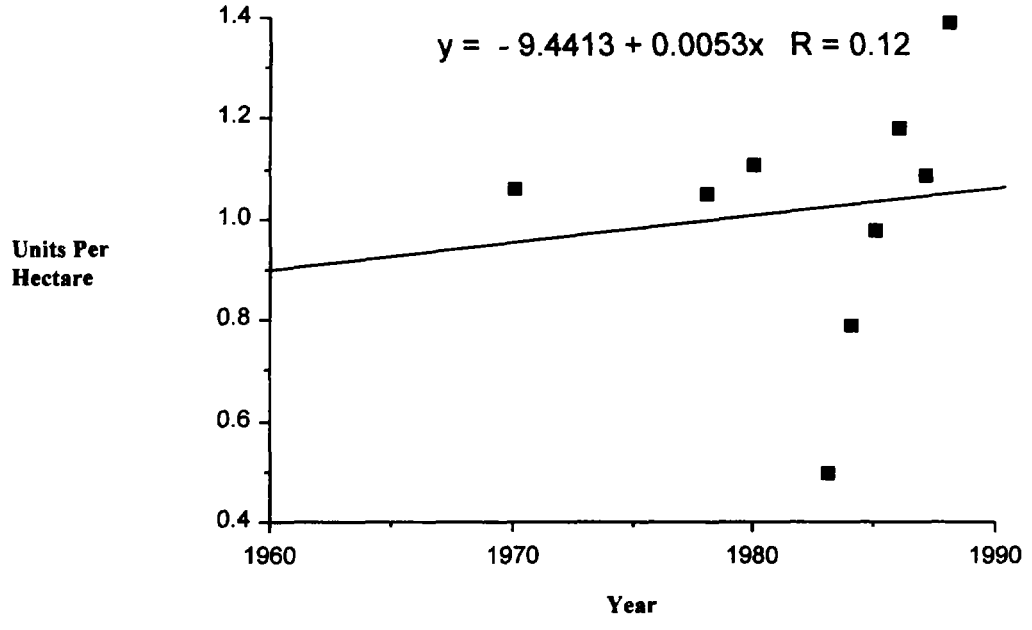


Figure 4.11: Output Per Hectare, Maize, Ghana



Disentangling the supply and demand influences, the expectations, the alternative cropping opportunities or lack thereof, the availability, and cost of inputs all shape the production decisions of farmers.

Relative crop prices: case study from Ghana. Farmers tend to make decisions on which combination of crops to plant, based on their judgment of which will yield the highest net income and other benefits such as food security. If there are data showing the real net returns to various crops over time, this information can be linked to land use data to provide useful insights on the reasons why particular crops are chosen.

Unfortunately, such time series are the exception rather than the rule. What is often available are time series of prices of various crop outputs and inputs. When these are expressed in real terms, it is possible by inspection to get a sense of whether some crop or crops are achieving a relative price advantage and whether this in turn has land use implications at the intensive or extensive margin.

The expansion at the *intensive margin* is defined as expansion on land already cultivated with the crop in question and involves increased output per unit area. Expansion at the *extensive margin* is defined as expansion onto land not already cultivated.

The response in this regard has environmental implications. Growth at the intensive margin is typically achieved by increasing the application of inputs to a given area of land. Thus, some combination of genetically improved plants, fertilizers, herbicides, pesticides, and water are applied to achieve increased yields. This is the normal route to increased output in relatively developed economies where such inputs are readily available, together with the expertise needed to do so; land for clearing may be absolutely unavailable or expensive to purchase or create (for example, via reclamation from the sea), and price supports for output are provided.

The environmental implications of expansion at the intensive margin are well known: if fertilizers are applied during wet conditions, runoff can occur and enrichment of the water courses can follow; pesticides can concentrate in the food chain and damage wildlife, and humans can be harmed by direct ingestion or by eating affected animals; irrigation can deplete groundwater resources and lead to salinization. None of these has

to happen but can with inappropriate management.

Expansion at the extensive margin typically involves clearing land—forest or scrub—generally using fire to do so. If the area cleared is indigenous, relatively untrammeled tropical forest, the expansion may often result in destruction of actual or potential commercial wood (on-site losses), damage to habitat for wildlife and rare species, and reduction in the capacity of the area to ameliorate the intensity of rainfall and store water, with implications for soil erosion and nutrient loss (off-site losses). These losses are compensated for in the case of farmers' clearing by the availability of land to farm and from which to harvest wood.

Let us examine real price trends for crops in Ghana. A wholesale price series is available, as is a wholesale price index. By applying the former to the latter in the manner outlined earlier, these price series were expressed in real terms in 1988 cedis.

The results are shown in table 4.6. The data indicate that, for most crop prices, price varied relatively little up to 1983, although this may in part be a function of the fact that only three years are covered prior to 1983, followed by a sharp real increase in 1983. This in turn was followed by declines that brought real prices in the late 1980s back to those levels obtained pre-1983. The sharp increase recorded in 1983 was associated with poor crop levels. The decline post-1983 was associated with sharp increases in supply in 1984 and thereafter. As the subsidy has been reduced, the real cost of fertilizer to farmers has increased (see table 4.7). What's interesting from an envi-

Box 4.2:

Identifying the Implications of Prices for Environmental Quality

Robert Repetto and his colleagues at the World Resources Institute in Washington, D.C. have been in the forefront of making the connection between price incentives and environmental performance. When government intervenes to subsidize fertilizers, herbicides, and pesticides and these are presumed to have environmentally degrading effects and when government intervenes to support prices of crops that deplete the soil or to reduce the prices of crops that protect environmental endowments, the consequence is environmental degradation.

By documenting the nature and extent of such interventions and observing associated environmental destruction, some fruitful policy debates have been opened up. But it is difficult to go from association to causation, and many linkages need to be further studied and the implications qualified. For example, fertilizer application can result in the water pollution, but, by increasing yield per hectare, it can also reduce the pressure to clear forest for agriculture. See Repetto (1988) for a good overview of the price/environment linkage hypothesis and a range of examples.

What are the implications for the NEAP in this case? The NEAP should reinforce efforts by agronomists to help farmers increase output per unit area. Such will typically initially be achieved not by a "great leap forward" using better seeds, fertilizers, pesticides, and so on but by improving cultivation practices, weeding, crop protection from livestock, and water conservation. Choices and policies tend to be driven by what is technologically possible rather than what is financially attractive or economically and practically feasible. The economist has an important role in identifying the realistic options at the margin and in nudging policies in this direction rather than toward the glamorous but unattainable.

ronmental point of view is the manner in which increases in output have been achieved.

If we compute the percent change in output and area over the 1978–87 period and present the results graphically, it implies that most of the increase in output over this period has been accomplished by increases at the extensive margin, that is, by increasing the area under production rather than by increasing the output per unit area. A word of caution here: by judicious choice of beginning and end years, it is possible to manipulate outcomes in such series. I tried a number of combinations, the results of which are consistent with the results in table 4.8 (see also figure 4.9).

This is what one would expect with real growth in the cost of the main input, fertilizer, which allows expansion per unit area (the intensive margin) and with additional land being either free or inexpensive. The largest expansion in area has taken place in maize. What is the significance of all this from an environmental perspective?

Given the output and input prices facing farmers and the need to secure their own food supply in a period of rapid population growth, they have expanded output mainly at the extensive margin with the emphasis in the latter regard on expansion in the area under maize. Another way of looking at this issue is to show the trend in productivity per unit area (table 4.9 and figure 4.10). You can also fit a linear curve to a scatter diagram and peruse the trends implied by it (figure 4.11). This plot for maize implies a slight productivity gain per hectare over time, but note the low R value, a product of the wide dispersion of data.

The erosion potential coefficients for some crops are shown in table 4.10. They range from a high of 1.00 for bare land to 0.0001 for dense forest.

Maize is relatively environmentally demanding in that it exposes the soil to the elements. But it also depletes nutrients from the soil and its expanding area involves the clearance of scrub and forest. This is not to say that expansion in maize production has to be environmentally deleterious. By utilizing systems of crop rotation, mulching, improved varieties and so on; controlling burning; and protecting key biotypes, it is possible to expand output without significant environmental damage. Given what we know about the techniques of production used in Ghana today, however, we conclude that it is environmentally deleterious with existing technologies and management techniques.

4.4 The NEAP Economist

Identify what seem to be the principal forms of economic activity that have implications for the environment. Then, for these:

- Identify existing pricing policies for key sectors with particular emphasis on the extent to which market-clearing prices prevail. Look out for such things as quotas or tariffs and taxes on imports and exports, the existence of monopoly purchasers and sellers, and the government's policy on the share of export prices accruing to the consumer.

- Construct *real* time series per unit of input and output for these key sectors.

- Assess what seems to have been happening over time, using graphs.

- Assess the direction of change in the use of environmental assets implied in the policies and real trends noted.

- Specifically, in regard to agriculture, examine trends in output per hectare and change in land use and output. If it is a time series of gross margin (value of output minus bought nonlabor inputs) and net margin (gross margin minus value of labor used), use this as it provides a direct measure of trends in net returns to the farm household.

- Specifically in regard to forestry, identify the extent to which the price charged for stumpage (standing timber) diverges from the price that would obtain under competitive conditions.

- Specifically in regard to the energy sector, examine trends in energy prices to consumers. Compute the long-run marginal costs of increments in electricity supply and note any discrepancies with sale price per unit. Is there

Year	Fertilizer Price Current *(AF$)*	Output per hectare *(tons)*	Forest Area Cleared *(000s hectares)*	CPI 1980 = 100
1980	100	12	10	100
1982	120	12	10	130
1984	200	11	12	140
1986	300	11	16	200
1988	300	11	15	220
1990	350	10	17	240
1992	350	11	14	260

any variation in pricing to encourage off-peak use and to discourage use at peak times?

- Attempt to set down the situation from the perspective of the key actors using the environment (role playing) as I have done it for a hypothetical farmer.

- Synthesize your view on what are the main price-related incentives that are encouraging the degradation of the environment in your country.

- Encourage research addressed to identifying the linkage between price signals and environmental performance.

Discussion Questions

1. Over the past two decades, food output per hectare in most African countries has not increased, whereas it has expanded considerably in other countries, notably in Asia. Why does this divergence in performance exist? Does it have positive or negative environmental implications?
2. Given the above price series for fertilizer, productivity per hectare, and area cleared for farming,

a. estimate the real trend in fertilizer price per kilogram, and
b. discuss possible environmental implications emphasizing the limitations of the data available and the priorities that you would impose in seeking further data.

Further Reading

Kosmo, Mark. 1989. "Commercial Energy Subsidies in Developing Countries: Opportunities for Reform." *Energy Policy* (June): 244–253.

Repetto, Robert. 1988. *Economic Policy Reform for Natural Resource Conservation.* Working Paper No. 4. Washington, D.C.: World Bank, Environment Division.

Chapter 5

Nonprice Incentives

Most of what we call nonprice incentives end up influencing prices. In this sense the distinction drawn is artificial, perhaps especially so in the case of taxation, which I address first. I follow with a review of other incentives.

5.1 Taxes as Incentives

Revolutions start and leaders fall because of taxation. The American revolution was said to be triggered by a perception of "taxation without representation." In more recent times, many commentators have attributed the change in political leadership in the United Kingdom in 1991 to the attempted introduction of the poll tax. Almost all governments use taxation systems to encourage some forms of economic activity and discourage others and to benefit some categories of individuals and penalize others. The design of taxation systems and the manner in which they affect behavior are influential in shaping economic performance and, therefore, environmental performance. Many of the tax-related reforms being undertaken under the aegis of structural adjustment have among their goals to encourage initiative and enterprise and develop taxation systems that allow capital, labor, and land to flow to their most productive uses.

In regard to the latter, theory and practice tend to support the view that taxation should be as uniform as possible among sectors. If one form of farming is heavily taxed and another is exempt, resources will flow into both until the return to effort at the margin is equalized. But this will mean that, from a national point of view, the tax-indulged activity will be overinvested in the sense that, if resources were reallocated from the tax shelter to the competitive taxed activity, total net output would be increased.

5.1.1 Categories of Taxes and Tax-Type Charges

I will briefly review the main tax categories and note possible implications or concerns to watch out for. This is more in the nature of an awareness-heightening exercise than a full treatment of the issues, which could and do command books of their own. The brevity of the treatment can be justified also on the basis that national tax systems in most African countries are undeveloped: relatively few tax categories are used, and collection is often erratic and incomplete. But, as the NEAP countries develop, taxation will become increasingly relevant, so that it is useful to be aware of some of the options and implications for environment. In addition, the advocacy of "green" taxation, emission charges, the use of tradable permits, and so on have been the *ideé fixé* of environmental economists in industrial countries for almost two decades. It is useful to understand where this thinking might fit in the NEAP process.

- *Individual or household income tax*, in which a share of an individual's income is taken by the government in tax, usually on a pay-as-you-earn basis. The rate typically increases on the marginal income as individual/household income increases. Some of this tax may be symbolically or otherwise earmarked as a contribution to a social security and health plan.

The main incentive effect evident from this type of taxation flows from the nature of the expenses or other allowances that are deductible. This tax will be more effective the fewer exemptions there are and the higher the marginal tax

rate. Thus, in the 1960s and 1970s, the United Kingdom had a high marginal tax rate and few exemptions, one of which was investment in forestry. This combination led to a high rate of private investment via intermediary companies in forest plantation establishment. The write-off applied to expenditure on plantation establishment but not acquisition of land; this encouraged the planting of poor quality land because the latter had to be fully paid for, while the former only cost 10 pence in the pound at one stage when the marginal tax rate in the United Kingdom for the highest incomes was 90 percent. In some countries, some categories of profession are exempt from income tax, for example, writers and artists in Ireland and farmers in other countries. Perhaps it could be considered for inclusion in a NEAP that environmental managers should also so qualify.

More generally, high income taxes and low capital taxes reduces the cost of capital in relation to labor. If investors have a choice in the combinations of labor and capital they use in their endeavors—and they usually do—such an asymmetry in the tax system will tend to replace labor with capital and reduce the potential generation of jobs that a given level of activity provides.

- *Corporate income (profit) taxes* in which a company pays a share of profits as tax.

Particular forms of activity can benefit from reduced—relative to the norm—corporate taxation. For example, some countries have exempted from taxes profits earned on exports, often confined to manufactured exports. This biases the system in favor of exports and can be an effective means of encouraging manufacturing activity as is shown by the success of Mauritius in building up an export-driven textile and clothing sector. It can also, however, have perverse effects: with a strong tax bias in favor of exports, little incentive exists to generate cross-sectoral multipliers within the country, because a supply to a local producer will attract tax. Likewise, there is little incentive to meet local domestic needs; a high import/high export enclave economy can be produced, relatively unlinked to the local economy. The environmental problems of such policies are ones of success. The primary rationale behind Mauritius' NEAP was to address the mainly industrial pollution generated by the industrial export zone (tax-favored), which was beginning to impinge negatively on tourism.

- *Value-added tax (VAT)* in which a percentage of the sale value at each transfer is paid as tax. It can be reclaimed by each purchaser except the final consumer. McKay, Pearson, and Smith (1990) review the theory and practice of this and other taxes as fiscal instruments in environmental policy. In many Francophone countries, taxes on production or turnover—*chiffre d'affaire*—are assessed.

Adjustments in this tax to favor particular goods or services will typically reduce their price in relation to other goods paying the full VAT charge. If the general VAT rate is, for example, 15 percent, a VAT exemption is a considerable benefit. In some countries, food and nonalcoholic beverages are VAT-exempt, as are some forms of energy consumption, such as electricity. Countries wanting to encourage use of an indigenous fuel, for example, coal, or a cleaner fuel, for example, gas, will provide preferential VAT rates. The problem is that a global reduction on widely consumed items such as food and energy is an expensive (from the Exchequer's point of view) means of achieving an objective. Take the case of energy, which is a highly income-elastic good, more and more of it being consumed as incomes increase. A tax exemption that applies to everyone will in a certain sense provide the greatest absolute benefit to those with the highest incomes; although the poor will also benefit through having an essential good at low cost, it is a blunt instrument for achieving this aim. More targeted taxes, to be addressed later, are a more fiscally efficient means of achieving equity objectives.

- *Excise duties* in which a fixed amount is assessed on particular products, for example, cigarettes and tobacco. This can be payable at manufacturing level, so, unlike a VAT, it is likely to influence directly the production decisions of manufacturers. It has been demonstrated as effective to some degree in reducing the consumption of cigarettes and al-

cohol. An excise duty on, for example, heavy fuel oil, will encourage refineries to reduce this component in their production and sales mix and will encourage consumers to do likewise as the duty gets reflected in the price. This type of tax is also used to encourage recycling in some jurisdictions, which assess this tax on nonrecyclable products. One of its disadvantages is that it must be adjusted to stay in line with inflation.

- *Sales tax* in which a percentage of sale value is paid by the final consumer. The issues and implications are the same as those that arise in regard to VAT and excise duties.

- *Property tax* in which land or buildings on it, or both, are taxed, usually as a percentage of assessed value.

These taxes tend to be contentious because they are "lumpy," that is, not paid on a pay-as-you-go basis. They are often based on valuations on which the tax authority and the owner do not agree; they are payable regardless of the individual's ability to pay at the time of the assessment; and they are difficult to avoid because they are based on fixed assets. They can be powerful influencers of the environment. If, for example, cleared land is exempt from property tax but forested land is not, quite a different decision-making dynamic from that which would result if the opposite applied will be produced. If new buildings are tax-exempt or assessed at a lower rate, accelerated depreciation of the existing building stock and replacement by new will be encouraged. In the case of urban settlements, these taxes will encourage expansion of the area into "green field" sites where new building is easy.

Taxing the land, payable regardless of what the land is used for, will tend to maximize the economic efficiency with which the property is used, because the owner's decision is not skewed by the tax. In some cities, this tax is only payable if there is property being used on the land. Property values that are expected to rise encourages the hoarding of derelict property, which does not attract a tax penalty.

- *Poll tax* in which a tax per person is assessed, which may or may not be varied in regard to ability to pay.

- *Gift and inheritance taxes* in which a percentage of the value of gifts and inheritances above a certain threshold are taxed as a percentage of the value. Such taxes have in the past been viewed in some countries primarily as a vehicle for transferring capital from those who have such capital to those who have not. Its environmental implications will depend on how the existing and new beneficiaries use the proceeds. In many countries with high death duties, old estates were sold off to pay death duties. In many cases, some of the more positive features from an environmental perspective—woodland, wildlife, and fine architecture—did not survive the transition. If such a transition is expected, it is important to have mechanisms in place to protect and manage the most valuable environmental assets.

- *Export taxes* in which a tax is imposed per unit of export. Such taxes are relatively easy to assess and collect and have been popular, for example, cocoa in Ghana and gum arabic in Sudan. They have the effect of reducing the return to the producer (thereby encouraging switches by producers to other, less taxed crops) and the volume and character of inputs employed. Whether such impacts are positive or negative environmentally will depend on the particulars of the situation.

In addition, there are taxes of particular interest in regard to environmental management. Strictly speaking, some or all these may not be regarded as taxes but as charges for access or use of resources or assimilative capacity. In fact, "charges" better captures their essence because they are designed to reflect the costs of using scarce resources. This is a convenient place, however, to address these.

- *Royalty* in which either a fixed amount per unit (for example, a ton) or a percentage of the transfer value is payable. A royalty, as compared with a profit-sharing arrangement, can discourage full utilization of a resource.

Table 5.1: Annual Profits in Mining (Hypothetical Case) with Royalty and with Profit Share

	Before Taxes	After Royalty	After Profit Share
Tax Assessed	-	25 Percent of Revenue	40 Percent of Profits
Output *(tons)*	600	600	600
Revenue *(AF$)*	600,000	600,000	600,000
Costs *(AF$)*	500,000	500,000	500,000
Taxes *(AF$)*	-	150,000	40,000
Profits *(AF$)*	100,000	-50,000	60,000

As a mine reaches the end of its life, extraction costs tend to increase and profits fall. A royalty-based tax will generally mean that the mine will stop extracting, that is, leave ore in the ground, sooner than if a royalty arrangement based on profit share prevailed. Let us look at a simple example, in which a small mine is extracting 600 tons of ore annually and selling it at AF$1,000 a ton, yielding a total revenue of AF$600,000 annually. Total costs of extraction are estimated to be AF$500,000, yielding a before-tax profit of AF$100,000. The profitability picture that emerges under two tax regimes, one in which a royalty of 25 percent is assessed on all revenue and the other in which a tax rate of 40 percent is assessed on all profits, is presented in table 5.1.

These figures show that the royalty-based system results in a loss of AF$50,000 whereas the profit share system leaves the mine still profitable. Because many mines are difficult to reopen once they have been closed, both economic and environmental advantages exist for encouraging full utilization. A variety of other considerations exist, of course, not least of which is that it is easier to monitor royalty-based systems than profit-based ones. The message is that different tax strategies have differing implications and you need to be aware of them.

Table 5.2: Net Revenue Situation, Before and After Tax *(AF$)*

Situation	Crop A	Crop B
Before Tax		
Revenue	200	200
Costs	120	140
Net Revenue before tax	80	60
After Tax		
Revenue	200	200
Tax	40	40
Other Costs	120	140
Total Costs	160	180
Net Revenue	40	20

5.1.2 Another Example of Tax-Influenced Behavior

The following are reasonable operating hypotheses with which to work:

- If one activity is favored by a tax regime over another competing one and they are mutually exclusive, other things being equal, those farmers or other investors for whom the tax system is relevant will prefer the tax-indulged activity.
- If a tax regime favors one activity over a competing one and they are not mutually exclusive, other things being equal, the tax-indulged activity will attract funds at the margin, which, if reallocated to the unindulged/indulged activity, would result in an increase in net output.

Let us take an example of a farmer who is considering what crop to plant on a five-hectare piece of land. She has to choose between one of two alternatives, crop types A and B. A tax amounting to 20 percent of gross revenue is payable. All data are in AF$. The revenue and cost positions before and after taxes for A and B are shown in table 5.2.

If there is no tax or if the tax applies equally to both, crop A will be preferred. If the tax is applied to A and not to B, however, the net revenues yielded are shown in table 5.3.

Table 5.3: Net Revenue Situation When Tax Applied to A and not B *(AF$)*

Crop	Net Revenue
A	40
B	60

Other things being equal, the farmer will clearly prefer B over A, which will in effect reduce the national net output by AF$20, because the net output of A before taxes at AF$80 is this amount greater than the AF$60 net output of B. The differential tax acts as a *wedge*, shifting production from the optimum. This notion of a wedge, acting to drive behavior in a suboptimal direction, is an important theme in economics.

It is important to remember that this is but one example, from which one can glean some insights but not an invariable guide. The literature on tax effects is voluminous and complex. Overall effects will depend on the incidence and magnitudes of taxes, their type, and the manners in which they are administered.

It is also important to remember that tax incentives are only of interest and relevance to those who pay taxes. For most farmers working in Africa at present, the tax systems are irrelevant, because they are not in the tax net, except so far as their output is taxed by government at the point of export. Nevertheless, even in those countries where relatively few are affected by tax provisions, the tax effect could be environmentally significant at the margin; if a new tax provision starts encouraging investment in activity with potentially substantial environmental effects, it may be only an attraction for city-based investors or multinationals, but the environmental impacts could be great and indirectly affect those not embraced by the tax system per se.

5.2 Advantages of Emission Charges

Emission charges have long been advocated by environmental economists. In some countries—

Box 5.1:

Taxation and Environmental Performance in Brazil

Perhaps the most environmentally influential examination of incentive effects in general and taxation incentives in particular was undertaken by Binswager (1989) with further historical detail and a focus on the role played by providing overland access discussed by Mahar (1989).

Binswager pinpointed a number of incentive effects that contributed substantially to explaining why the forests of the Amazon basin are being cleared. Among the most significant of these was thought to be the relatively generous tax credits available to investors who cleared the forest and undertook cattle ranching. Without the tax credits, such investments would not be attractive to investors; with the credit, they were. The tax credit has subsequently been withdrawn by the Brazilian government.

These papers highlight the value of analyzing the direction of incentives. They identify a number of incentives inimical to conservation of Brazilian forests and indicate that change in these will be necessary to change behavior. By identifying some of the key causal factors, they set the agenda for change. The main weakness of such analysis is that it does not address the significance of other actors whose actions fall outside the incentives portfolio addressed, for example, smallholders in the case of Brazil. With regard to payoff to effort, however, an incentives analysis on the Brazilian model should yield substantial net benefits.

mainly, but not exclusively, in Europe—they have been applied. The experience in Scandinavia is especially rich (details are available in Moe [1994]). These charges can only be used in cases of point sources of pollution, in which the emissions can be estimated, and have mainly been applied in Europe to emissions to freshwater systems. The use of prices to ration access by vehicles to congested central city districts has been implemented with some success in Singapore; a number of pilot schemes are being tested elsewhere. Taxes on sulfur emissions to the air apply in some jurisdictions; the European Commission advocated the application of a tax on carbon as a means of reducing carbon emissions and thereby mitigating the greenhouse effect. These taxes have some attractive features:

- They internalize some of the costs of pollution; what were external costs now become costs borne by the perpetrator and ultimately by the consumers of his or her products. Instead of acting as a wedge, preventing the economy from nearing an economically efficient optimum, they move the economy toward such an optimum.

- They allow the polluter to choose the least-cost method to mitigation, that is, they do not impose an end-of-pipe technical fix, thereby minimizing abatement costs.

- They encourage innovation by providing a constant incentive to improve on the reduction of emissions.

- They should result in higher prices for the relatively more polluting goods.

- They generate funding, which can be recycled into the economy or used to fund general environmental activity.

In practice, the rates imposed are frequently too low to influence behavior. Monitoring costs make it difficult to impose a pure "polluter pays" strategy. The method generates considerable antagonism from industrialists, who often prefer a command-control system, which provides them with subsidies rather than imposing costs.

5.3 Tradable (Pollution) Rights or Permits

With this policy instrument, rights to emit a given quantity of pollution are assigned. These rights can then be traded in the marketplace. If a firm wants to expand output or open a new plant and increase emissions by a given quantity, the right to do so must be purchased from some individual who, or firm that, already holds such rights. This has been applied in the United States with regard to air pollution but is otherwise little used. Various categories of tradable permit have evolved: *Netting* allows a plant to avoid the higher standards that would apply to a particular source by reducing emissions from another source *within the same plant.* Offsets are allowed for new sources only if the firm in question obtains enough emission credits within the same area. *Bubbles* allow trading of sources within the same plant, whereas *banking* allows a source to build up credits for future use. This system was applied with particular success to refineries that were mandated to reach a specified lead content in petrol: those refineries that could reduce emissions relatively cheaply to below the standard were allowed to do so and trade the increment of reduction below the standard to those refineries for which it was relatively costly to meet the standard. The total cost of meeting the standard overall in this fashion was much lower than it would have been if every refinery had simply been required to meet the standard without the possibility of trade.

As compared with emissions charges, the tradable permit has two advantages:

- It sets a cap on pollution levels. With the charge, it is difficult to be sure that it is set at a level sufficiently high to induce the necessary environmental performance.

- The pain imposed on some of the existing polluters is compensated for by the fact that they are given a valuable property right; they acquired for free the right to sell their pollution rights if they decide to get out of business or otherwise reduce emissions. Thus, the political difficulties that charges per se tend to encounter are overcome.

Some of the experiences in the United States, however, have been less than successful. Certain conditions must be met: for example, a sufficient number of firms must be involved to provide some competition; the rights must be sufficiently long-lasting to allow trading to develop; and an overall emissions limit must be set that is sufficiently restrictive to make the permits and their trading worthwhile, which limits the application of the instrument.

I dwell on emission charges and tradable permits because they provide the policy context that drives much of the literature in environmental economics in industrial countries. They have compelling merits when addressed to the right issues in the right context. (Hahn [1989] provides a useful review of experience with charges and tradable permits.) For the next ten to 15 years, however, most of the environmental issues in most of Africa will be dominated by the challenges of soil degradation, deforestation, urbanization, and household pollution. It is important not to allow a subtle form of intellectual imperialism to take hold, in which techniques of interest primarily as management tools in industrial economies come to dominate your strategy. At the same time, as your country industrializes, keep in mind that methods exist that encourage economic efficiency and have application to that minor—but growing—segment of the economy for which they are appropriate.

5.4 Green Taxation

In many industrial countries, there is much discussion on the use of "green" taxes to provide incentives for producers and consumers to act in fashions that are environmentally positive. These green taxes mainly comprise two categories of taxes already discussed but brought under the media-friendly label of "green." First, *indirect taxes* comprise mainly VAT and excise duties. They are called indirect because they are not imposed on a pollutant but on a product or products, the consumption of which is polluting. At the margin, they help shift the decisions of consumers in favor of conservation and the use of substitutes. Because excise duties are borne by whoever uses the product in question, that is, the tax is not reclaimable by producers as in the case of the VAT and is product-specific, it is regarded as a more powerful incentive than the VAT. Second, *direct taxes* or charges are imposed on particular emissions regarded as environmentally negative. The experience with such taxes is reviewed by Hahn (1989).

For many African NEAP countries, these opportunities may not yet be relevant, because the tax structure and environmental management system do not allow their effective implementation. As the tax systems evolve, however, the opportunities for "green" taxation along these lines will increase and could comprise an invaluable component of a NEAP. To do so, the fiscal authorities will have to become involved, as they guard their prerogatives in the tax area with great tenacity. Again, this necessity can become an opportunity, as it allows you to connect with key actors in the policy process, whose attention may otherwise be difficult to command. *Blueprint for a Green Economy* by Pearce, Markandya, and Barbier (1989) comprises a useful model on how to synthesize material in this domain.

5.5 Public Investment Incentive Impacts

Binswager and Mahar in their work on Brazil noted above pointed out that, in addition to the tax incentives already noted, the building of a highway into the forest, which allowed the influx of settlers to accelerate the process of burning, clearance, and settlement, comprised a central explanation for the destruction of the rain forest. This road was funded publicly with the assistance of a World Bank loan.

This is an example of a publicly supported investment for which, with the benefit of hindsight, the negative environmental impacts should have been identified. Such large-scale proposals will be picked up in the environmental assessment procedures that most countries and multilateral agencies, including the World Bank, now mandate. (See World Bank [1991] for details on the latter.) An ex post conclusion that it was not environmentally or economically wise to build the road, however, begs the question that will face the NEAP economist when similar path-breaking initiatives are proposed for development in Africa. This explains at least partly why governments provide

tax benefits that reduce net output or invest in infrastructure with doubtful long-term benefits.

Governments embrace initiatives in the following cases:

- They promise to open up new areas of enterprise that heretofore have not contributed to a country's economic development. It will be argued that to develop a new area, for example, flower growing, olive cultivation, and textile production, an incentive is needed to get the attention of investors and reward them for the time it takes to learn about a new area, to reduce the costs of entry by providing cheap capital, and in general to reduce the risk. In the case of prospective multinational investors, it may be necessary to compete in the world market for such investment.

- They improve security by generating activity and settlement in areas under potential dispute by neighbors, probably an underlying rationale for the Brazilian incentives noted above.

- They engender a sense of gratitude in citizens or ethnic groups or both, which is of particular importance to the success of those in power. These could include the urban poor threatening stability in the cities, those contributing most generously to party funds, particular ethnic groups or regions, or a combination of these, who need to know that the government cares about their welfare.

These comprise a combination of what economists refer to as distributional concerns and economic efficiency arguments concerning risk reduction.

It is important that the NEAP economist deal with these political concerns, which are not picked up in traditional economic analysis, in an effective fashion that the public understands and that the decision makers can see addresses their needs.

The specifics of such a method can only be addressed in relation to a particular proposal, to be dealt with later under "Comparing Benefits and Costs." It is important in the first instance to address the economic efficiency of the proposals. Other more political issues should also be addressed.

5.5.1 Highway Through a Virgin Forest: a Hypothetical Proposal

A strategy in this latter regard can be set out in reference to the example of a hypothetical proposal to provide a road through a country's fast-disappearing tropical forest.

This method would involve focusing on the benefits expected to flow to the various client groups to be served by this project and asking and attempting to answer the following questions:

1. *Are there other ways in which these benefits can be delivered for the same or lower net costs?*

An extensive literature now exists on experience in providing the benefits of conserving forests directly to the residents of the area. A comprehensive review of appropriate policies and an in-depth consideration of several case studies is provided by Kiss (1990). The gist of the findings is that, if there is substantive government and international NGO support that includes a real commitment to local ownership and control often sustained by a tourism interest, it is possible with sufficient time, effort, and up-front finance and training to arrive at arrangements that both protect the forests and confer substantial local economic development benefits, albeit often not of the traditional type. The mix may comprise a combination of exploitation for meat and other benefits, the capture of tourism revenues, and the generation of employment as guides and guards.

These options and the implications for key existing or potential client groups of the government need to be identified. In cases where the interests of key centers of influence are not being addressed, the NEAP economist should seek out such opportunities in fashions that are consistent with the environmental objectives. In the case of biodiversity conservation, the international community may have a role to play by providing resources to make the protection of the forest economically viable. The role of the NEAP economist will be important in making this case, based

on a well-documented analysis of the options and their implications.

2. *Are there access options that would meet some of the development objectives but limit damage to at least some of the environmentally important areas?*

A combination of rail and plane access may meet some of the needs. Alternative road routings can be assessed to test the extent to which a routing is feasible and relatively environmentally benign. The additional costs incurred should be estimated because such information will be useful in current debates concerning biodiversity conservation and compensation.

The assignment of property rights to communities or individuals or both along the route with responsibilities to limit access by migrants may be useful.

By addressing these two questions, you will be generating information that should be central to the decision-making process. If it is decided to go ahead with the road, the data will underpin that decision and provide a basis for limiting the ensuing environmental damage. If the contrary is decided, the information will provide the underlying rationale and direct attention to the development options that can be embraced without the highway.

5.6 Capturing Rent as an Incentive

In the context in which it is used here, rent can be defined as the surplus available after all factors of production have secured the minimum return needed to keep them engaged in the activity in question. This concept is often applied to natural resources: if the price of oil is $22 a barrel and the costs of extraction and transport, including a competitive return on the capital engaged therein, amounts to $12, the rent yielded by this oil at the prevailing technologies and input and output prices is $10 (22 – 12). Enterprise follows the rents; if a rent-yielding opportunity can be secured and if its developer is allowed to keep all or some of the rent, by definition, this opportunity will yield a return to effort above that which would prevail in activities in which competitive market conditions prevail.

5.6.1 Government Policy as a Creator and Destroyer of Rents

Government policies are influential in creating or diminishing rents and in deciding who gets them. If, for example, a monopoly on the import of cars is conferred, the conferee can capture a substantial rent, because he will be able to charge a price for cars substantially in excess of the minimum needed to make a competitive profit on effort expended. If a company has a concession to harvest wood from an area at a nominal cost that is a fraction of the value of its standing timber, the concessionaire will capture the rent yielded by this forest. If, however, this same wood was auctioned off in a competitive auction, the owner would capture the rent, because competition would bid away the rent from the developer. We have seen that preferential taxation of some forms of economic activity generate rents.

It is the availability or potential availability of rents that in part allows corruption to exist, because it provides a pool of resources with which to make transfer payments. The development fates of countries are heavily influenced by the extent to which government intervenes to create rent-seeking opportunities and what happens to the rents captured; if a government captures the rents and in effect spends the proceeds on importing arms or if a private company captures the rents and reinvests the proceeds overseas, the outcome will be different than if the rent is reinvested in productive activity within the country, whether by government or the private sector.

Structural adjustment can be interpreted in part as an effort to eliminate the artificial creation of rents by government and in those cases where rents are a product of resource endowments to channel the rents generated to productive opportunities. It was noted in chapter 3 that one of the problems of small economies characteristic of Africa is diseconomies of scale in domestic markets. The volume of transactions is so low that there is room only for one low-cost producer; if there are more and they are sharing the domestic market, they will both be operating at a level that does not allow them to take full advantage of economies of scale. The solution is to encourage exports via free trade zones and otherwise, but this typically involves competing with the best

Box 5.2:

Rent Capture in the Forest: What is the Optimum?

In most countries in Africa, natural forests are exploited under the concession system, in which a concessionaire gets the right to harvest wood from a specified forest area, a fee is paid per unit of wood harvested and taken out of the forest, and a modest annual fee is also payable. The means of allocating concessions vary, but in few cases they are allocated on the basis of a competitive bid, in which sealed bids are sought from a number of prospective concessionaires and the concession is allocated to the highest bidder. The price paid by concessionaires for the wood is administratively determined and is typically only a small fraction of the price that the wood would fetch under competitive bid conditions. If wood would fetch $70 a cubic meter standing (that is, before harvest) under competitive bid conditions but the concessionaire pays $20, the $50 difference is captured by the concessionaire. This rent is distributed as follows, the combination depending on the particular circumstances prevailing:

- The concessionaire
- Inefficient harvesting crews
- Inefficient transport/processing
- Side payments to get the concession
- Below market price to consumers

The low price results in inefficiency in harvesting, transport, and processing. In choosing the optimum combination of inputs (labor, saws, sawing and processing techniques, mode of transport, and so on), those involved will base their decisions on their relative costs; if wood is relatively cheap, they will tend to use it more prodigally than if it were more expensive. It also provides less of an incentive to manage the forest efficiently and to reinvest. This logic has led to the conventional wisdom that concessionaires should pay government the full competitive market price for wood. But, what if government is corrupt, inefficient, or both? Under such circumstances, does it make sense to squeeze the rent out of the concessionaire and his associates in the production chain? If the balance of advantage lies in allowing the rent to be captured by those in the production chain, this is called a "second-best" solution. Further discussion of this and a range of other issues is available in Hyde and Newman (1991).

that the world has to offer and negotiating with neighboring countries. This is not always feasible.

In the context of this discussion of incentives, it is important to be aware that rent capture is a powerful incentive. In assessing any incentive situation, the NEAP economist should ask: Is there is a rent to be captured? Who is capturing it at present? How does this affect the use of environmental assets? Can the rent be eliminated by competition, and if so, what are the implications?

5.7 The NEAP Economist

In reviewing the tax system, you need to understand for each existing or proposed charge the tax rates and basis, the level of tax revenues and the distribution of the burden, offsetting policies, and the earmarking of revenues. Specifically:

- Review the tax system in your country and identify for each major provision which interests are indulged and which are in effect discriminated against.

- Identify the specific environmental implications that are likely to flow from the existing tax system.
- Review any new tax proposals that are likely to be proposed with a view to identifying incentive effects, especially on industry.
- Identify the main situations that seem to yield rents and evaluate the incentive implications in regard to use and management of the environment.
- Draft a package of "green taxation" measures as a contribution to the composition of the NEAP.
- Develop a view on the existing or upcoming situations to which the use of emissions charges or tradable permits or both could usefully contribute.

Discussion Questions

1. Are property taxes assessed in your country? How might such taxes be designed to shape the location and nature of urban development?
2. Given the schedule (above right) of total costs of control and the associated reduction in emissions—measured in kilograms of Biological Oxygen Demand (BOD)[6]—what emissions charge level would need to be imposed to reduce emissions to 50,000 kilograms? (Hint: compute the marginal cost per unit of BOD [column (v)] and plot it against total emissions on the horizontal axis and AF$ on the vertical axis.)

Table 5.4: Hypothetical Data for Discussion Question No. 2

Total Cost (TC) *(000s AF$)*	Change in TC	Total Emissions (TE) *(000s kilograms BOD)*	Change in TE	Marginal Cost (MC) *(AF$)*
(i)	(ii)	(iii)	(iv)	(v) (ii) ÷ (iv)
0		1,000		
	10		500	
10		500		
	10		300	
20		200		
	10		100	
30		100		
	10		50	
40		50		
	10		30	
50		20		
	10		10	
60		10		
	10		5	
70		5		
	10		1	
80		4		

Further Reading

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[6] The amount of oxygen needed by microorganisms to decompose the waste.

Chapter 6

Property Rights and Tenure Systems

In chapter 2, the centrality of inadequacies in property rights assignment as an underlying cause of environmental degradation was discussed. This was done in general terms, in the context of outlining the theory of market failure and its relation to environmental degradation. In this chapter, I address the specifics of the position in African countries.

6.1 Historical Context in Africa

It is important for the NEAP economist to be aware of the history that shapes contemporary attitudes on tenure. This will be particular to each country and in some cases to regions within a country. In many countries, relatively free access to land has characterized societies for thousands of years; no significant environmental problems were engendered. The extent of the population and technologies available did not exceed the recuperative capacities of the land, wildlife, and forests in any fundamental sense. It is important to be sensitive to the fact that cultural attitudes developed over the millennia are not easily shed or even modified significantly. One of the central environmental challenges facing African societies arises from the fact that within the past generation land, trees, water, and wildlife have suddenly become relatively scarce in some regions. How ownership—the ability and willingness to exclude users—will be exercised will define to an important extent how successful environmental management will be.

The colonial experience will also shape attitudes to the ownership of environmental assets. The destructive implications of open access resources was understood by most colonial administrations; they typically addressed the problem by a combination of force—"Keep out or you'll suffer"—and regulations that required that certain cultivation practices, plant rotations, and so on be practiced. Although the problem analysis may have been correct, the solutions were not politically and socially sustainable and in general created a high level of alienation among local populations toward conservation objectives.

More generally, for rural societies, access to natural resources defines relationships culturally, economically, and socially. It follows that proposals for change must acknowledge the force of these relationships and attempt to accommodate them. Accommodation does not necessarily imply adherence to the status quo. In an important paper on rangeland ecology and management in Africa, Behnke and Scoones (1992) make the point that herd movement in Africa is a significant means of adjusting to local imbalances in stock numbers and forage availability and that retaining this feature is important to successful stock management. Past efforts to reform pastoral tenure rights have concentrated on delimiting boundaries and restricting livestock to these areas. This has failed. They suggest that the objective should rather be to develop legal forms providing security of tenure, while permitting flexibility in use patterns, with control of resources devolved to local producers and producer groups.

6.2 Tenure and Economic and Environmental Performance

What is the position in African countries on tenure, and what are the implications? As a preliminary to this discussion, it should be pointed out that all evidence indicates that farmers in Africa, as elsewhere, behave rationally: they use the resources available to them to maximize their well-being. Furthermore, the evidence indicates that

when opportunities appear that are likely to improve their situation, they are quick to seize these opportunities. Thus, in examining the tenure issue, we assume that resource users behave rationally given the choices they face.

Migot-Adholla and others (1991) provide the most comprehensive investigation of the impacts of tenurial arrangements on productivity in Africa. Their results imply that the experience in the three countries examined—Ghana, Kenya, and Rwanda—differs from that of documented non-African experience. They set out to test two hypotheses:

- As population pressure increases and commercialization proceeds, what they term "individualization of land" emerges and other forms of tenure are replaced by the individual owner.
- The acceleration of improvement in tenure fixity would increase productivity. They also discuss the impact of tenure on credit access and use and on investment in land improvement and review recent government interventions on land tenure.

They took ten regions representative of various types of farming and population densities and surveyed about 940 households practicing rainfed agriculture during 1987–88. Data on the economic and social characteristics of the household and the parcels farmed were gathered, including how the land in question was acquired and what rights the head of household could exercise, for example, to grow annual and perennial crops, make permanent improvements, gather firewood, transfer land, and so on. The taxonomy used to characterize land transfer is of interest. Land was characterized as:

- *Limited transfer.* No permanent transfer or alienation rights. May have temporary transfer privileges.
- *Preferential transfer.* May be permanently transferred but only within the family or lineage, that is, through gift or bequest.
- *Complete transfer.* May be alienated outside the lineage through the right to sell.

The authors also distinguish between "all parcels" and "permanently held parcels." When the "permanently held" data are analyzed separately, the following categorization is used:

- No right to sell
- Right to sell with approval
- Right to sell without approval

If one assumes that "complete transfer" and "right to sell without approval" represent the strongest expression of individualization, the authors find that the evidence from Ghana and Rwanda respectively support the hypothesis that increased population pressure and commercialization respectively increase the extent of individualization. They conclude from this that population and commercial pressures will automatically lead to more individual tenurial arrangements and, therefore, that government intervention is not necessarily called for.

To test the relation between land rights and land productivity using parcel level data, they estimated regression equations relating yield (gross value per hectare) to a vector of household characteristics (to capture resource and skill levels), parcel characteristics (to capture size and land quality differences), and a set of dummy variables for the land rights characteristics.

The authors found no relation between land rights and land productivity in Ghana and Kenya. In the case of Rwanda, they found that "short-term use" rights (mainly rented land) were more productive than parcels in all other land rights categories.

No significant relation was found between the use of formal credit and the proportion of land held with complete transfer rights. They suggest that this may be in part because when land has been used as collateral, as in the case of Kenya, it has been difficult in practice for the banks to realize the asset in the event of default because prospective purchasers were afraid to take possession for fear of reprisals. For a bank, collateral that

Table 6.1 Impact of Land Tenure on Production in Thailand

Status of Holding	Production Baht/Rai	Percent Annual Increase Yielded by Titling
Encroached State Land	998	18.9
Undocumented Land	1,020	16.0
Certificate of Utilization	1,122	5.4
Title Deed	1,183	0.0

Note: "Baht" is the unit of currency; the "Rai" is the unit of area.

cannot be realized may be worse than no collateral.

In Rwanda and in one region of Ghana, a positive relation existed between investment in improvements and the extent of land rights; in Rwanda, the right to bequeath land was a crucial determinant in this regard. For the other two regions in Ghana and in Kenya no such relation was identifiable.

The authors' overall conclusion is that intervention on tenure should only be undertaken in response to real local demand for such change and should adapt existing land tenure forms, rather than instituting radical reform of the individualistic type.

These African findings are in sharp contrast to those recorded in a detailed series of studies on the effects of a World Bank-supported land-titling program in Thailand. Angus-Leppan (1989) provides the analysis from which the data below are drawn; details with regard to methodologies and so on are found in Feder and others (1988), the latter being regarded as a classic in its field. A detailed statistical analysis of the impacts of this program was carried out ex post, controlling for the usual nontenure-related variables, notably land quality and location. Four categories of land type were recognized in regard to tenure status. In ascending order of security of tenure, the categories ranged from "encroached state land" (least secure) through "undocumented land," land with a "certificate of utilization," and finally land with "title deed" (most secure). The average annual productivity gains in each category are shown in table 6.1.

What explains the striking gains achieved in Thailand and their absence in the three African countries studied? What does it imply for the work of the NEAP economist?

6.2.1 Implications for Environmental Analysis

From an environmental economics point of view, these studies are seriously deficient in not addressing the property rights issues concerning natural endowments that are of central relevance: forestry, wildlife, and livestock systems. It is precisely the "residual" nature of these assets and their common property character that leads to much of the destructive tendencies observed. For example, it was noted earlier that much of the increased output in Ghana has been achieved at the extensive margin by expansion into forest and other open land. This happens partly because of the relative prices of land compared with other factors of production. This in turn is partly a product of the tenure arrangements. But this dimension, of central interest from an environmental perspective, did not comprise part of the terms of reference of the studies reviewed.

The difference between the studies is likely due to a number of elements: the large-scale Thailand Study covers most of the country, providing nationally generalizable data. The country is densely populated and commercialized with a vibrant entrepreneurial tradition; a strong set of incentives encourage land users to legitimize their situation. The African study is regionally defined and does not, as the authors acknowledge, systematically pick up areas where indigenous systems of tenure are weak and where the incidence of land disputes is high; in such areas, improvements in tenurial arrangements could bring a substantial payoff. If such areas comprise a significant proportion of the total, the implications need to be addressed; but we do not know to what extent they are significant. Another distinction that seems to be important is that in the case of Thailand, in contrast to the African experience, improved tenure led to improved access to loans.

Another element likely to explain the difference is the presence of other prior factors inhibit-

ing productivity increases, even when the tenure constraint is lifted. Migot-Adolla and others (1991) hypothesize that poor infrastructure, inadequate prices, poor factor markets, and limited or no choice of economically cost-effective alternatives are likely to be the limiting constraints at present. This hypothesis finds some support in the work of Bojö (1991) in Lesotho, discussed in chapter 10, where the tenure situation for cropland does not appear to be the limiting factor inhibiting farmers from taking measures to arrest soil erosion.

A potential problem with the African study is the categorization of fixity of tenure with degree of transferability. In the management of environmental assets, the ability and willingness to exclude is crucial; the two are not necessarily synonymous. In this regard, economists sometimes distinguish between *static efficiency*, when an existing user of land optimizes his or her situation, and *dynamic efficiency*, when the land can be transferred and a more efficient user or one with better access to skills and capital can take over.

6.3 The NEAP Economist

You need to find out the tenurial situation regarding as many of the key assets of environmental significance as possible. It is essential to direct concern not only to the agricultural land use resource but to the environmental assets that are or may be threatened by inadequate effective property rights. You then need to assess their economic and environmental implications. Finally, you should draw some conclusions on the tenurial policy changes, if any, that such results imply. This, of course, is the idealized situation; in practice, as always, some gaps will be left; in some cases, you will depend exclusively on the judgment of local officials. Remember that your interest is in effective, not legal ownership; in the ability and willingness to control access; and the ability, as opposed to the legal right, to transfer.

6.3.1 The Existing Situation

Because the ability and willingness to limit access are so crucial, you should attempt to categorize the tenure situation using some measure of this as suggested in figure 6.1 You will want to devise your own resource categories. You may find it useful to divide your country into regions. Your primary objective is to get a sense of the orders of magnitude of the tenurial arrangements.

It would also be useful to categorize the tenure situation according to the tenurial taxonomy adopted by Migot-Adholla and others, classifying the resources on the basis of ease of transfer (limited, preferential, and complete).

What units should you use? In the case of

Figure 6.1 Tenurial Arrangements (Sample Format for Gathering Data)

Resource	Effective Ability to Limit Access		
	None	Limited	Complete
Crops			
Livestock Grazing			
Forestry			
State			
Communal			
Nature Reserves			
Wildlife			
Freshwater			
Wetlands			
Fisheries			
Marine Resources			
Urban Land			
Urban Buildings			

land, area units, such as hectares or acres, will be appropriate. It would be useful, however, to complement the area data if possible with information on volume, for example, the number of cubic meters of wood, animals, buildings, by category, that are in different tenure categories.

You should also try to assess the extent to which the ability and willingness to limit access prevails. I have somewhat of a preoccupation on this score, because it seems to be omitted from most tenure studies. In my limited experience talking to farmers, exclusion (of livestock in particular) seems to be one of their greatest preoccupations and the most obvious explanation for lack of investment in some enterprises.

Implications of the existing situation. Assess the implications of the existing situation in economic efficiency and environmental impact. We have seen how difficult it is to identify the productivity implications. Strong interest in this subject, however, is leading to studies that will yield information from which you can draw.

Structured discussions with experts in agriculture, forestry, wildlife management, fisheries management, and so on will be invaluable. The following is the kind of discussion that should be directed at them:

> It is argued that inadequacies in the security of tenure in land, trees, wildlife, fisheries, water, and so on means that the resource in question is poorly managed. Inadequacies in the security of tenure are said to arise to the extent that the owners do not or cannot limit access to the resource and the resource cannot be transferred to others, for sale or otherwise. Poor management is said to result because those harvesting the resource have little incentive to do so efficiently to keep the wastage down to an economically efficient level; they have little incentive to make yield-enhancing or resource-conserving or both types of investments for the future. Potentially more efficient users cannot gain access to the resource because its transfer is inhibited or prohibited.
>
> The consequence is said to be that the resource is eventually degraded and may be completely destroyed if its natural resilience is such that it cannot withstand the pressures. You are an expert in the management of this resource. Here are the tenure systems that seem to prevail in your field of interest. Taking each one in turn, how do you feel that it:
>
> - affects harvesting behavior?
> - affects management behavior?
> - affects investment behavior?
>
> Overall, what is your sense of the impacts that the existing tenure situation has on annual output and productivity in:
>
> - the short run (over the next five years)?
> - the medium run (over the next ten years)?
> - the long run (over the next 20 to 50 years)?
>
> Are there other constraints, for example, poor prices, inadequate infrastructure, inability to access inputs, and lack of appropriate technology, that are more binding than inadequate tenure arrangements and that in a sense will need to be addressed successfully before changes in tenure will make any difference? That is, if the tenure problems were successfully addressed, would this make a difference under existing conditions and policies?
>
> If you feel that the existing tenure arrangements are inadequate, what do you feel should be done about the problem? Can you cite examples that support your view?

This kind of discussion can yield important insights, and can be conducted with a small group of experts or individually. If it is believed that they are sufficiently informed to give estimates of the areas or volumes or both under different tenure systems and the productivity loss or otherwise associated with different systems, it may be desirable to prepare a written questionnaire, whose results form the basis, usually following further

discussion with the experts, for suitable, qualified range estimates. When this method is formalized into the Delphi technique, opinions are sought individually, which are synthesized and presented to the participants, as individuals or a group. They are invited to consider their opinions again in view of those of their colleagues. After such iteration, a consensus view can develop or an informed range of opinions can be manifest. Before you embark on this iterative method, you need to believe that the resulting improvement in information will justify the extra effort.

You should consider dividing your attention into the short term—what you can glean over the next one to two years from existing data and the techniques discussed above—and the long term (five years or more), in which you commission research on the local situation or encourage others to do so.

Discussion Questions

1. It is argued that giving local communities ownership rights to valuable wildlife, for example, elephants and rhinoceroses, will result in more conservation and more efficient use than from central government control and management. Discuss.
2. "If individuals are given rights to acquire and sell land, the rich urban speculators will buy up all the valuable land and cheat local communities out of their birth right." Discuss.
3. If firewood is getting so scarce, why do investors not buy land, plant wood, and supply the market?

Further Reading

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Chapter 7

Focusing on Costs: General Issues

A number of issues addressed in this chapter are directly germane to the project analysis in chapter 10. They should be read together. Costs are highlighted separately because they rarely get the analytical attention they deserve.

Many analysts seem to believe that costs are boring and benefits exciting. Many studies devote most of their effort to the estimation of benefits and only mention costs in passing and hardly ever the effective use of cost data as an analytical tool. This asymmetry in analytical attention probably derives from the possibility of being creative and analytically interesting in addressing benefits, whereas one is merely useful when squeezing what is usable from cost data.

7.1 Recurrent Costs

A distinction is normally made between capital and recurrent costs, the latter being generally expressed annually over the life of the project or program. With recurrent costs, a distinction is often made between operating costs and maintenance costs. Typically, substantial efforts will be made to ensure that investment costs are accurate but much less to ensure the accurate estimate of recurrent costs. The latter are often shown as 10 percent or 15 percent of capital costs with justification of the assumption. This relative lack of attention to recurrent costs can be disastrous for a country. If a $10 million project has annual maintenance costs amounting to 15 percent of capital costs and the expected life of the project is 20 years, the capitalized cost of the annual recurrent charge of $1.5 million at a real interest rate of 10 percent will be:

$$1.5[(1.10)^{20} - 1/.10(1.10)^{20}] = 12.77 \text{ million}$$

This exceeds the capital costs, which is why the World Bank in its Staff Appraisal Reports on proposed investments includes a section on cost recovery and fiscal impact, the latter addressing the impacts on government finances. Structural adjustment emphasizes the importance of transparency in the ways in which costs are allocated; implicit in this philosophy is the perspective that the user pays.

The NEAP economist must pay particular attention to recurrent costs and their financing, because deficiencies in this area doom many, perhaps most, projects: trees need to be weeded and protected from livestock for many years, drains need to be kept constantly clear, soil conservation efforts must be maintained, roofs of buildings must be kept in repair, water pumps must be serviced regularly, and so on. If various questions—how large are recurrent costs, who is going to carry them, how will they be carried and for how long, and what are the positive and negative incentives encouraging or discouraging proper maintenance—are not satisfactorily addressed, failure is likely. It is often the case that the capital costs are borne by a combination of grant and low interest loan, but the maintenance costs are borne by your government, the community, and individuals. If this is the situation, you have a particular responsibility to ensure that the country is not being saddled with unsustainable costs or an incentive system that guarantees failure.

7.1.1 Recurrent Costs and Incentives

A strong incentive to taking on the maintenance and operating costs needed for efficient operation is essential. This means that the providers of maintenance should have a strong incentive to do

Box 7.1:

Comparing Costs of Tree Planting and Management

Most NEAPs will include a proposal to plant trees. How will you know if the proposal is reasonable? Two questions should be addressed:

- Are the costs proposed in line with such costs elsewhere in your country and others? If the average or standard costs of planting and maintaining a forest per hectare amounts to $1,000 and $65 respectively and the estimated costs of the reforestation proposals in the NEAP amount to $5,000 and $500 a hectare respectively, the disparity provides a useful basis for discussion. Why are the proposed costs so high? Can they be reduced? If indeed the NEAP planting costs are the best that can be achieved, the issue of whether the same impacts could be achieved more cheaply by other means can be addressed.
- Are the right incentives in place to protect the trees? Trees are easy to plant but more difficult to maintain. Who will protect them from livestock intrusion and firewood collectors? What incentives will those who planted and manage the trees have to do their job effectively? Will there be community support for planting trees?

so effectively and should incur losses if they do not. This is perhaps one of the primary arguments for privatization: effective maintenance is more likely when the owner directly reaps the benefits and bears the costs than when the state bears the losses of poor operation and maintenance. Design of incentive mechanisms to achieve appropriate maintenance for state-owned organizations is also possible.

7.2 Costs Per Unit of Input

If comparative data are available, computing costs per unit of input gives the decision maker an immediate sense of the cost-effectiveness of a particular project. To achieve the most cost-effective solution is to achieve the desired impact at least cost.

This perspective is vital to inject into the NEAP ethic, because if no focus exists on comparative costs, the idea can take root that, because this project is not "commercial," it should not be subjected to the same scrutiny to ensure cost-effectiveness.

7.3 Costs Per Unit of Output

Providing costs per unit of output is also useful for purposes of comparison and discussion. For example, the benefits of a proposed national park include conserving three rare and endangered species of birds, protecting a range of other unique biota, and providing controlled recreation for an average of 100,000 visitors a year. The capital costs are estimated at AF$2,000,000 and the operating costs—including ongoing repair and maintenance—amount to AF$50,000. What are the total capital and operating costs per visitor, assuming a time horizon of 50 years and a real interest rate of 10 percent?

The capital costs must be annualized over the 50-year life of the project to derive an estimate of the annual equivalent of the capital sum, using an annualizing formula taken from standard investment appraisal texts. To this must be added the annual maintenance cost. By dividing the total by the expected number of visitors, the annual equivalent capital and recurrent costs can be estimated (see box 7.2).

Box 7.2:

Annualizing Costs

Capital Costs Annualized:

$$2{,}000{,}000[0.10(1.10)^{50}/(1.10)^{50} - 1.00] = 2{,}000{,}000 \times 0.1009 = 201{,}800$$

Annualized Capital Costs Per Visitor = 201,800/100,000 = AF$2.02

Annual Maintenance Costs = 50,000
Annual Maintenance Costs Per Visitor = AF$0.50

Category	Annualized Capital	Annual Maintenance	Total
Total *(AF$)*	201,800	50,000	251,800
Per Visitor *(AF$)*	2.02	0.50	2.52

7.3.1 Estimating Cost Recovery

If this were a private development, the developer would need to get an average of AF$2.52 from each of 100,000 visitors to break even. This provides a data base from which a number of useful questions can be explored: We are now in a position to assess if any prospects exist for collecting a fee that contributes to cost recovery or if the visitors will only pay an amount equal to or less than the recurrent costs. These unit costs can also be compared with those incurred elsewhere to give a sense of, given the objective to be achieved, whether the costs of doing so are reasonably cost-effective. It also raises issues of price elasticity of demand. How will the number of visitors be affected by pricing? Are there means via sales in a shop, the provision of concessionaire guide services, and so on to add to income?

The extent of the subsidy required to secure species conservation, which is a joint product with the recreation experience, is clear if we can assume some willingness to pay on the part of the visitor. This type of data will become increasingly important as the global community moves toward a transfer of resources in exchange for the achievement of globally relevant benefits.

Note that the costs are in constant, that is, net of inflation, terms. Thus, the annual recurrent costs of AF$50,000 will have to increase in line with inflation. At the start of the project, the recurrent costs average AF$0.50 per visitor (50,000 ÷ 100,000). A charge of AF$0.50 per visitor assessed as a means of financing the recurrent costs will have to be increased in line with inflation, and the park will have to get this revenue or its equivalent. Many projects have collapsed into failure and disrepair because such essential adjustments have not been observed.

7.4 Focus on Cost-Effectiveness and Exchequer Costs

The focus on costs per unit of output allows decision makers to ensure themselves of cost-effectiveness: is this the cheapest way of getting the job done? Given that it is often difficult or impossible to quantify the monetary benefits of environmental projects and programs, this is valuable data on which to fall back. It addresses the question: if we are going to do this, is this the best value for the resources expended? The menu of tasks will exceed by several-fold the resources available to do them. The NEAP economist will fulfill a useful function if he or she helps ensure that what is undertaken is cost-effective, thereby helping to ensure that the most can be achieved with resources available. In addressing investment options for the NEAP, it can be useful to analyze options by their likely impact on the gov-

Box 7.3:

Economics in the Seychelles Environmental Action Plan

The impact of implementing the Seychelles' National Environmental Action Plan on the nation's foreign debt burden is estimated in the plan under two scenarios, one of which provides funding at much more concessional rates than the other. It is concluded that, without generous donor support, the burden on public finances would be unsustainable if the more environmentally attractive of the two options were taken. The case is made that the potential dilemma can be resolved by either dropping some of the lower priority items from the list or securing the additional preferential funding. This presented the information in a fashion that proved both useful and effective at the donors' meeting that followed.

ernment's budget and the sustainability of what is proposed.

7.5 The Opportunity Cost Concept

An understanding of this concept is fundamental to undertaking economic analysis. Opportunity costs are the benefits foregone by using resources in other than their highest-yielding opportunity. Firewood is often free to the collector, but its absence imposes substantial costs; the costs incurred in the absence of firewood represents its opportunity cost. In addressing alternatives, economists concern themselves with opportunity costs almost exclusively, although the starting point in identifying opportunity costs is often the cash costs.

Box 7.4

Opportunity Cost: a Simple Example

If a government can get $18 a barrel for oil on the world market but chooses to give it to its own citizens or a local refinery or both for the equivalent of $10 a barrel, the private cost is $10 but the opportunity cost—what is foregone to indulge the citizenry—is $8 (18 –10); the price that reflects the full opportunity costs is $18.

Cash costs are, however, central to analyzing incentives because the costs borne by the individual shape his or her behavior.

7.6 Estimating Gross Costs of Environmental Degradation

Gross Domestic Product (GDP) measures the market value of the flow of goods and services produced in an economy. Gross National Product (GNP) adjusts the GDP to account for earnings flowing to or from abroad. They are computed following conventions developed after the Second World War and provide a degree of consistency worldwide that allows intercountry comparisons. Although originally developed in the 1940s to give information on the balance between total supply and demand and on savings and investment in reproducible capital (Mäler 1990), when expressed in per capita terms, these are used conventionally as indexes of overall well-being. As such, they are deficient in at least three respects: they do not account for how the "pie" is distributed and, therefore, how utility is distributed; they measure only flow of goods and services, not the net effects on stocks; and they vary significantly in the degree to which they pick up activities that yield goods and services but are not traded in markets.

Continuing efforts have been made over the past several years to derive an index that better reflects well-being and quality-of-life considerations. The United Nations is at present conducting

Box 7.5:

Measuring Sustainability

Pearce and Atkinson (1993) have developed an interesting means of categorizing countries to indicate whether they are on sustainable development paths. They make a distinction between "weak sustainability"—the constant capital rule, in which an aggregate capital stock no smaller than the present one is passed onto the next generation—and "strong sustainability," in which, in addition to conserving the overall capital stock, the natural capital or at least its key features are conserved.

They apply the "weak sustainability" rule to a number of countries as follows: for each country analyzed, they estimate the rate of depreciation of natural capital—sometimes called resource rent—and made capital and compare these with the rate of saving. If the rate of depreciation of natural and made capital exceeds the rate of saving, the country is not reinvesting sufficiently to replace the natural and made capital drawdown and fails the "weak sustainability" test. If a country has a higher saving rate than the rate of depreciation of natural and made capital, it passes the test. The results for a few countries are shown below:

Table 7.1: A Measure of Sustainability

Country	Rate of Saving	Rate of Depreciation of Made Capital	Rate of Depreciation of Natural Capital	Net Saving Rate
	(i)	(ii)	(iii)	(i) – [(ii) + (iii)]
Japan	33	14	2	17
Poland	30	11	3	16
Costa Rica	26	3	8	15
Netherlands	25	10	1	14
USA	18	12	3	3
Mexico	24	12	12	0
UK	18	12	6	0
Malawi	8	7	4	-3
Nigeria	15	3	17	-5
Ethiopia	3	1	9	-7
Burkina Faso	2	1	10	-9
Madagascar	8	1	16	-9
Mali	-4	4	6	-14

It can be seen that all the African countries listed are on unsustainable development paths, according to this definition.

a comprehensive reexamination of the guidelines for its System of National Accounts.

In parallel with this review, the Human Development Index, which is a composite weighting measured on a scale of 0 to 1 by country of longevity, knowledge, and consumption, has been prepared by the U.N. Development Programme. Longevity is measured by life expectancy, knowledge is measured by literacy, and consumption is measured by GDP (U.N. Development Programme 1990). But this is not produced annually,

and the relative contributions to human development must be weighted.

Daly and Cobb (1989) have produced an Index of Sustainable Economic Welfare, which is comprehensive, taking into account consumption, which they adjust for distributional inequality, and then incorporating consideration of a series of environmental costs. These include depletion of nonrenewable resources, loss of farmland from soil erosion and urbanization, loss of wetlands, and a long-term environmental damage adjustment factor to accommodate such things as greenhouse gas and ozone depletion effects. Again, disagreement can be substantial about the variables included and their weightings; difficulty with the latter tends to comprise the Achilles heel in universalizing such methods and gaining acceptance of them as true reflections of well-being.

7.7 Adjusting the National Income Accounts

Rather than attempting to provide weightings of various dimensions of well-being not now addressed by National Income Accounts, it is difficult to work at adjusting the accounts using market values but including some of those dimensions not captured by the existing data-gathering systems. Peskin (1989) and Lutz and Serafy (1988) review the various issues involved in incorporating environmental dimensions in national accounting frameworks in developing countries. Peskin and Lutz (1990) review experience in this regard in industrial countries.

The following are some of the elements on which these revisions have focused. They highlight the great difficulty of making substantive changes likely to command widespread agreement.

7.7.1 Adjustment on Environmental Protection and Clean-Up.

The costs of cleaning up are included in the computation of Gross National Product. Some argue this is fatuous because the more pollution created, the more must be cleaned up and the greater the contribution to GDP. But this ignores that the resources engaged in clean-up would yield benefits elsewhere in the economy if they were not devoted to a clean-up. Money spent cleaning up a lake is not available to improve the efficiency of the transport system; the lake clean-up, however, produces utility to its users. Thus, National Income Accounts do already include the effects of outlays on clean-up and environmental protection generally.

7.7.2 Adjustment Because of Losses in Health and Well-being

The National Income Accounts as conventionally measured do pick up the losses incurred to the extent that the negative environmental impacts reduce market-valued output. For example, if water pollution makes people sick and they cannot work in fields or factories for some weeks, the cost of degradation will be captured. Destruction of a beautiful vista or shoreline so tourists no longer visit the country in significant numbers is a cost that gets "captured," albeit with a few years of lag time perhaps. To the extent, however, that diminishment of the view is borne by people in reduced aesthetic enjoyment that does not adversely affect their productivity, the degradation imposes a cost not reflected in the National Accounts. Accommodating such costs, however, in fashions that command credibility and feasibility in developing countries poses a significant challenge.

7.7.3 Adjusting for Losses in the Capital Assets of a Country

A plausible argument can be made that, because GDP only measures the flow of goods and services in a period, this output could be achieved at substantial costs in reduction in capital or wealth. Currently, by deducting capital consumption allowances (reproducible capital), Net Domestic Product (NDP) is derived. Prince (1992) of the U.S. Congressional Budget Office illustrates how the United States is beginning to analyze this issue and provides an illustrative estimate of an adjusted Net National Product (NNP) for 1982–89, in which depreciation associated with air quality, water quality, federal oil and gas, and agricultural land is deducted from conventional NDP. He also provides a "Natural Resource Balance Sheet," showing the level of depreciation that, if applied, would sustain the value they held in 1981 in real terms.

Repetto and others (1989) provide perhaps the most comprehensive examples of an attempt to

adjust the National Accounts of a developing country—Indonesia—to accommodate changes in wealth by adjusting for changes in stocks of oil, forest, and top soil. They have also (1991) adjusted the National Accounts of Costa Rica to reflect the fact that much of the growth recorded in the conventional accounts is achieved by drawing down the forest capital. This work was followed by that of Bartelmus, Lutz, and Schweinfest (1992), who estimated the adjusted accounts for Papua New Guinea, focusing on agriculture, forestry, and mining and in the process identified the data gaps to fill to make further progress. The early work in environmental accounting is summarized in Ahmad, Serafy, and Lutz (1989).

In making such adjustments, it is important not to focus exclusively on the cost side—the "drawdown" of natural resources. Virtually every industrial country in the world has drawn down its resource endowment to in part provide the resources to finance development of intellectual resources, infrastructure, and so on. The extent to which the resource surplus is or is not creatively used will largely define their prospects of achieving a transition to growing well-being. Such reallocations should appear in the Net National Income Accounts. Thus, the verdict on the implications of drawing down the patrimony for national well-being is conditional; if the drawdown is used to provide a platform for further income generation, that is, if the human and made capital stocks are augmented, capturing only the reduction in the natural asset base in National Accounting may provide an exaggerated sense of the loss; but if the converse is the case, that is, if the asset base is being extirpated to maintain consumption, excluding this reduction somehow in the accounting framework will be a misleading indicator of well-being in the long term. In particular, to focus on the negative implications for the natural environment without balancing this with consideration of improvements, if any, in human capital could give misleading results. (See box 7.5 for an interesting method to addressing this issue.)

Of course, the industrial countries made the transition when the stock of biodiversity was richer, that is, less scarce, than it is today. The assimilative capacities of the earth's upper atmosphere had not yet been exceeded. Thus, sustainability from a global perspective may demand a different method. We are, however, discussing accounting from a narrow national perspective.

Bojö (1991) assessed the impacts of soil erosion on crop production—mainly maize, sorghum, and wheat—and yield in Lesotho. Multiple regression analysis was applied to a ten-year data series to relate production in tons for each crop (the dependent variable) to area harvested in hectares, plant-available precipitation in millimeters, fertilizer added to the soil in kilograms/hectare, and accumulated erosion in tons/hectare (the independent variables). The results showed no statistically significant impact of accumulated erosion on production of maize and sorghum. When data and time allow, the Bojö method has much to recommend it; it provides a comprehensive analytical framework and allows a relatively rigorous testing of hypotheses, which are often accepted as true without having been tested. But the method also demands skill and data; it could not be applied to overstocking and range degradation, which are a major—perhaps *the* major—source of environmental degradation in Lesotho, because limitations of data and expertise precluded their analysis. In the absence of adequate time series data, it is possible to conduct a sector-by-sector analysis, in which the gross costs imposed by environmental degradation are estimated for a point in time by sector. The results are crude and need careful interpretation, a subject we take up in chapter 8.

7.7.4 Satellite Accounts

The Statistical Office of the United Nations, which sets guidelines for the standard system of National Accounts, is working on guidelines for the production of satellite accounts that can be presented with the conventional accounts, showing performance relative to a variety of environmental indicators. Tongeren and others (1991) provide a preliminary indication on the framework likely to emerge from this process by using Mexico as a case study to illustrate how to produce a system of economic and environmental accounts.

The data are for 1985, a year for which detailed input and output information is available. An input/output table shows the flows from sec-

Box 7.6:

Nauru as a Case Study in Unsustainability

Nauru is a small South Pacific island, which at independence 25 years ago was one of the world's richest countries measured in per capita income. This income was based on the exploitation of its phosphate deposits, which were strip-mined by British Phosphate Commissioners, a joint partnership among Britain, Australia, and New Zealand.

The phosphate, however, is due to run out in two years. Today, the Nauruians are confined to the coast; the central plateau is devoid of trees, plants, or birds. Food must be imported; the incidence of obesity, diabetes, and heart disease is high; life expectancy is low. The island is now seeking compensation to restore the island to a state where food can be grown again.

Source: The Independent (1993, 11).

tors into other sectors (rows) and the inputs into sectors from the other sectors in the economy (columns). Input/output tables tend to be about five years or more out-of-date, because the availability of data on intersectoral flows tends to lag behind the availability of national aggregate data, such as are found in conventional National Accounts, by several years. It is conceptually easy but empirically difficult to link environmental/resource flows to the economic flows. The fact that the United Nations is looking to input/output analysis as the key framework to address the environmental dimensions means that realistically this method will probably not be ready for application in Africa for several years.

7.8 The NEAP Economist

The NEAP economist should be mindful of the following points in his or her work:

- For all proposals, focus attention on recurrent costs and the closely related issue of maintenance: the magnitude of costs, who incurs them, and what incentives will be in place to ensure that maintenance is carried out.

- Estimate the capital and recurrent costs per unit of input and per unit of output. Compare them with standards or norms. If norms are not available, ensure they are made available.

- It is not a useful investment of scarce intellectual resources to attempt the full integration of environmental impacts into the national accounting system. (This view is supported by Markandya and Perrings [1991], who review the experience with natural resource accounting in Norway, France, and Canada and note the limitations that accounting for ecologically sustainable development are likely to raise in most developing countries.)

- Nevertheless, the evidence continues to accumulate that depreciation of natural capital in many developing countries exceeds net savings, that is, the ability to replace such losses. Making approximate estimates of such depreciation should be considered, along the lines illustrated in box 7.5.

- Keep in touch with developments in regard to the integration of environmental dimensions into the National Accounts. Perhaps one NEAP team should be heavily involved in the U.N. exercise and keep the rest informed.

Discussion Questions

1. Why, in the case of public investment proposals, is most attention paid to capital costs with relatively little devoted to recurrent costs?

2. How might norms be established for the unit cost of inputs and outputs?

3. If a country has natural resource depreciation amounting to AF$200 million annually and net savings of AF$150 million, is this sustainable? Explain.

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Chapter 8

Estimating Gross Costs of Environmental Degradation, Sectoral Analysis: A Ghana Case Study

In this chapter, the term "gross costs" is used to signify the total costs imposed by environmental degradation.[7] "Gross" indicates that the benefits of such degradation have not been netted out. When soil erodes, it may enrich some lands downstream; when forest is cleared illegally, by burning or otherwise, it may yield enriched soil and provide wood. But these benefits are not deducted from the gross costs mainly because it proved impossible to estimate them. When the term "costs" is used, it signifies gross costs.

Why is it useful to identify the gross costs imposed by environmental degradation? In the NEAP process, at least three reasons can be identified:

- First, to capture the attention of the policy process and the key ministries that allocate resources, it is useful to demonstrate that the economy will suffer significant losses if the environmental issues are not addressed.

- Second, to help establish priorities for the NEAP, it is useful if the costs imposed by environmental degradation by different sectors have been estimated.

- Third, the process of estimation requires that the NEAP economist become engaged with decision makers in all significant sectors of the economy, providing crucial cross-sectoral links, which are at the heart of the NEAP process. The data developed as part of the costs estimation exercise are also useful if project evaluation is undertaken.

Tutu and I (1990) estimated the costs of environmental degradation for Ghana for 1989–90. For each sector, we asked the following question metaphorically: how much would producers or consumers be willing to pay to avoid the degradation associated with the sector in question? We used various means to get an approximation to this question. We converted cedis to dollars on the basis of a conversion rate of 325 cedis to the dollar, the rates that applied in the open market in 1989–90.

Before getting into the minutiae of methodology, it is important to note that the estimation of gross costs is quite separate from the issue of what, if anything, should be done about it. The costs could be large, yet no intervention might be justified because the costs of such intervention exceed the benefits. This is most unlikely but conceivable. Because diminishing returns set in, the costs of eliminating all the degradation and associated costs is also most unlikely to be justified; at some point, the costs of reducing degradation will exceed the benefits.

We identified the following sectors for analysis: crop production, livestock production, wood production, wildlife and biodiversity, mining, and manufacturing. We estimated negative health effects, which are the product of a number of sectors, separately, taking care not to double count, that is, not to include them in both the sectoral analysis and health analysis per se.

[7] The work discussed in this chapter was undertaken jointly by the author and Dr. Kwadwo Tutu, Department of Economics, University of Ghana, Accra.

8.1 Methodology

For each sector, we adopted the following method:

- We reviewed any available literature on the sector that linked environmental degradation to productivity. Identifying this environmental production function was the most difficult thing to achieve. The World Bank had undertaken a number of sectoral studies associated with the structural adjustment process; these proved invaluable sources of information and further make the case for linking the NEAP economic analysis with the analytical work associated with structural adjustment or other similar exercises.

- We conducted extensive discussions with the chief executives and scientists with responsibilities for the sector in question. From these discussions, we were made aware of data in departmental files that were not published but relevant to our quest, and we developed insights on the key issues and relationships. Where data were not available, it was possible in some cases to identify a range within which impacts were most likely to fall, based on the expertise and insights of the practitioners.

In the discussion that follows, we outline the efforts we made that failed. These indicate (1) *cul de sacs* that are inevitably encountered in such work and (2) the areas that may require more effort if our endeavors are to be improved on.

8.1.1 Valuing at the Margin

Markets operate at the margin, where flows of goods and services are traded. We apply marginal values to the total environment-related asset. For example, we apply a unit value of wood derived from transactions at the margin to the estimated total volume of wood lost annually as a result of environmental degradation. If in fact the total stock of wood lost were to come to market, the equilibrium price would fall as a result of the increased supply. We make no allowance for this, simply because no information exists on price elasticities of supply and the market for standing timber is in any event far from being competitive.

8.1.2 Valuing at Source

We value the damage costs at the point where they occur and do not attempt to identify linked effects up or down the production chain. Thus, in the case of wood, we estimate the willingness to pay to prevent losses in the forest but make no attempt to identify whether an excess willingness to pay exists on the part of wood processors, the construction sector, and so on. In certain cases, this will understate the costs that environmental degradation imposes. We did not address this issue because even where the data are good, incorporating linked effects is difficult to achieve in a fashion that is intellectually rigorous; the main difficulty derives from the fact that, if opportunities are precluded downstream as a result of resource degradation that occurs earlier in the production chain, at least some of those resources engaged downstream will flow into other activities; they are not all necessarily lost or somehow sterilized as a result. In the case of Ghana and most developing countries, the difficulties are such that they preclude a credible attempt at identifying net downstream effects.

8.1.3 Timing of Costs

Perhaps the biggest weakness of our cost analysis is the fact that we were not able to adjust the results for the fact that their effects are felt in the future. As wood is burned and as soil degrades, most of the negative impacts will occur in the future. Indeed, it can be argued that it is precisely the fact that the costs are deferred that allows the problem to continue unaddressed. An extensive literature addresses the most appropriate means of adjusting for the effects of time. Our rate of time preference is the discount rate that reflects the weighting we give to future benefits and costs in relation to the present: if the rate at which we discount the future is 20 percent a year, applying conventional discounting formulae, to be discussed in chapter 9, tells us that we would be indifferent about whether we received $100 today or $248.8, that is, $100(1.20)^5 = 100(2.488) = 248.8$, five years hence.

We have made no adjustment for the fact that the costs in most cases are deferred, because it proved impossible to get credible estimates on the time at which the losses occurring in 1989–90

Box 8.1:

Rate of Time Preference and Influence on Behavior

We can compare the threshold amount at which we would be indifferent for a number of different rates of time preference:

Annual Rate of Time Preference *(percent)*	Threshold Amount Five Years From Now
10	161.1
20	248.8
30	371.3
40	537.8

Thus, if our rate of time preference is 20 percent, and we are offered the choice of $100 today or $230 (or any amount below 248.8) five years from now, we will choose the $100 today; the wait is not justified. The higher the rate of time preference, the heavier is the future discounted, so that, when our rate of time preference is 40 percent, we will need at least the expectation of $537.8 five years from now to justify deferring $100 consumption today. Because the rate of time preference for consumption generally increases as incomes decline, this explains in part the difficulty that poor farmers and other producers have in deferring consumption to undertake investment. The rate of return has to be so high to compete with the pressing needs of today that most output-enhancing investments, including those associated with conservation, are foregone.

Associated with the rate of time preference is the opportunity cost of capital—what is foregone in the best alternative available by allocating resources to the project in question. If the best available alternative will yield a real rate of return of 20 percent a year, this becomes the discount rate to apply to investment proposals. Under certain circumstances, the rate of time preference and the opportunity cost of capital will be the same. These discount rates are based on the experience and values of individual producers and consumers. To what extent are they different from the rate at which society discounts the future? This poses practical issues, such as the risk-spreading effects on discount rates associated with large numbers of projects and philosophical questions such as how to weight the values and interests of generations yet unborn.

would in most cases be experienced on the ground. Thus, our annual cost estimates are stated as if the discount rate were zero.

8.2 Sectoral Analysis

We can consider a variety of approaches for evaluating environment-related losses from exploitation of crops, livestock, and forestry.

8.2.1 Crops

The main environmental impact associated with cropping is erosion and associated nutrient and soil loss. It is usual to distinguish between on-site losses (incurred by the farmer) and off-site losses, such as siltation of irrigation systems, harbors, and reservoirs (including hydroelectric power reservoirs); damage to fisheries; and the effects of intensified flooding. Twenty five percent of Ghana's land area is classified as subject to moderate to severe erosion. The question we needed answered was: how much should Ghanaian farmers and others adversely affected by erosion be willing to pay to prevent it? We focused exclusively on on-site losses, although some of the off-site cost implications were addressed under other headings.

Estimating loss on the basis of reduction in productivity. We attempted to estimate the net annual loss as a result of productivity losses stemming from erosion. Although estimates of an annual loss of 1–3 percent in productivity were frequently averred, no empirical work sustained or refuted such estimates. The translation of a productivity loss into an economic loss was not undertaken. The Ministry of Agriculture does maintain some farm budget data, so that, if the losses in productivity were valid, some estimate of net output loss by crop would be possible.

Tables 8.1 and 8.2 show the types of data that are available for some cropping systems but not for the range of farming systems associated with land eroded to varying degrees. Using improved technologies, data are available for maize/cassava production per hectare for 1990 in constant cedis.

Table 8.1: Gross and Net Margin per Hectare, Maize, Ghana, 1990 *(cedis)*

Gross Output	225,000
Variable Inputs (fertilizer, seeds, etc.)	-50,000
Gross Margin	175,000
Long-term inputs (capital, land)	-100,000
Net Margin	75,000

An annual decline in productivity of 2 percent would imply the Gross and Net Margins shown in table 8.2 in some of the years following, if there were no adjustment in inputs.

It is clear that what seems to be a rather modest rate of productivity decline represents, given the assumptions made, a rather dramatic decline in net margin, which is cut in half after about ten years. Farmers would not, however, keep their output mix and their inputs constant. They might well change their crop completely to adapt to the changing situation, for example, from relatively erosion-sensitive crops, such as maize, soybeans, groundnuts, and upland rice, to relatively insensitive crops, such as cassava. They might replace eroding nutrients with fertilizers, thereby maintaining output above that projected. If good farm budget data are available, if the responses of farmers to changing productivity can be predicted, and if the areas suffering productivity losses under different farming systems are known, the net loss, estimated by the change in net margin, can be approximated.

Bishop and Allen (1989) in their analysis of on-site costs of soil erosion in Mali adopted this kind of method. They used a model of the erosion/yield relationship based on research carried out by the International Institute for Tropical Agriculture in Ibadan, Nigeria. They then integrate the implications of the reduced yields into farm budgets to estimate the net return foregone as a consequence of erosion.

As described in more detail in chapter 10, Bojö (1991) adopted a similar method, assessing the impacts of soil erosion on crop production (mainly maize, sorghum, and wheat) and yield in Lesotho. Multiple regression analysis was applied to a ten-year data series to relate production in tons for each crop (the dependent variable) to area harvested in hectares, plant-available precipitation in millimeters, fertilizer added to the soil in kilograms/hectare, and accumulated erosion in tons/hectare (the independent variables). The results showed no statistically significant impact of accumulated erosion on production of maize and sorghum.

Magrath and Arens (1989) estimate the costs of soil erosion on Java by using a variety of sources to estimate the annual percent change in yield associated with erosion and then used farm budget data to derive the implications for net output.

Table 8.2: Impact of 10 Percent Productivity Decline on Gross and Net Margins, Maize, Ghana, 1991, Static Case *(cedis)*

	1993	1996	1999	2002
Gross Output	216,270	203,791	192,032	180,952
Variable Inputs	-50,000	-50,000	-50,000	-50,000
Gross Margin	166,270	153,791	142,032	130,952
Long-term Inputs	-100,000	-100,000	-100,000	-100,000
Net Margin	66,270	53,791	42,032	30,952

We did not have the kind of productivity and budget data to which Bishop and Allen (1989), Bojö (1991), and Magrath and Arens (1989) had access. We then attempted a second-best valuation option: change in capital value of land.

Estimating loss on the basis of change in land value. We examined the land price data and attempted to estimate how many hectares a year lose productivity as a result of erosion and how this is reflected in land prices. If it were possible to classify land in the erosion-prone zones into categories and estimate the average loss in capital value resulting in each category, this would yield some estimate of the costs imposed by erosion. The key assumptions would be that land markets were reasonably competitive and that erosion status explained most of the difference in value.

Table 8.3: Hypothetical Value of Eroded and Uneroded Land

Category	Area 000s hectares	Price per Hectare *(cedis)*	
		No erosion	Eroded
A	50	100,000	10,000
B	30	150,000	10,000
C	40	250,000	25,000

In the hypothetical example shown in table 8.3, the area in each of three categories of land—A, B, and C—and the price per hectare for each category are shown before and after erosion.

Table 8.4: Hypothetical Capital Losses of Eroded and Uneroded Land *(cedis)*

Category	Annual Average Value Loss per Hectare	Total Annual Average Capital Loss
A	4,500	225,000
B	7,000	210,000
C	11,250	450,000
Total		**885,000**

If it were possible to categorize the land as shown in table 8.3 and if it took, on average, 20 years to move from uneroded to eroded, we could say that, on average, the capital losses per hectare and in total are those shown in table 8.4. The annual average value loss per hectare is derived by dividing the difference between slightly eroded and seriously eroded by 20; the capital loss is derived by multiplying this number by the area in hectares. Thus, in the case of A, (100,000 – 10,000)/20 = 4,500 x 50 = 225,000.

If we knew the actual flow of annual real capital value loss over time and knew the rate at which to discount it, we could do so and compute the annual equivalent thereof. (The means of deriving it are shown in chapter 10 on "Comparing Benefits and Costs.") This would provide an estimate of the annual losses today over the life of the soil.

Unfortunately, the erosion data are not available in this fashion, the information on land prices in Ghana is poor, rural land prices can be cyclical and subject to other forces, and it is not clear that there are competitive markets. Adopting this method would have required us to do our own survey, which was not feasible and would not have been a wise allocation of effort given that (1) most land does not appear to be traded in markets, (2) the market in land that does exist is not competitive, (3) market price reporting is not undertaken systematically, and (4) that which is done is not related to quality. Location would also likely prove a crucial factor determining land value, but the data probably would not allow the credible use of multiple regression techniques to incorporate such considerations into the analysis. Finally, we adopted a third-best (after change in net productivity and change in capital value of land) strategy: data do exist on the nutrient losses associated with erosion.

Valuing nutrient losses. We valued these losses at their replacement cost. This is much less satisfactory than estimating the loss in net productivity or the loss in capital value of land (the latter under certain conditions being the capitalized value of the former), because, being further removed from market information that is relevant to the farmers, it is more indirect; some of the loss may not result in productivity loss; and the farmers have a variety of responses to nutrient losses in addition to replacement.

Table 8.5: Value of Nutrients Removed by Crop, Ghana, 1988

Crop	Production 000s Tons	Total Nutrients Removed 000s Tons	
		Nitrogen	Phosphate
Maize	550	27.5	11.0
Sorghum	370	11.1	4.6
Rice	120	1.8	0.9
Cassava	3,300	20.6	5.0
Yam	1,200	5.5	2.2
Cocoyam	1,200	5.5	-
Cowpea	14	-	0.2
Groundnut	140	-	1.4
Total	**6,894**	**72.0**	**25.3**

Source: World Bank (1989, 2, 15).

The data in table 8.5 on the quantities of nutrients removed by the present production systems were estimated by crop for 1988.

> To provide the total amount of nitrogen removed by the crops in a single year would require the equivalent of about 332,000 tons of ammonium sulfate, while to provide the phosphorous would need about 116,000 tons of single super phosphate or 330,000 tons of 15:15:15 compound fertilizer.(World Bank 1989, 14)

The compound fertilizer was valued at a pre-subsidy cost of 78,820 cedis a ton, amounting to a total annual replacement cost of 26 billion cedis or $80 million. For the reasons noted above, this undoubtedly exceeds the maximum willingness of crop farmers to pay to avoid these losses, but this overstatement is compensated for at least in part by the fact that nutrient losses from cotton and tobacco are not available and so could not be included.

8.2.2 Livestock Production

Production of livestock feed from natural sources is unlikely to increase over the next two decades. All the official projections expect a reduction as the cropped area increases. Overgrazing, defined as a level of demand on the available forage that is not sustainable, which means that the resource is in effect mined, is already apparent in three regions of Ghana. The Ministry of Agriculture quantifies the food demands of livestock in tons of digestible protein and also estimates the tons of maize that would substitute for this deficit.

Table 8.6 shows the data estimated for 1988.

Table 8.6: Estimated Food Demands of Livestock, Ghana, 1988

Loss	Tons
Protein Deficit	385,000
Maize Equivalent	40,000

Valuing the maize equivalent of the nutrient loss at the market price of 68,500 cedis ($211) a ton yields a total 2,740 million cedis or $8.4 million.

8.2.3 Costs Imposed Downstream

Erosion can impose costs downstream (off-site) in the following fashions:

Reduced efficiency of hydroelectric projects. They silt up more rapidly than would be the case with natural erosion, imposing some combination of dredging costs to maintain the capacity of the dam, reduced output, and shortened life. In most cases, the annual or annualized costs of removing the additional silt generated by inappropriate agricultural practices will provide a reasonable estimate of the costs imposed by erosion-induced siltation as this will often be the most cost-effective response available to the utility. If this is not technologically feasible or exceeds the costs of the output foregone, estimation of the net value of the output loss must be attempted.

Electricity output that is available to meet peak demands is typically more valuable than

base load. Hydroelectric power is often used to meet peak demand. The significance of the losses will depend in part on whether the output foregone as a result of silting is a relatively low-valued base load or high-valued peak load. If the reduction in electricity output is to be valued, it should be done by estimating the costs of replacing the output foregone at the margin rather than by what consumers would be willing to pay to avoid the reduction; because utilities are monopolies whose prices are regulated, the price paid by consumers does not typically reflect the economic costs to the nation of expansions or reductions at the margin.

The utility operating the hydroelectric schemes should be able to estimate the total net costs (recurrent and capital) imposed by siltation. It is important not to double count: if additional dredging will allow the maintenance of output, a projected loss of output should not be added to the dredging costs, because undertaking the latter will preclude the former. In Ghana, erosion-induced costs of electricity generation were judged not to be significant, but the issue was not explored in depth with the utility.

Siltation of ports and urban drainage systems. Estuaries are natural accumulators; a buildup of material is inexorable. But erosion can dramatically increase the load above the baseline. In most cases, the Port Authority will have to provide more dredging services in the port to compensate for erosion-induced siltation. Likewise, the drains in coastal towns fill prematurely with silt, imposing a combination of increased clean-up costs, more flooding and waterborne disease. We noted the silting of drains in Accra but simply did not have the time to value the costs imposed on the harbor or the city water supply and drainage system, except as far as they were captured by our analysis of health costs or the costs imposed elsewhere in Ghana as a result of increased maintenance requirements for water supply systems.

8.2.4 Forestry

Pearce (1989) proposes the concept of total economic value, comprising use values (timber, nontimber products, and ecotourism), indirect uses (ecological functions, watershed protection, and mineral recycling functions), and existence value (unrelated to any particular functions) as a taxonomy for organizing discussion of forest values. He argues that in many instances use value alone justifies forest conservation and that destruction is often a product of poor policies and inadequate tenure.

Two sources of loss exist in forestry. At the extensive margin, forests are destroyed by fire and other clearance methods. At the intensive margin, losses result from the harvesting process. In both cases, inadequacies in the assignment of property rights and below-market pricing of wood are likely to be the main causes, an issue not addressed here.

Between 1986 and 1988, an inventory of the merchantable trees in the reserves—mainly closed or natural high forest—in Ghana was undertaken. An earlier survey in 1973 estimated nonmerchantable volumes and volumes in the savannah woodlands. From these two surveys, it was possible to estimate the average volume per hectare as shown in table 8.7.

Table 8.7: Average Standing Timber Volume per Hectare, Ghana Forests, by Category *(cubic meters)*

Category	Average Volume per Hectare		
	Commercial	Other	Total
Closed Forest			
>70 cms diameter	87	-	87
>30–70 cms. diameter	75	-	75
Other	-	361	361
Total Closed Forest	162	361	523
Savannah Woodland	-	21	21

Losses at the extensive margin. The first step was to estimate how many hectares are lost each year as a result of environmental degradation. The degradation process is a consequence of forest clearance, mainly by fire. The extent to which such losses are deliberate or accidental is not known. Ghana's Forest Service estimated annual losses in the range of 10,000–23,000 hectares of

high forest and 100,000–240,000 hectares of savannah woodland over the 1980–84 period. We made the conservative assumption that the "other" category in closed forest has zero value and thus did not include it in the losses estimated in table 8.8.

To put these losses in context, the 2.43 million cubic meters of commercial losses amount to 1.29 percent of the total estimate of 188.9 million cubic meters of standing commercial timber in Ghana.

Losses at the intensive margin. It is estimated by forestry experts that as much wood is lost in harvesting as is actually harvested for commercial purposes, the latter amounting to 1.35 million cubic meters. Thus, the losses caused by harvesting are also estimated as 1.35 million cubic meters.

Wood is sold commercially by the state on the concession system, in which a concessionaire is given an area for a specified number of years. He is charged an annual silvicultural fee per hectare, together with a royalty fee per tree taken out. No tree with a diameter breast height of less than 68 centimeters (107 centimeters for many species) may be felled. At each selection felling, one to two trees a hectare with an average merchantable volume of 7.87 cubic meters per tree are removed. Sixty percent of the output is exported. Firewood is available for harvesting for free or for a nominal charge.

Because substantial devaluations of the cedi have taken place over the past decade, exporting activities with a low import content have become much more lucrative; this includes log exports. Because the concession terms are infrequently revised, the holders capture a rent, equal to the difference between the returns they would need to keep logging and the return that actually accrues. The royalty fee in 1989 was 1,220 cedis ($3.75) per cubic meter. This is estimated to be one-seventeenth of the derived demand price (the export log price less the costs of harvest, extraction, loading, and transport). The standing timber price that could prevail under competitive market conditions would be 20,740 cedis ($63.82) per cubic meter. It is proposed to increase the royalty to 3,660 cedis per cubic meter. We adopted this as the core market-clearing price for large commercial logs, conscious that it is conservative as only 18 percent (3,660/20,740 x 100) of the estimated competitive price. This conservatism could be justified on the basis that the wood losses are random, whereas the wood harvested is selected because of its marketability. Downward adjustments to 1,830 cedis and 1,220 cedis were made to reflect smaller-sized commercial timber (30–70 centimeters diameter) and firewood (savannah wood) respectively.

The values resulting from this valuation process are shown in table 8.9. Thus, total annual wood losses are estimated at 10,843 million cedis, or $33.36 million. This is the estimate of annual gross willingness to pay to avoid incurring these losses.

Valuing nontimber forest losses. The forests provide a range of goods and services of great value and are being lost as the natural forest is

Table 8.8: Estimated Volume Losses at the Extensive Margin, High Forest and Savannah Woodland, Ghana, 1988

Forest Type	Area *(hectares)*	Volume per Hectare *(cubic meters)*	Total Volume *(million cubic meters)*
Closed Forest	15,000		
>70 centimeters diameter		87	1.305
>30–70 centimeters diameter		75	1.125
Total Closed Forest	15,000	162	2.430
Savannah Woodland Volume (mainly firewood)	60,000	21	1.260
Grand Total	75,000		3.690

Table 8.9: Total Estimated Value and Volume of Environment-Related Wood Losses

Forest Type	Unit Value *(cedis)*	Volume *(million cubic meters)*	Total Value *(million cedis)*
Closed Forest			
>70 cms diameter	3,660	1.305	4,777
>30–70 cms. diameter	1,830	1.125	2,059
Savannah	1,220	1.260	1,537
Harvest Waste	1,830	1.350	2,470
Total		**5.040**	**10,843**

eliminated. Most of these goods and services are not valued in markets, although some are to a limited extent. The uses for which money changes hands are: hunting licenses, bush meat sales, and minor forest products. We reviewed the data available in these regards.

Trees protect soil against wind and rain, recycle nutrients, provide shelter, store nutrients, and mitigate the intensity of flooding. The gross costs associated with these losses are captured to a limited extent in the discussion of agriculture. Forests provide shelter and nurture for wildlife.

Valuing forest user benefits. We attempted to evaluate the user benefits by estimating hunting license income, the in-forest value of bush meat sales, and the value of minor forest products:

- *Hunting license income* is received from permits issued in national parks and reserves. Total income from this source in 1989 amounted to 977,890 cedis or just more than $3,000. It was estimated that permits were issued to less than 5 percent of the total number of hunters. Thus, these data were of little use in deriving willingness to pay to prevent losses of forest habitat.

- Some 50,000 kilograms of *bush meat* is traded annually in the market in Accra. This is valued on the market at about 3,000 cedis a kilogram or 150 million cedis in total. It is estimated that the value in the bush is two-thirds of this or 100 million cedis ($308,000).

- Ghana's Forestry Department recognizes 60 categories of what the organization terms "minor forest products." These include: canes, sponge, atua leaves, and latex. These are sold for modest revenue: for 1984—the last year for which data exist—revenues amounted to about 1.2 million cedis or less than $4,000.

We conclude that the market-related data available on hunting, food value, and minor forest

Box 8.2:

On-Site and Off-Site Benefits of Afforestation in Northern Nigeria

Anderson (1987) estimated the benefits yielded by afforestation in northern Nigeria as follows:

He estimated the benefits of preventing soil fertility loss by estimating the present value of all agricultural output with an afforestation project and deducting the present value of output without the project, assuming a decline in soil fertility.

The benefits of enhanced fertility, as a result of improved moisture retention and nutrient recycling, were identified by estimating the incremental effects of afforestation on crop yield.

The benefits of increasing livestock production as a result of the increased fodder were measured by the present value of the estimated increment in livestock.

The benefits of tree products—poles, fruits, and firewood—were estimated by multiplying increased volume by price.

products—with the exception of bush meat—are seriously deficient: only a tiny fraction of the goods and services that are provided are documented. The associated unit values are probably substantially understated in the case of hunting licenses and minor forest products.

Valuing existence and option value. In addition to the use values, forests in some cases also provide what economists call existence value and option value. Existence value is provided when people get utility from just knowing that the forest and the species that depend on it exist, even though they never intend viewing or otherwise utilizing them. Option value is yielded by virtue of keeping the option open for future visitation or use of an environmental endowment that is unique. Existence and option value is yielded by forests and other ecosystems that comprise unique ecosystems of great rarity and interest for research and product development. Ghana has such forest ecosystems; other unique ecosystems also exist on the coast. They have not as yet, however, commanded the same level of international interest, for example, as the forests of Madagascar. As a consequence, no evidence on the ground exists for willingness to pay on the part of, for example, the World Wide Fund for Nature, to conserve the forest endowment.

In estimating the gross value of environmental costs resulting from forest degradation, it is also necessary to be specific on the forest areas and associated endowment being lost. If the forest overall is being depleted but those with unique ecosystems are being conserved, it is clearly not appropriate to attribute unique ecosystem loss as a cost of overall degradation. Likewise, if the forests in which most bush meat is found are not being depleted, applying some global average may be misleading.

Thus, in spite of a considerable investment of effort, we failed to derive credible estimates of the gross costs annually of nontimber forest losses.

8.3 Health Costs Resulting from Environmental Degradation

Poor health imposes a number of costs on society: the pain and anguish experienced by patients and their families, additional health services (drugs, nursing, doctor input, and hospitalization), productivity losses in days lost from work, and days worked at lower productivity.

We could not estimate the pain and anguish imposed, but we did succeed in deriving estimates of the additional costs in drugs, medical resources, and work losses imposed.

8.3.1 Costs of Drugs

The number of cases and associated drug costs are shown in table 8.10.

8.3.2 Costs of Medical Personnel and Hospitalization.

In addition to the drug costs listed in table 8.10, costs were incurred for medical personnel and hospitalization. We estimated that a doctor and a nurse spent one hour each with each case, including hospitalization costs. The hourly costs of a

Table 8.10: New Cases of Environment-Related Diseases, Ghana, 1988

Disease	Number of Cases *(000s)*	Drug Costs *(000s cedis)*
Malaria	1,233	69,041
Diarrheal	222	17,310
Infection	206	63,026
Skin diseases, including ulcers	120	191,334
Intestinal worms	104	3,123
Measles	58	n.a.
Pneumonia	21	4,726
Bilhartzia (Shist)	13	7,643
Onchocherciasis	11	1,398
Tuberculosis	9	n.a.
Whooping cough	7	1,632
Typhoid fever	4	1,025
Total	**2,008**	**360,258**

Source: Department of Health Statistics and Pharmacy Division, Ministry of Health, Ghana.

doctor's and a nurse's time and the total personnel costs are estimated in table 8.11, which assumes that the costs of the hospital infrastructures, including nonmedical personnel and maintenance, are fixed.

Table 8.11: Hourly Costs and Total Medical Personnel Costs, 1988

Category	Hourly Costs *(cedis)*	Total Costs *(000s cedis)*
Doctor	175	351,400
Nurse	60	120,480
Total	**235**	**471,880**

8.3.3 Output Foregone

The mean monthly earnings of an adult worker in 1988—7,500 cedis—is assumed to represent the opportunity cost of not being able to work as a result of environment-related disease. This in turn is regarded as a reasonable proxy for the output foregone as a result of the environment-related disease. We assumed that a full working month comprises 25 days, so that the average daily wage is 7,500 ÷ 25 = 300 cedis. We assumed that two days are lost as a consequence of disease and that 50 percent of the cases reported are adults. (Under reporting tends to be much higher in the case of children.) Thus, the value in thousands of cedis of total output foregone is estimated as the number of cases x average number of sick days per case x adult proportion of total cases x earnings per day:

$$(2{,}008 \times 2 \times 0.5) \times 300 = 840{,}000$$

Table 8.12: Total Health Costs *(000s cedis)*

Drugs	360,258
Medical resources	471,880
Output foregone	840,000
Total	**1,672,138**

These estimates probably significantly underestimate the total benefits, as they do not incorporate an estimate of the willingness of the beneficiaries themselves to pay to avoid illness or to increase their "life chances."

Box 8.3:

The Willingness to Pay for Improved Sanitation in Kumasi, Ghana

A study was conducted to learn the willingness of householders in Kumasi, Ghana, to pay for the provision of a water closet and piped sewerage system or for a ventilated pit latrine (KVIP), which does not require piped sewerage. Existing expenditure per household amounted to an average of $0.50; the willingness to pay for an improvement amounted to $1.50 per household.

On this basis, a subsidy of $60 million would be required to provide a water closet, but this would fall to $4 million if the ventilated pit latrine were provided. The health benefits accruing to the community as whole, that is, the benefits not captured by the individual willingness to pay were not estimated. The interesting question analytically is: would these health benefits exceed $4 million?

Source: Whittington and others (1992)

8.4 Conclusions

With a relatively modest investment of time, economists can begin the process of identifying orders of magnitude on the gross costs of environmental degradation and the priorities that seem to flow from it. Large margins of error—in excess of 50 percent—exist in the estimates. It is important not to be overinfluenced by the analysis, which focuses on what is quantifiable over a short period without any field work. The environmental degradation costs that were quantified are shown in table 8.13.

Converting at the prevailing 1989 rate of 325 cedis per U.S. dollar, which represents the market

Table 8.13: Total Estimated Gross Costs of Environmental Degradation

(000s of cedis)

Category	Gross Annual Cost	Percent of Total
Soil erosion	26,000	63
Land Degradation	2,790	7
Forestry	10,843	26
Health	1,672	4
Total	**41,305**	**100**

rate prevailing at this time, yields a total gross cost of $127 million.

Recall that it proved impossible to estimate the nontimber losses caused by degradation, notably the food and other goods and services yielded and the research and option values associated with unique ecosystems. The gross costs associated with industry and mining likewise proved impossible to derive in the time available. In establishing priorities, these gaps and the large margin of error surrounding the estimates need to be kept in mind.

The work described in this chapter was done in partnership with a Ghanaian economist, an ideal approach for gaining access and providing continuity. Looking at this exercise in retrospect, I believe it met its objectives of getting some policy attention and focusing more attention on the soil degradation issue. We learned a lot about the key issues in the various sectors, for example, the deficiencies in the pricing of stumpage (standing forest) and the priorities that should attend data gathering (linking soil loss to productivity loss to net income loss). In retrospect, I believe we should have spent more of our scarce time seeking out the off-site costs; these are the true externalities, the internalization of which would yield an improvement in economic efficiency. Not having an idea of their magnitude is a significant weakness of the study.

8.5 The NEAP Economist

The NEAP economist should be mindful of the following points in his or her work:

- Assess whether the payoff of a crude estimate of gross costs of environmental degradation would be of sufficient priority to spend perhaps six to eight weeks of your or a colleague's time.

- If so, for each sector of substantive economic significance in the economy, estimate the willingness to pay to avoid the gross losses imposed. Try to use the value of productivity losses, using market prices adjusted where necessary to reflect distortions in the market, to produce *shadow prices* for the willingness to pay. (The derivation and use of shadow prices are discussed in chapter 9). As second- and third-best options, use change in capital value and replacement costs.

- As you proceed, pull out the key policy issues of environmental interest that emerge. In our Ghana study, for example, perhaps the most interesting by-products in this respect were:

  1. The poor pricing policy for stumpage, which as a result of the devaluations and associated policies of structural adjustment, was resulting in large windfall gains for concessionaires and little incentive to reinvest in the forest because of tenurial deficiencies. (An interesting review of pricing and concession policies regarding lumber is provided by Grut, Grey, and Egli [1991] and a comprehensive review of a range of policy relevant issues in forestry is provided by Hyde and Newman [1991].)
  2. The likely negative environmental impact of increased cocoa production on forest clearance.

- Focus at least 30 percent of your attention on estimating off-site costs, some of which internalized would yield economic efficiency gains.

- Summarize your results in a way that emphasizes the frailty of the data and conclusions.

Discussion Questions

1. What are the main reasons why forests are destroyed?

2. Outline the limitations of the use of nutrient value as a means of valuing soil and forage loss.
3. How might the off-site losses associated with soil degradation best be estimated?
4. What is the linkage between gross costs of environmental degradation and Gross National Product?

Further Reading

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Chapter 9

Evaluation of Benefits

The purpose of evaluation is to help clarify the options for decision makers, to help them become aware of the implications of choices. In earlier chapters, I addressed this issue in terms of analyzing the implications of incentives, such as price and tenure arrangements, for environmental assets and in terms of identifying the costs associated with environmental degradation and policy options. These are all key contributions to the evaluation process. They have been presented first, in part to emphasize the point that economic analysis can contribute much to the clarification of options without valuing environmental benefits per se.

In this chapter, I use evaluation in a relatively narrow sense. The objective is to show how to estimate benefits of program and project options, generally in the context of a proposed set of investments. In chapter 10, the means of comparing costs and benefits will be discussed. Environmental investment programs (EIPs) are an integral part of many NEAPs. The NEAP economist will often be asked to justify or otherwise what is proposed on economic grounds. This chapter is designed to help him/her to do so.

Because costs have already been discussed at length, this chapter focuses on the evaluation of benefits. The distinction, however, is fundamentally artificial; benefits and costs are two sides of the same coin: the benefits of conservation will often be to prevent imposition of costs.

A vast literature exists on this subject. The issues involved can be quite complex. It would take an additional volume to address adequately the theoretical and practical nuances involved. This chapter presents some of the key conclusions on how to proceed. Their intellectual justifications are only briefly addressed.

The term "program" will be used here to refer to a package of distinct, but related, mutually reinforcing measures, whereas a "project" is an individual investment. I emphasize but do not confine myself to consideration of program evaluation for two reasons: it is the essence of the NEAP process to identify groups of mutually reinforcing measures. It is also often easier to identify and evaluate benefits associated with a group of measures than to do so for individual projects. In addition, the literature addressed to the evaluation of projects is extensive in contrast to that which addresses the combinations characteristic of NEAPs.

It is important not to be intimidated into inaction by difficulties in quantification; even a qualitative discussion of benefits and costs can yield important insights.

9.1 General Considerations

In evaluating benefits, it is useful to distinguish between financial and economic efficiency to understand the concept of opportunity cost and the relation between market performance and societal welfare.

9.1.1 Financial and Economic Efficiency

An important distinction is made between financial and economic efficiency: financial efficiency is efficiency as judged by the individual or community making the decisions. They will make their judgments based on the price signals they receive in the marketplace without reference to whether such price signals reflect the real costs

and benefits. If, for example, farmers are benefiting from heavily subsidized fertilizer and fuel, they will make their decisions on how much to use based on how much it costs to use and the perceived increase in benefit their use can be expected to yield. They will make no adjustment for the extent of subsidy involved, that is, they will maximize financial efficiency.

Economic efficiency, however, does adjust prices and costs to reflect the difference between individual interest and national interest. Prices are adjusted to reflect their opportunity cost.

9.1.2 Opportunity Cost

This issue has already been discussed in chapter 7 on costs. It is, however, so fundamental to the estimation of benefits that it is reviewed here again. Opportunity cost represents what is being foregone elsewhere in the economy if an input is used or if an output is consumed. If markets are competitive and no significant external costs and benefits and government price controls or price supports exist, the market signals will provide a reasonable measure of opportunity cost. If these conditions are not met, however, adjustments may be warranted so that prices reflect opportunity costs, that is, so they reflect economic efficiency as opposed to financial efficiency. Some examples include:

- **Unemployed worker.** If a worker is unemployed, with no prospects of being reemployed, and is not providing useful nonmarketed services, for example, child minding or cooking at home, there is no output foregone by employing him or her; the opportunity cost of so doing is zero, although some cost should perhaps be imputed for the loss of leisure time. If the going wage rate of unskilled labor is AF$3 a day, but such labor is paid AF$10 a day on a government-financed project, the shadow wage representing the opportunity cost of such labor is AF$3 a day.

- **Stumpage (standing timber).** If wood valued at AF$50,000 a year is being sold standing (on the stump) from a tropical forest and it is now decided to terminate wood sales to protect the watershed and generate other benefits, the opportunity cost in the value of wood sales foregone to generate these other benefits is AF$50,000, assuming that this is what the wood would fetch in competitive markets. If, however, the AF$50,000 is what the wood would be sold for but it would achieve AF$150,000 in a competitive market, the latter is the appropriate shadow price to use.

In general, in cost-benefit analysis, the valuation of benefits should reflect full opportunity costs.

9.1.3 Markets and Welfare

Economists have defined the characteristics that markets need to be competitive: these include lack of market power by individual producers and consumers, adequate information, and the assignment of property rights. They have demonstrated that competitive markets will bring an economy to an optimal situation from an economic efficiency point of view. Optimality is defined as a situation in which no one can be made better off without making someone else worse off; all the opportunities for mutually beneficial exchange have been taken, that is, the gains from exchange have been exhausted. (These issues are addressed in more detail in chapter 2, "Theory and Its Policy Implications Reviewed.")

9.1.4 Estimating the Environmental Production Function and Sensitivity Analysis

The environmental production function defines the relationship between inputs and benefits. It was noted in the discussion of costs that establishing this relationship, that is, quantifying the magnitude of the benefits associated with a given level of inputs, comprises the single greatest difficulty for the individual who is analyzing choices. The practical problems in this regard were highlighted again in the Ghana case study (see chapter 8). If we could predict with reasonable accuracy the extent to which biodiversity would be protected, soils would be conserved, effective tenure would be assigned, and so on as a consequence of NEAP-inspired actions, the analysis of choices would be relatively straight-

forward. But we know that this happy situation will not exist in the foreseeable future.

The use of *sensitivity analysis* is the most effective means of indicating to decision makers the implications of different outcomes: instead of making a single assumption on the response to an initiative, the analyst does the comparisons for a number of different outcomes, ranging from pessimistic to optimistic.

9.2 Willingness to Pay

How much are beneficiaries willing to pay in aggregate for the environmental benefits to be provided by the EIP? This is the question that the analyst attempts to answer. A corollary to this, namely, how much in aggregate are individuals willing to accept to forego an environmental benefit that exists. This may or may not accord with the estimate of willingness to pay, depending on a number of conditions, including how property rights are assigned. I adopt the willingness-to-pay convention as the norm. Knetsch (1993) raises a number of important reservations concerning the lack of symmetry between "willingness to pay" and "willingness to accept" and the fact that contingent valuation techniques yield inconsistent results depending on the package being proposed to users or consumers.

As noted in chapter 7 on costs, benefits will often take the form of avoidance costs—for example, the total willingness to pay to prevent soil losses and associated productivity and off-land costs—to maintain biodiversity, meat production, and watershed protection in tropical forests. But the benefits can also be positive; for example, a positive benefit would be a national park that attracts visitors. As in the case of costs, benefits are measured at the source and are marginal in the

Box 9.1:

Methods of Benefit Evaluation

Munasinghe and Lutz (1991) review alternative methods to valuation in which they distinguish three:

1. *Direct valuation*, including changes in productivity, loss of earnings, and actual defensive expenditures.
2. *Surrogate market values*, including changes in property values; wage differentials based on environmental conditions, called "hedonic pricing;" and the travel-cost method to recreation valuation. The latter regards the visitors who travel farthest as marginal because they would not come with any additional costs; it assumes those closer will capture a surplus equal to the difference between the travel costs of the farthest and their own (actual) travel costs.
3. *Replacement costs and contingent valuation.* Contingent valuation typically involves asking what resource beneficiaries or potential beneficiaries are willing to pay to conserve an asset. An important challenge to be met in the design of the survey is to discourage respondents from giving strategic responses—low if they feel the responses may be used to develop a fee schedule, high if they feel that they would not have to pay, but that a high value will encourage conservation of the asset in question.

This taxonomy is further elaborated in Munasinghe (1992), from which much of what follows in this section is drawn.

Where feasible, direct valuation (changes in productivity) should be used, but this will often not be possible, in which case surrogate market values and (as a last resort.) replacement costs and contingent valuation methods can be considered.

sense that, unless evidence exists to the contrary, it is assumed that the magnitude of benefits provided is not sufficiently large to influence the market to change the equilibrium price. In my review of methods in this section, I concentrate on the measurement of benefits and costs that accrue to the residents of the NEAP countries.

Amsberg (1993) has suggested that a "user cost" or "depletion premium" be applied in the evaluation of natural resource projects. The cost or premium should be estimated based on the costs of providing a sustainable alternative once the resource in question is depleted. In this paper the sustainability constraint is incorporated to the extent that external costs and benefits are incorporated into the analysis, but no attempt is made to introduce a premium for depletion.

9.2.1 Changes in Productivity

The following hierarchy of approaches to the evaluation of change in productivity can be recognized: changes in net output, loss of earnings, and defensive expenditures.

Net output changes. The easiest way to clarify the valuation processes is by example. Bojö (1991) evaluated an ongoing Farm Improvement with Soil Conservation (FISC) program in Lesotho. This study is treated in some detail in chapter 10. Here I give a flavor of the method to benefit estimation. Certain benefits are associated with it:

- *Prevention of loss in soil productivity,* which he estimates would in the absence of the project amount to a 1 percent annual decline. This corresponds to an initial loss of seven kilograms and eight kilograms a hectare a year respectively for maize and sorghum, based on a 14-year historical average where the project is located. He examined price trends from 1976 to 1990 and concluded that real maize prices had increased and real sorghum prices had declined at an average annual rate of 2 percent. He assumed in his base case that current prices stay constant in real terms in the future and applied these to the estimation of losses prevented. No adjustments were made to distinguish between financial prices and economic prices, because the markets for these outputs are competitive and the exchange rate distortions are not relevant and in any event not substantial, because the local currency (loti) is fixed on a par with the internationally convertible South African rand.

- *Fruit trees* are also an element in the project with consequent production—in spite of high losses caused by grazing—of peaches and apples expected. Prices to farmers are assumed to be 50 percent of the current market price for the relevant imported fruit. These prices are expected to prevail in the future.

- *Trees*—mainly pine—have been planted for firewood. These are expected to be harvested in year 12, at which time the average tree volume is expected to be 0.15 cubic meters. Because no market in fuelwood exists per se, it was necessary to impute value: for cattle owners, firewood would allow them to substitute such wood for dung, which has value as fertilizer, and could also substitute for brushwood, for both of which markets exist. It was assumed that the real price for fuelwood would rise by 2 percent annually, although no documented price trend was available to support this assumption.

- Fodder *grass production* is also an output of the project. Expected output is projected, and output value is based on a survey. Price is expected to increase in real terms by 2 percent annually, because of continued overgrazing and the likely increase in herd sizes. Because the grass is produced on land that would otherwise produce food crops, the value of the food crop foregone is an opportunity cost, the value of which must be deducted.

Note that even though this is a high profile, well-funded project, and the analysis is *ex post* (that is, undertaken after most of the project in question has been implemented) the production function data—what is produced as a consequence of the project—are poor, as are price and trend data. This highlights the extreme difficulty in undertaking credible *ex ante* analysis (that is, before the project has been started), where there are no performance data on which to draw.

Loss of earnings. This method is most commonly used in evaluating the losses in net output that result from sickness and premature death. Environment-related health effects are significant, as is shown in table 9.1. But to value such losses can be fraught with difficulties (see box 9.2).

Chapter 8 showed the losses resulting from environment-induced illness in Ghana, comprising the aggregate value of estimated earnings foregone as a consequence of environment-induced illness. No attempt was made in the case of Ghana to impute a value for the productivity lost as a consequence of the premature deaths resulting from environment-induced illness. The principles to be followed are the same: the years of productive life lost are estimated and then valued as in the case of illness. We did not value life in this fashion because we believed that to do so might undermine the credibility of the entire analysis for those involved in the NEAP process in Ghana.

Table 9.1: Estimated Burden of Disease in Poor Household Environments, Sub-Saharan Africa

(millions of DALYs)*

Disease	Males	Females	Total
Diarrheal Diseases	15.7	14.6	30.3
Tropical Cluster	3.9	2.6	6.5
Intestinal Worms	0.42	0.43	0.85
Respiratory Infections	16.2	15.4	31.6
Total	**36.22**	**33.03**	**69.25**

* Disability Adjusted Life Years.

Defensive expenditures. Defensive expenditures are outlays that are required to counter or mitigate the damage imposed by environmental degradation. In the case of Ghana, in addition to the estimate of loss of earnings induced by environment-related illness, the productive resources in medical staff time and hospital resources foregone as a result—defensive expenditures—were also estimated. In many African countries, erosion imposes defensive expenditures downstream: reservoirs, hydroelectric dams, irrigation systems, and

Box 9.2:

A Health Warning for NEAP Economists

Evaluating health impacts is an area where humanitarian and egalitarian instincts can easily seem to clash with the economist's calculus. Valuing loss of earnings can be interpreted as imputing no value if no earnings are foregone: this in turn might lead to the conclusion that environmental protection be concentrated on the most productive, who presumably would be earning the most income, and ignore the old, the relatively unproductive poor and chronically ill, and the young, whose earning ability is long deferred, or concentrated on countries or regions with the most productive individuals.

If a pollution problem adversely affects the health of people who are primarily elderly, a cost-benefit analysis of the options in which the productivity gain/loss is the main measure of cost-benefit could conclude that their premature deaths is a net benefit. This is so because, no longer being productive, they are a net cost to the country. In other words, loss of earnings is only one facet of the problem; other issues may transcend the earnings issue.

It is important that the NEAP economist not damage the credibility of economics by implying that the value of a life in any fundamental sense is captured by the earnings foregone estimate. An interesting discussion on this and related issues took place in *The Economist* [Anon. 1992a and 1992b] following an internal memo on the subject by Lawrence Summers, then Chief Economist at the World Bank.

urban drainage systems all require maintenance due to erosion.

As always, the biggest evaluation difficulty lies in knowing the production function, that is, how much the actions being evaluated will reduce defensive expenditures. We have seen in chapter 8 that an estimate of the gross damages imposed by environmental degradation can be derived. In evaluating a NEAP program designed to reduce these losses, it is necessary to estimate to what extent the losses will be reduced by the NEAP proposals. This in turn involves identifying the "with and without" situation; that is, the erosion levels with and without the proposed action, the difference being attributed to the action.

9.2.2 Surrogate Market Values

This group includes changes in property values, wage differentials based on environmental conditions, and the travel cost method to recreation valuation.

Changes in property values. In the Ghana study, we attempted to use change in land value as a means of approximating the losses induced by erosion, but failed. In general, markets for land and property will be insufficiently developed to allow credible use of this method. The position, however, is likely to improve over time.

Wage differentials. If an environment is degraded, it may be necessary to pay a premium to attract labor or keep it in a particular location or activity. Indeed, environmental deficiencies may comprise an almost absolute constraint on the availability of certain types of scarce labor. For a country attempting to establish, for instance, a base in financial services or informatics, it will be necessary in the short to medium term to attract skilled labor from other countries. A country that can offer a high physical and cultural quality of life, relatively low crime rates, and low rates of disease will have important strategic advantages in attracting labor over those that do not. To the extent that these are absent, it may be possible to compensate by paying a salary premium. Because their locational options are much more limited, the same will apply to a lesser extent in the case of workers who are not internationally mobile.

To the extent that the wage differential is attributable to the difference in environmental quality, it provides some measure of the willingness to pay for improvement. In evaluating particular NEAP proposals, the with/without issue must be addressed: to what extent will the measures proposed reduce the premium? Based on our experience in Africa, the prospects of quantifying the wage differential to a defensible extent are low.

Travel cost. The principal assumption of this method is that the visitors who travel farthest are regarded as being marginal in that they would not come with any additional costs; those closer are assumed to capture a surplus equal to the difference between the costs of the farthest visitor and their own actual costs. This method was developed by Clawson and Knetsch (1966) in the United States. When the method is applied to isolated recreation magnets that comprise single destinations for most of the visitors and when the analysis comprises an ex post review of an existing attraction rather than an analysis of a new proposal, this method, subject to a variety of caveats but primarily the assumption that utility is the same across visitors, can be useful.

9.2.3 Replacement Costs and Contingent Valuation

These two approaches are used to value environment-related losses.

Replacement costs. When an environment is degraded, the costs of replacing the losses can be estimated. This is a relatively poor measure of willingness to pay, because it only estimates the costs of replacement not whether anyone would be willing to incur these costs. When all else fails, however, replacement costs do give an upper estimate to the willingness to pay.

In chapter 8, the gross costs of replacement of nutrient losses in Ghana were estimated because it proved impossible to derive productivity losses.

An estimated 330,000 tons of 15-15-15 fertilizer could replace these nutrients at a presubsidy cost of 78,820 cedis a ton, amounting to a total annual replacement cost of 26 billion cedis or $80 million. This exceeds, probably substantially, the

maximum willingness of crop farmers to pay to avoid these losses, because it does not reflect the adaptive responses of farmers.

Contingent valuation. The contingent valuation method (CVM) uses surveys to ask the "what if?" kind of question. By definition, the values yielded by the contingent method are not based on actual behavior. The method typically involves preparing and administering a questionnaire to a sample from which generalizations to the population can be made. The questions are designed to discern the willingness to pay for the experiences in question and to do so without triggering biased responses. Thus, for example, if the assessment concerned the willingness to pay for hunting, instead of asking users to respond directly, they might be asked to indicate their response in hunting activity to increases in the total costs of the hunting experience, including costs of ammunition, travel, license fees, and so on.

This method has been applied in industrial countries mainly in the domain of outdoor recreation, for which services are provided by the state at no or a nominal charge to beneficiaries. This method has assumed particular significance in the United States in the case of federally funded water projects. Such projects have to be justified in cost-benefit terms, so there is a strong incentive to evaluate water-based recreation benefits, which can comprise up to 80 percent of the measured benefits.

In the context of African NEAP countries, it is likely that values based on contingent valuation methods will command less credibility than those more directly based on market information, although this is likely to change over time as survey type information is more frequently gathered and used as a basis for decisions.

Already, a few studies illustrate the insights CVM can bring to the analysis of choice. Brown and Henry (1989) estimated the willingness to pay for elephant safari experiences in Kenya by using a questionnaire of visitors. The findings were of great policy interest in that they showed a willingness to pay additional sums to conserve the elephants and that the attraction of the area as a tourist destination would be seriously damaged if elephant numbers decreased substantially. Whittington and others (1992) used CVM to assess the willingness of households in Kumasi, Ghana, to pay for alternative modes of water supply and sanitary services; the findings indicated a strong balance of advantage for ventilated pit latrines.

Each category of output has particular features, but habitats that are unique and judged to be of global significance raise issues that deserve separate discussion.

9.2.4 Valuing Unique Habitats

Every habitat is unique in the sense that it is not identical to any other. Habitats exist, however, that are recognized as being distinctively different from those occurring elsewhere on the planet, support a range of rare plant and animal species, and can be protected to the extent that there is a willingness to pay to conserve them. In the NEAP countries, this category of resource is found mainly in the tropical forest zone and on the coast.

In evaluating the benefits from this resource category, a distinction is often made between *use value* and *nonuse value*. The former, as the name implies, comprises benefits that flow from the use of the resource, for example, the provision of food, wood, shelter, protection of soil and water, and conservation of potentially useful genetic information. *Option value*—benefits that flow from maintaining options for use in the future—is a special category of use value.

The main benefit in the nonuse category is known as *existence value*, comprising the utility that accrues from simply knowing that the resource exists. Sometimes an additional category, *bequest value*—the benefit that accrues from having the ability to endow future generations with the resource in question—is also recognized.

9.2.5 An Example of Benefit Valuation

Munasinghe (1992) discusses the details of a cost-benefit analysis by Ruitenbeek (1989) of a proposal to establish Korup National Park in Cameroon, which would have the effect of conserving a tropical forest area of 126,000 hectares, with an additional buffer area of 300,000 hectares. The following benefit categories were included:

- *Tourism.* One thousand visitors to be attracted, spending an average of $275 a visit on goods and services of which an estimated 43 percent represents the willingness to pay to achieve this flow of visitors.

- *Genetic value.* This is estimated at $5,000 per discovery of a new product for one or more of the following uses: pharmaceuticals, chemicals, and crop improvements, with an annual number of discoveries estimated at ten.

- *Watershed protection.* The total fishery value protected by the forest was estimated in the range of $10 to $12 million annually, based on the value of sales or income to fishermen.

- *Control of flood risk.* In the absence of the forest, flooding is expected every five years. The expected value of the resulting income losses are estimated at $1.4 million annually.

- *Soil fertility maintenance.* The productivity losses (10 percent on 25 percent of the area) are expected to reduce output by more than $500,000 a year.

For each of these benefit categories, the expected timing of the benefits is estimated, allowing the analyst to compare them by discounting the benefit and cost flows to the present.

The analysis per se is confined to those benefits able to be captured within Cameroon. It is recognized, however, that benefits, including genetic value and watershed benefits, also accrue outside the country, which are also estimated.

As in all such analyses, identifying the environmental production function is the most daunting challenge. On what basis can one estimate that, if the national park is not created, ten fewer biodiversity-based discoveries will occur a year in Cameroon? In the absence of the park, can we be sure that the losses predicted will be sustained by the fishery? The second stage of the process—the valuation—also raises difficult challenges: in the absence of the park, is the projected income loss for fishermen and farmers a good estimate of their maximum willingness to pay to prevent such loss? If they have other opportunities for the use of their time and other resources, such estimates will exaggerate the true opportunity cost of the losses and, therefore, the willingness to pay to avoid them. In other words, the difficulties of benefit valuation and estimation are profound, but a start can be made.

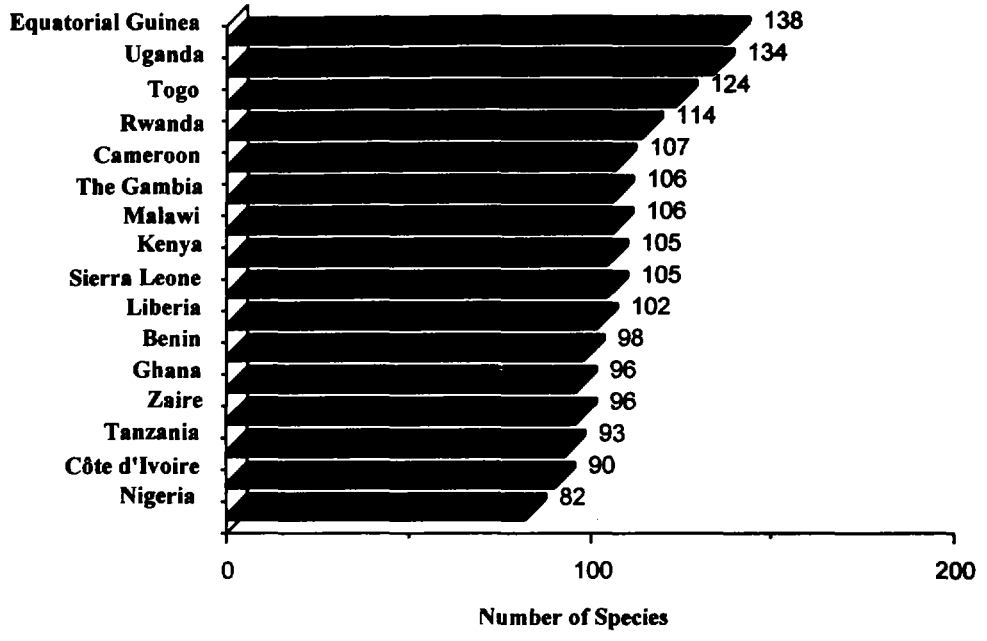
Whenever the opportunity arises, you should use whatever data are available to highlight unique or valuable features of the biota likely to be of interest in the evaluation process. I reviewed the significance of the wildlife endowment of Uganda and found a small number uniquely endemic to the country; Uganda would not rank high on the scale of uniqueness. The nation, however, does accommodate an extraordinary variety of species with the second highest density in Africa, of considerable economic interest as Uganda tries to reclaim its formerly high reputation for tourism based on wildlife. Figure 9.1 helps make the case.

This concentrated richness—the high ratio of diversity per unit area—means that the payoff in biodiversity conserved per hectare should be high. As noted above, the benefits of such biodiversity conservation per se accrue first to the tourism sector; without the diversity of wildlife in a natural setting that ecotourists demand, Uganda's tourist sector has no future. But the benefits of biodiversity also flow to the global community—which retains options for developing medicines, more productive food varieties, and so on—in the future as far as maintaining this genetic endowment allows; it also provides a base for scientific understanding of ecosystem processes, which also store carbon, thereby diminishing the contribution to global warming.

9.3 Risk and Uncertainty

Risk is defined as a situation to which you can apply probabilities. The concept is perhaps best illustrated in the table on the next page. A simple hypothetical situation is posed wherein the probability of a given weather condition is estimated in column (I), the crop yield associated with that weather condition is shown in column (ii), and the

Figure 9.1: Top 16 African Countries in Number of Mammal Species per 10,000 Square Kilometers



expected value—the sum of the product of the probability and the estimated yield in each case—is shown in column (iii). In this case, the expected value is 22; the output on average will tend toward this production level, other things being equal over a number of years, but it will vary substantially from year to year. If an investment program is proposed that will yield output over 25 years, it might be assumed that the expected value would be a reasonable average to use. The weather patterns, however, may not allow the assignment of probabilities.

This example highlights an essential difficulty: it assumes that the probabilities can be assigned, whereas in most cases they cannot. The condition in which probabilities cannot be assigned is called *uncertainty.* It is important to address this issue despite the difficulties and useful to recognize in the analysis that outcomes are variable and unpredictable. The use of scenarios to which probabilities may or may not be assigned allows you to interrogate experts in a nonchallenging fashion; if one particular outcome is presented as the truth and has official sanction, despite the lack of supporting evidence, it can be useful to insist on a range of possible outcomes, which allow for debate. It also allows the analyst to explore the issue of "risk aversion." If the decision maker gives greater weight to the "downside" possibilities than to the "upside" potential, he or she will have an implicit expected value lower than that indicated.

Table 9.2: Estimating Expected Yield

Weather Conditions	Probability (i)	Yield (ii) *(tons)*	Expected Value (iii) = (I) x (ii) *(tons)*
Drought	0.1	5	0.5
Very dry	0.4	15	6
Moderate rain	0.3	35	10.5
Heavy rain	0.2	25	5
Expected value			**22.0**

In practice, the way in which the NEAP economist addresses this problem is via *sensitivity analysis*, which has already been discussed. Thus, in the simple example outlined above, the returns would be estimated for the four different weather outlooks. Any evidence for probabilities can be discussed separately. A robust finding is if the project is attractive under the worst weather conditions. Conversely, the fact that viability depends on the achievement of sustained good weather (moderate rain) is not reassuring. The issues involved in incorporating risk and uncertainty are further treated by Munasinghe (1993).

9.4 The NEAP Economist

The NEAP economist should be mindful of the following points in his or her work:

- When you are attempting to estimate the benefits accruing as a consequence of the NEAP, apply a hierarchy similar to that proposed in the gross cost estimation. In other words, try to derive estimates of change in net output first; if that proves impossible, try using surrogate market values (change in capital values and so on) and finally, if all else fails, use replacement cost or contingent valuation or both.

- Adopt the with/without method; what would the benefits be without the NEAP and with the NEAP, the difference being attributable to the NEAP. This distinguishes the benefit estimation from the estimation of gross costs discussed in chapter 8; in the latter case, no "with scenario" existed to compare with a "without" scenario.

Discussion Questions

1. Explain the difference between financial efficiency and economic efficiency.
2. Discuss how change in productivity can be used to estimate the benefits of soil conservation.
3. Outline how contingent valuation might be used to support conserving wildlife habitat.
4. You have three estimates of annual visitor numbers—5,000, 10,000, and 30,000—to a proposed national park. How might you incorporate a consideration of these estimates into your analysis of the cost per visitor and the benefits likely to be yielded by the national park?

Further Reading

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Chapter 10

Comparing Benefits and Costs

Ward and Deren (1991) provide a detailed treatment of the methods used in applying economics in project appraisal. The focus is on how to shadow price appropriately, that is, how to adjust prices to reflect the national interest as opposed to the financial interest, emphasizing necessary adjustments to reflect the differences between official exchange rates and what would prevail in the market were the exchange rate reflected by market forces—what the World Bank calls "the parallel market."

10.1 The Demise of Cost-Benefit Analysis in the World Bank?

Little and Mirrlees (1974) pioneered the development of shadow-pricing procedures in the early 1970s. They reflected on the demise of project appraisal since the early 1980s as an instrument of project choice (Little and Mirrlees 1990). The following causes were identified:

- The complexity of the procedures to derive the shadow prices.
- The emphasis that the World Bank now places on macroeconomic management and the transfer of resources to the developing world unrelated necessarily to projects.
- Institutional changes in the World Bank that eliminated a central controlling and coordinating function in this domain.

The shadow-pricing methods they developed were necessitated by the inadequacies of currency and other markets and imposed an intricacy to the shadow-pricing system, whose implementation demanded sustained commitment by the donors, lenders, and the developing countries themselves that was simply not forthcoming. In my view, in addition to the reasons cited by Little and Mirlees, another reason for the failure of these methods to command wide support was that decision makers could not readily validate these analyses intuitively by linking them to emerging results. This is the central and to a degree unavoidable problem with complex models; their results are based on such complexity that decision makers have to take them on faith or ignore them.

Little and Mirlees note that, in the interests of communicating effectively, it is important not to simplify to the point where rigor is lost. Fortunately for the analyst, the opening up of activity to market forces, including the narrowing of the gap between official exchange rates and parallel market rates to the point that in many countries they almost converge (see World Bank [1992a, 44, 45]) has removed many of the anomalies that previously needed to be addressed. In this chapter I attempt to strike a balance between rigor and practicality and transparency, which is consistent with good practice but does not intimidate the NEAP economist into inertia.

It is assumed that the costs and benefits have been identified and all that remains is to compare them. If the costs and benefits occurred at the same time, such comparisons would simply be a matter of determining if the latter were less than the former. They do not usually occur, however, at the same time; this has to be reflected in the analysis, because a return received today is worth more than one received ten years from now and a cost deferred is less onerous than a cost that must be borne today. The adjustment for time typically involves discounting the net benefit flow back to the present to give a common point for time com-

parison. (Meier and Munasinghe [1994] present a method for evaluating proposals using multiple criteria or what they call multi-attribute analysis to be used in situations in which it is not possible to reduce the benefits and costs to a single measure of value.)

10.2 Real Compared with Nominal

In chapter 2, the necessity to express time series values in constant (net of inflation) terms was emphasized. This applies also to the comparison of costs and benefits and the interest rate used to adjust for the time dimension. They should all either be in real terms (net of inflation) or all in nominal terms (inclusive of the effects of inflation). It is conventional and usually more convenient to express everything in real terms. This convention is often implemented by assuming that current, that is, today's unit cost and benefit values will obtain in the future and netting the presumed effects of inflation out of the prevailing interest rate to derive the real rate of interest. More sophisticated analyses can provide a real time series and combine this with a discussion of emerging trends in markets and technology to conclude that prices were likely to increase/decrease in real terms in the future. Then such analyses can build such predictions into their analyses.

If the rate of inflation is 7 percent and the nominal rate of interest is 12 percent, the real rate of interest (X) is computed as follows: 1.0X (1.07) = 1.12; 1.0X = 1.12 ÷ 1.07 = 1.0467, that is, the real rate of interest is 4.67 percent.

The analyst should be aware that doing the estimations in real terms has one serious drawback in decision making; it does not tell the decision maker what the cash flow implications of implementation are. For this, it is necessary to present data in nominal (that is, including the effects of inflation) terms. This can be presented as a satellite display.

10.3 Adjusting for Time

Goods and services received today are worth more to most people than the same goods received sometime in the future. If we are faced with the choice of receiving $1,000 today or the same amount (in real terms) ten years from now, we would prefer the money now, because we can use it now to generate more money or goods and services during the ten-year period. We will forego this earning capability if we wait ten years for our $1,000. For this reason, people are willing to pay interest to buy a house, invest in education or their business: time is money. To compare alternatives that have flows of costs and benefits occurring at different times, we have to adjust for the time factor. The rate of interest reflects the value of time.

10.3.1 The Interest Rate

What interest rate should apply? The interest rate represents the opportunity costs of time, what is foregone by waiting. In financial analysis, the opportunity cost concept is captured by the best alternative rate of return; what rate of return is being foregone by undertaking the project in question? The consumer's perspective is also relevant: how much am I willing to pay to defer consumption rather than consume today? People who are poor are presumed to discount the future heavily. For one who is near starvation, food today is worth much more than food in a few weeks or days time. The discount rate applied to the future in such circumstances is called the *rate of time preference* and will generally be higher the poorer the individuals involved. It follows that the lower people's income level, the higher the rate of return they need to divert resources from consumption to investment. This goes far to explain the cycle of poverty in which many of the poor are trapped.

It is difficult, however, to generalize about the association between poverty and environmental degradation. Pearce and Warford (1993) discuss the evidence in some detail: they suggest that poverty does not itself necessarily lead to environmental degradation but reduces the ability of the poor to respond and adapt. Often the only option they have to stress is to exploit the "commons," or to move to the cities. So, the initial environmental losses are compounded by additional degradation. It also seems that for many countries the first stage of economic development can be environmentally destructive. As the economies develop further and mature, however, concern for environmental quality increases, which soon becomes reflected in public policy.

The interest rate that one observes in markets is the outcome of monetary (including exchange rate) policy, tax and related provisions, and thousands of individual investment and rate of time preference decisions. Extensive literature exists on whether a distinction exists between "society's" rate of time preference and the interest rate that results from numerous individual decisions. In practical terms, if markets are reasonably competitive, the analyst typically uses the prevailing real rate of interest but also uses a substantial range above and below this level to test the sensitivity of the results to interest rate changes.

The World Bank has in recent years advocated 10 percent, but this seems high, judged against the opportunities foregone in some African countries in which returns in many cases have been negative. The lower the interest rate, the more likely benefits in the future will exceed costs now. Proponents of projects with long-deferred benefits often advocate low rates to help their proposal's benefits exceed costs. "Give me the right interest rate, and I can justify any project" goes the refrain, recalling the discussion between Diogenes and Socrates in which Diogenes says: "Give me a fulcrum, and I will move the world." Socrates replies: "Would it be better off in some other place?"

10.4 The Investment Criteria

When choosing among alternative investments, the criteria available include maximizing net present value, internal rate of return, and cost-benefit ratio.

10.4.1 Evaluating the Criteria

In judging criteria, it is useful to distinguish between choices that are *mutually exclusive*, that is, only one of the set being evaluated can be undertaken, and those that are not, that is, any of the set available may be undertaken. If investors are considering investing in a mine or a factory, these choices are generally not mutually exclusive, that is, both may be undertaken if the net returns seem to justify it. If investors who own 1,000 hectares are choosing between planting trees on it or growing cotton, these choices are mutually exclusive; if one is undertaken, the other cannot on the given area of land.

In analyzing investments that are not mutually exclusive, investors wishing to maximize their net returns would choose all investments that yielded a positive NPV; all those with an internal rate of return greater than the discount rate of interest applied; or those with a cost-benefit ratio greater than one. Each of the criteria will give the same result.

If we wish to rank alternatives or choose between mutually exclusive alternatives, however, the maximization of NPV (that is, choosing the alternative with the largest NPV) is the only criterion that can be used; both the internal rate of return and cost-benefit ratio criteria can discriminate against larger projects, as shown in the following example, assuming an interest rate of 12 percent:

Year	Option A	Option B	Increment in going from A to B
0	-10	-100	-90
2	20	160	140
NPV	6	28	22
IRR (percent)	41	26	24

Note: The Net Present Values were calculated as follows:

$$NPV_A = -10 + 20 / (1.12)^2 = -10 + 15.94 = 5.94$$

$$NPV_B = -100 + 160 (1.12)^2 = -100 + 127.55 = 27.55$$

$$NPV_{B-A} = -90 + 140 (1.12)^2 = -90 + 111.61 = 21.61$$

The internal rates of return were calculated by iteration, raising the discount rate successively until the NPV was equal to zero.

Applying the IRR criterion, the high-yielding investment A, showing an IRR of 41 percent, would be preferred over B, which yields only 26 percent. This would involve, however, foregoing additional investment of 90 (that is, 100–10), which would yield an additional benefit of 140 (that is, 160–20), which brings down the average rate of return on the investment. The additional in-

Box 10.1:

Investment Criteria

Net Present Value (NPV), sometimes also called *Net Discounted Revenue* (NDR), is the difference between benefits and costs, adjusted for the effects of time by discounting them back to the present, that is, to year zero. The costs and benefits are brought back to the present by means of discounting at the rate of interest that is judged to reflect the scarcity value of time. Each year, the net benefit is derived and then discounted. The sum of such discounted values comprises the NPV, shown in the example below over four years as follows:

$$NPV = (B_1 - C_1) / (1 + i)^1 + (B_2 - C_2) / (1 + i)^2 + (B_3 - C_3) / (1 + i)^3 + (B_4 - C_4) / (1 + i)^4$$

where: B = benefits, C = costs, and i = annual interest rate. In general, for n years:

$$NPV = \Sigma(B_n - C_n) / (1 + i)^n$$

Various alternative means exist to present the NPV. Among the most useful is the *Annual Equivalent,* which is the amount that, if received each year over the life of the investment, would be equivalent to the NPV. Equivalence in this sense means that an investor would be indifferent if he or she had the NPV now or the Annual Equivalent each year over the life of the investment; a lump sum amount equal to the NPV would be just sufficient to allow the Annual Equivalent to be withdrawn each year for n years, so that the last withdrawal would reduce the lump sum to zero.

The *internal rate of return* is that rate of interest that, if applied to the discounting of the net-benefit stream over the life of the investment would yield an NPV of zero; that is, the interest rate equates costs and benefits after they are discounted to the year zero. The IRR is what investors mean when they say "the rate of return on this investment is 18 percent." In this case, applying a discount rate of 18 percent to the net benefit stream will yield an NPV equal to zero.

To estimate the *cost-benefit ratio*, benefits and costs are discounted to the present and then expressed as a ratio of benefits over costs; the largest ratio is the preferred choice using this criterion.

vestment, however, nevertheless yields a return (24 percent) well above the rate (12 percent) at which money can be borrowed or that represents the rate of return on the best alternative available. The return on this increment is well above the "hurdle rate" of 12 percent, so the investment should be intensified; B should be undertaken. The NPV criterion reflects this opportunity, and therefore is the correct criterion to apply in cases where the choices are mutually exclusive.

If these investments were not mutually exclusive, that is, both of them could be undertaken, both of them should be undertaken, because they both pass the NPV test (and the IRR and the B/C ratio tests). In addition to this limitation of the IRR, under certain conditions, two different alternative rates of return will yield an NPV equal to zero, that is, a unique solution does not exist.

10.4.2 Mutually Exclusive Investments With Different Lives

If mutually exclusive investments occur over different times, then:

1. compute the Annual Equivalent of the NPV over the respective lives of the alternatives, and then
2. choose the highest of these as the preferred option.

Example: An investor is considering planting an area with broadleaf trees or with conifers. The broadleaf trees will be clear-felled after 50 years, the conifers after 25 years. We adjust for the fact that over the life of the broadleaf trees it would be possible to grow another crop of conifers by comparing not their NPVs but their Annual Equivalents over 50 years (broadleaf trees) and 25 years (conifers) respectively. The following are the cash-flow implications of the alternatives: Assume an interest rate of 8 percent.

Year	Broadleaf Trees (A)	Conifers (B)
0	-100	-90
25	-	1,075
50	8,000	-

$$NPV_A = -100 + 8{,}000 / (1.08)^{50} + -100 + 171 = 70$$

$$NPV_B = -90 + 1{,}075 / (1.08)^{25} = -90 + 157 = 67$$

The Annual Equivalent (AE) formula is:

$$AE = NPV\,[i\,(1 + i)^n / (1 + i)^n - 1.00]$$

$$AE_A = 70\,[(0.08\,(1.08)^{50} / (1.08)^{50} - 1.00] = 70\,[0.08\,(46.90) / 46.90 - 1.00] = 70\,[0.0817] = 5.72$$

$$AE_B = 67\,[(0.08\,(1.08)^{25} / (1.08)^{25} - 1.00] = 67\,[0.08\,(6.848) / 6.848 - 1.00] = 67\,[0.0937] = 6.28$$

The results can be summarized as follows:

Option	NPV	AE
A		5.72
B		6.28

On the basis of the NPV criterion, Option A would be preferred. Once the adjustment has been made, however, to reflect the different time horizons via the Annual Equivalent, the preferred option is B. Estimating the NPVs for each investment over an infinity of rotations would also adjust for the inequality in time horizons, but I have found decision makers resist this method as it runs counter to their intuition.

Let us look at two examples, each with an environmental theme, of the application of cost-benefit analysis in Africa. The first is from Mauritius and the second Lesotho.

10.5 An Example from Mauritius

The benefits of an environmental investment package in Mauritius were estimated on the basis of the losses that would have been incurred in the tourism sector if the investments in question were not undertaken, together with the benefits yielded as a result of improved health.

10.5.1 Background

Mauritius was one of the first countries to engage in the NEAP process. A principal output of the first stages of this process was a program of environmental investment that addressed the key environmental problems. These comprised *inter alia* investments in water supply and sewage treatment, provision of serviced sites for industry, and disposal facilities for industrial and municipal waste, upgrading of labs and pollution-testing facilities, and establishment of a national park. The total investment package proposed amounted to $108 million to be implemented over three years with an average expenditure of $36 million a year. This package was called the Environmental Investment Program (EIP).

The Mauritius economy is based on three sectors:

- *Agriculture*, comprising mainly sugarcane production, which benefits greatly from access to European Community support prices for sugar, which at the time of the analysis were three to four times the world price. Sugarcane provides good ground cover, so that crop-related soil erosion is not a problem on the island. The cultivation of sugar as practiced in Mauritius, however, requires substantial inputs of fertilizers, herbicides, and insecticides.

- The *textile and clothing industry*, which has expanded rapidly in recent years and in 1989

contributed 50 percent to merchandise exports (World Bank 1992b). Mauritius is one of the few African countries that has achieved the transition from a natural resource-based to an industrializing economy. This industrial development took place over a period when there was little control of land use or waste disposal; a number of environmental problems resulted, the most significant of which was the proliferation of dye works with little of no treatment of wastes, which were disposed of mainly into rivers and the sea.

- *Tourism*, which has developed rapidly over the past decade, based on the magnificent natural endowment of beaches and the concept of Mauritius as an unspoiled island paradise, away from it all.

Hotel development has been controlled by allowing only one-story buildings, limiting both the visual impact and the intensity of use in any particular location. Within this restriction, however, hotel development has proliferated. Relatively uncontrolled location and waste disposal arrangements have led to environmental problems. Incipient signs of environmental degradation, including deterioration in the coral reefs, contamination of groundwater, and reduced water quality in the bays, have become evident.

Mauritius held a successful donors conference at which the elements of the NEAP were presented, together with the associated investment program. A subset of this program was proposed for a World Bank loan. I was asked, as part of the justification documentation going to the World Bank Board, to review the benefits and costs of the overall NEAP investment package. The following comprises the main elements of my analysis, which was undertaken mainly during the appraisal mission in Mauritius.

10.5.2 Macroeconomic Perspective

Thus far, Mauritius has been remarkably successful in maintaining agricultural output while simultaneously developing industry and tourism. This compatibility, however, cannot be sustained without significant investment in environmental infrastructure and management, mainly because the comparative advantage of Mauritius as a tourist destination depends fundamentally on the perception of the country as a pristine mecca. No matter how impressive the beaches, relatively few are going to travel 2,000 miles for them alone if the overall impression is of an island in environmental decline.

Tourism seems to be the sector with the best prospects for growth in the short to medium term. Constrained by European Community quota, sugar production is unlikely to increase. Expansion in textiles and clothing manufacture has slowed because rising wage levels have begun to reduce competitiveness with some new entrants to the field and recession and trade restrictions in main markets limit growth prospects. Agriculture is likely to eventually succeed in diversifying away from sugar; new forms of higher order industrialization will occur. (A comprehensive report on recent developments and prospects by sector is provided in World Bank [1992b].) But in the short to medium term, tourism is of central importance. The NEAP investment program can, therefore, be interpreted as defensive expenditure, designed to protect the potential of tourism and without which tourism and, therefore, the economy is likely to suffer substantial losses. Such investment will also yield other benefits, which are discussed below.

10.5.3 Program Disaggregation

The World Bank component of the overall NEAP investment package was rather modest in amount relative to the total and addressed to some extent to residual elements, such as the provision of labs. Initially, I attempted to disaggregate the benefits associated with the World Bank program from the rest and failed; it was not possible to separate most of the benefits associated with these investments from the benefits in general. The fallback was to look at all of the NEAP and identify all associated costs and benefits. The results will give a sense of the overall validity of the NEAP package; it will not provide much sense—although there are a few exceptions noted below—of the economic efficiency of the component elements within this package.

10.5.4 Base Year and Planning Horizon

I selected the year 1989 as the base year and a planning horizon of up to 20 years over which

benefits and costs were expected to accrue. Cost-benefit analyses usually take a longer horizon. Fifty years would be typical in many natural resource analyses. For the following reasons, however, the horizon was kept short:

- The economy of Mauritius has evolved rapidly in the past decade; change will continue to characterize it. I believed that to extend the canvas beyond 20 years would challenge credibility.

- Most of the estimated benefits of protecting the environment result from protecting tourism. If this were not done, that is, if the NEAP were not implemented and the deterioration took place with the projected consequences for tourism, an attempt could be made to recover the situation by investing in protection. It would take time to make the investments and an even longer time to recover the markets lost. The latter, however, could eventually be achieved. This comprises another reason for keeping the planning horizon fairly short.

- Because the benefits of the investment begin to accrue early in the cycle, the losses in benefits (after discounting) after 20 years are modest.

10.5.5 Estimation of Costs

At the time of the analysis, the Mauritius economy was nearing full employment; the currency was competitively priced, that is, no parallel foreign exchange market existed; the economy was relatively open to competition; and no price subsidies existed for the inputs or outputs relevant for this study. I assumed, therefore, that there was no need to adjust market prices of inputs to reflect differences between the market prices prevailing and the price that would obtain under competitive market conditions. This important simplifying assumption is only possible where markets are allowed to operate. The process of deriving credible shadow prices, that is, adjusting for distortions in the marketplace, for example, removing the effects of tariffs, quota restrictions, overvalued official exchange rates, and so on, is complex; each adjustment reduces the reliability of the resulting estimate. It follows that cost-benefit analysis in general is likely to be more feasible and credible the more market-driven the economy and the more the macroeconomic policy framework allows such to prevail.

As noted earlier, the total capital costs amount to $108 million. In the absence of contrary information, I assumed that the investment would be made in equal annual amounts over three years, commencing in 1991, and that the recurrent costs would amount to approximately 10 percent of the capital costs or $11 million annually. Note that these estimates are real, that is, net of inflation. So, with positive rates of inflation, the cash outlays will exceed the amounts specified here.

The estimate of recurrent costs is tentative and in this respect reflects a weakness already noted in the discussion in chapter 7 on cost estimation. Because capital costs are immediate and have to be borrowed or raised in grant to undertake a project, their estimation typically commands much more attention than recurrent costs, which occur in the future and do not have to be provided immediately. The implications of such asymmetry in the attention paid to capital and recurrent costs have been noted earlier.

The costs expected to be incurred are shown in table 10.1.

Table 10.1: Estimated Cost of Environmental Investment Programs, Mauritius, 1991–2019 *(millions of US$)*

Year	Cost
1991	-36
1992	-36
1993	-36
1994–2019 per annum	-11

Implicit in accepting this cost stream is the view that it represents the least cost, that is, most cost-effective means of achieving the objectives. The EIP package for the NEAP evolved over a two-year period of discussion and debate involving the main environmental, private sector, and nongovernmental and government agency interests, so that it is reasonable to assume that the measures represent a sound package in both cost and effectiveness.

10.5.6 Estimation of Benefits

As noted earlier, a principal objective of the NEAP investment package is the protection of the country's comparative advantage as a tourist destination. In accepting tourism as an attributable benefit, I have made the following assumptions:

1. The NEAP package of measures will succeed in maintaining the quality of the Mauritian environment.
2. No other factor will intervene to prevent realization of the country's tourist potential. The nonenvironmental factors that in other countries have so intervened include political instability, rapidly increasing crime, escalating prices, and a sharp increase in infectious diseases. Mauritius is stable politically, crime rates are low and show no significant increase, malaria has been eliminated, and the incidence of AIDS is low. If the country's macroeconomic policies were inadequate, the potential would exist for sharp real rises in costs, which would damage competitiveness. But Mauritius has targeted the higher-income end of the tourist market, which is less price-sensitive than mass tourism, and macroeconomic policies have in recent years been successful in keeping Mauritius cost-competitive. It is committed to a continuation of such policies. The other sectors—industry and agriculture—cannot afford cost inflation. Thus, although this is a strong assumption, it appears to have a high degree of plausibility in the context of Mauritius.

Estimating tourism benefits. Some literature exists on tourism and development but nothing addressed specifically to the question: what is the maximum that the beneficiaries from tourism in a country would be willing to pay to protect a given increment of the tourism income stream? I dealt with the matter as follows: I first attempted to estimate the difference in gross tourist income with and without the EIP, associating the "without" case with environmental degradation. I then estimated the proportion of this expenditure representing willingness to pay to prevent the loss of this flow.

All of the tourism experts consulted shared the opinion that deterioration of Mauritius' environment would adversely affect the country's reputation as a pristine, away-from-it-all Pacific paradise. This in turn would adversely affect visitor numbers and expenditures. But no one could or would estimate what such impacts were likely to be. In 1989 total expenditure by tourists was $184 million. It was assumed that growth would continue at a real rate of 5 percent a year up to and including 1993 to yield an expenditure level in that year of $224 million (1989 US$). Thereafter, three different scenarios were suggested:

Scenario 1. With a high quality environment, real annual growth of 5 percent will continue. Without a high quality environment, that is, without an EIP, no growth will be realized but the expenditure level achieved in 1993 will be maintained.

Scenario 2. With a high quality environment, an increase in real annual growth to 10 percent will be achieved. Without a high quality environment, that is, without an EIP, no growth will be realized but the expenditure level achieved in 1993 will be maintained.

Scenario 3. With a high quality environment, an annual growth rate of 2 percent a year will be achieved. Without a high quality environment, that is, without an EIP, expenditure level will decline at a rate of 7 percent a year.

In each situation, the estimated tourism expenditure attributable to the EIP is the difference between the trend projected with EIP (growth) and without EIP (no growth in scenarios one and two, decline in scenario three). Table 10.2 presents the three situations: The data raise a number of issues: how plausible is it to project a tourism expenditure of more than a billion dollars by 2009 (the 10 percent annual growth scenario, column [vi])? The answer depends to some extent on global trends and the competitiveness of Mauritius in them and on the nature of the expenditure; if much of it represented increased expenditure per visitor, at least assimilative capacity constraints might not be the primary limiting factors. If growth declined as shown in column (iii), how long would it take for the tourist sector to regroup and make the necessary marketing and environmental investments to arrest the decline and possibly to reverse it?

Table 10.2: Projected Tourism Expenditure in Mauritius Using Three Scenarios
(millions of 1989 US$)

Year	No Growth	Growth Rates				Scenarios		
		-7%	2%	5%	10%	1	2	3
(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii) [(v)-(ii)]	(viii) [(vi) - (ii)]	(ix) [(iv)-(iii)]
1989	184	-	-	-	-	-	-	-
1990	193	-	-	-	-	-	-	-
1991	203	-	-	-	-	-	-	-
1992	213	-	-	-	-	-	-	-
1993	224	224	224	224	224	-	-	-
1994	224	209	228	235	246	11	22	19
1995	224	196	233	247	271	23	47	37
1996	224	183	238	259	298	35	74	55
1997	224	171	242	272	328	48	104	71
1998	224	160	247	285	361	61	137	87
1999	224	149	252	300	397	76	173	103
2000	224	139	257	315	437	91	213	118
2001	224	130	262	330	480	106	256	132
2002	224	122	268	347	528	123	304	146
2003	224	114	273	364	581	140	357	159
2004	224	106	279	382	639	158	415	173
2005	224	99	284	402	703	178	479	185
2006	224	93	290	422	773	198	549	197
2007	224	87	296	443	851	219	627	209
2008	224	81	301	465	936	241	712	220
2009	224	76	308	488	1,029	264	805	232

In 1989 it was estimated that tourism's contribution to GDP amounted to 1,019 million rupees; because gross receipts from tourism amounted to 2,830 million rupees, 1,019/2,830 or 36 percent of total expenditure comprises value added. Because capital and labor must be rewarded out of value added, it would overstate the case to say that willingness to pay was equal to value added on the first round of tourist expenditure. Willingness to pay, however, will apply throughout the direct, indirect, and induced sectors that benefit from tourism expenditure; much of the construction industry, with a contribution to GDP of 1,467 million rupees in 1989, and the transport (taxis and airlines) sectors are driven in part by tourism. Balancing the fact that first-round willingness to pay at the margin will be somewhat less than value added but that this imbalance would be more than corrected for when other effects are included, we conclude that 30 percent of gross tourism receipts or expenditure comprise a reasonable estimate of willingness to pay to generate/retain tourism expenditure at the margin. Applying this coefficient to the amounts listed in columns (vii), (viii), and (ix) in table 10.2 yields the estimates in table 10.3.

Estimating health benefits. The difficulties in establishing the link—the production function—between improvements in water supply and waste disposal, and better health were manifest in the study of the benefits and costs of water supply and provision of waste disposal undertaken for a region of Zimbabwe (Fredriksson and Persson 1989).

Mauritius has managed to virtually eliminate malaria but still has a significant incidence of enteritis and other diarrheal diseases. The trend in the latter over the 1982–88 period is shown in table 10.4.

It is estimated that the incidence will be cut by 50 percent as a result of the EIP, notably the investment projected for water supply and sewage treatment. Because there is no historic downward trend evident, I took the 1988 figure as the baseline from which progress would be judged.

Table 10.3: Willingness to Pay to Prevent Loss of Tourism Expenditure at the Margin, Three Scenarios

Year	No Growth	Willingness to pay		
		1 (5% growth)	2 (10% growth)	3 (2% growth)
1989	184	-	-	-
1990	193	-	-	-
1991	203	-	-	-
1992	213	-	-	-
1993	224	-	-	
1994	224	3	7	6
1995	224	7	14	11
1996	224	10	22	16
1997	224	14	31	21
1998	224	18	41	26
1999	224	23	52	31
2000	224	27	64	35
2001	224	32	77	40
2002	224	37	91	44
2003	224	42	107	48
2004	224	47	124	52
2005	224	53	144	55
2006	224	59	165	59
2007	224	66	188	63
2008	224	72	214	66
2009	224	79	241	70

The savings estimated are of two types: the reduction in hospital and dispensary costs, or the freeing up of them to deal with other problems, and the reduction in output foregone. Because the economy has been operating at close to full employment, little if any divergence exists between official and market currency exchange rates, and markets generally are not controlled, I have assumed that the financial costs of hospitalization, the wage rate, and so on reflect the opportunity costs to society of the factors they employ. I made the assumptions in table 10.5, based on data provided by Mauritius' Health Department.

Table 10.4: Number of Cases of Enteritis and Other Diarrheal Diseases, Mauritius, 1982–88

Year	Number of Cases	
	Hospital	Dispensary
1982	5,509	23,565
1983	5,093	25,286
1984	4,590	24,813
1985	3,932	22,722
1986	3,813	26,950
1987	3,722	27,939
1988	4,467	27,521

Source: Data provided by Dr. E. Neewor, Department of Health, Mauritius.

Table 10.5: Assumptions Concerning Health Effects of the Environment Investment Program, Mauritius

Reduction in incidence achieved by EIP *(percent)*	50
Cost of hospitalization per night *(rupees)*	800
Coast of dispensary visit *(rupees)*	300
Average stay in hospital *(nights)*	2.7
Average daily earnings in manufacturing *(rupees)*	147
Patients of working age *(percent)*	50
Number of days lost due to a hospital visit	5
Number of days lost due to a dispensary visit	3

Table 10.6: Value of Health Cost Savings and Prevention of Productivity Losses
(millions of rupees)

Category	Computation	Amount
Reduced hospital costs	4,467 x 0.5 x 2.7 x 800	4.82
Reduced dispensary costs	27,521 x 0.5 x. 1.0 (number of visits) x 300	4.13
Output foregone (hospital)	4,467 x 0.5 x 5 (days) x 0.5 x 147	0.82
Output foregone (dispensary)	27,521 x 0.5 x 3 (days) x 0.5 147	3.03
Total		**12.80**

Note: The 0.5 in each case reflects the fact that the EIP is expected to reduce the incidence in half. The second 0.5 in the cases of output foregone reflects the fact that only half of the treated population are part of the labor force.

Table 10.7: Total Estimated Willingness to Pay to Achieve the Benefits of the NEAP Investment Package Under Three Scenarios

Year	Willingness to Pay Scenarios		
	1	2	3
1989	-	-	-
1990	-	-	-
1991	-	-	-
1992	-	-	-
1993	-	-	-
1994	6	10	9
1995	10	17	14
1996	13	25	19
1997	17	34	24
1998	21	44	29
1999	26	55	34
2000	30	67	38
2001	35	80	43
2002	40	94	47
2003	45	110	51
2004	50	127	55
2005	56	147	58
2006	62	168	62
2007	69	191	66
2008	75	217	69
2009	82	244	73

Based on table 10.5, the health benefits of the NEAP are shown in table 10.6. This amounts to $0.83 million (converted at a rate of 15.4 rupees per dollar), which is rounded up to $1.0 million (the nearest million).

Other quantified benefits. There are two elements of the EIP package—preparation of the National Physical Plan and the development of a data base for public lands—which are designed, among other reasons, to allow more efficient investment and utilization of infrastructure, helping ensure that new investment in roads, sewerage, and electricity are complementary. A range of experts indicated that this would involve annual savings of at least $2 million.

Adding the health ($1 million) and other quantifiable benefits ($2 million) to each of the scenarios estimated for tourism yields the total benefits as shown in table 10.7.

We are now in a position to present the net benefit flow (table 10.8), by combining the costs estimated in table 10.1 with the benefits estimated in table 10.7.

10.5.7 Evaluation

The evaluation involves conveying to the reader a sense of whether the NEAP package makes sense when the benefits are compared with the costs. We must also adjust for the different times when costs and returns occur.

Because we are not comparing mutually exclusive alternatives, the internal rate of return can be used and compared with a "hurdle rate," which represents the opportunity cost of the resources being committed to the EIP.

Net Present Value (NPV). To estimate the NPV, we need to select a rate of discount. No official rate of discount applied in appraisal appears to exist in Mauritius that would represent the opportunity cost of capital. In the World Bank, a discount rate of 10 percent is regarded as standard, but this is under review. I took a range of discount rates—5, 10, and 15 percent—which one would expect to encapsulate the real opportunity costs in the economy. Applying these rates to the three

Table 10.8: Net Benefit Projections, Three Scenarios *(millions of 1989 US$)*

Year	Scenario		
	1	2	3
1991	-36	-36	-36
1992	-36	-36	-36
1993	-36	-36	-36
1994	-5	-1	-2
1995	-1	6	3
1996	2	14	8
1997	6	23	13
1998	10	33	18
1999	15	44	23
2000	19	56	27
2001	24	69	32
2002	29	83	36
2003	34	99	40
2004	39	116	44
2005	45	136	47
2006	51	157	51
2007	58	180	55
2008	64	206	58
2009	71	233	62

Note: The post-1993 numbers are derived by deducting the recurrent costs of $11 million from the total estimated willingness to pay for each scenario.

scenarios in the discount formula $NPV = \sum (B_n - C_n) / (1 + i)^n$ yields the NPV shown in table 10.9.

These results indicate that the NPV is positive for all scenarios with a 10 percent rate of discount; if the latter does represent the opportunity costs of capital and if the various assumptions hold, the EIP package can be expected to yield a return greater than its costs.

Internal Rate of Return (IRR). The internal rate of return is the rate of discount that yields an NPV of zero, that is, that equates costs and benefits after adjusting for time. The IRR for the three scenarios is shown in table 10.10 for a range of benefit termination dates. The year 2009 is the standard assumption in regard to time horizon. I believed, however, that it would be useful to assess the implications of shorter time horizons in relation to the benefits of the EIP package. Such would be relevant if, for example, the EIP was not implemented, the environment degraded, and tourism losses were incurred, but, by investing in an aggressive and creative marketing strategy designed to counter the negative publicity engenddered by degradation, it was possible to recover the market.

Table 10.9: Net Present Value for a Range of Discount Rates Under Three Scenarios

Discount Rate	Scenario		
(percent)	1	2	3
5	130	1,346	407
10	26	304	55
15	-25	136	-3

Table 10.10: Internal Rates of Return for a Range of Benefit Termination Years Under Three Scenarios

(percent)

Year Benefits Terminated	Scenario		
	1	2	3
2003	2.29	17.95	7.55
2005	6.95	21.39	11.02
2007	10.01	23.55	13.20
2009	12.08	24.95	14.64

10.5.8 Results

The results indicate that if the threshold discount rate is 10 percent and if the benefits continue as projected until 2009, the return is above the threshold for each scenario. This holds true if the horizon is shortened to 2007. For shorter horizons, the internal rate of return falls below the threshold, except for scenario two, which shows almost an 18 percent IRR even when the horizon is shortened to 2003. Overall, the results seem to be fairly robust in that for a range of scenarios, planning horizons, and discount rates, the returns are within an acceptable range when the latter is defined as a real rate of return of 10 percent.

This case study exhibits a number of strengths and weaknesses. Strengths include the following:

1. It focuses the NEAP process on the payoff, some of the key benefits to be yielded by the process.

2. It highlights the centrality of the NEAP process to successful future development of the island's economy.
3. It identifies the primary gaps in knowledge (see weaknesses below) that need to be filled if good decisions are to be made in the future.
4. It provides some reassurance, if the underlying assumptions are accepted, that the investment package will yield a net return to the economy.

The weaknesses flow from the tenuousness of some of the assumptions:

1. The relation between implementation and the outcome in environmental conservation.

The NEAP package is presumed to achieve its objective of protecting the reality and the image of Mauritius as a pristine haven. But we know from experience that the most common source of poor results in the case of investment in developing countries is that objectives are not achieved. What if the operation of the water supply and treatment plants is deficient and a few pollution "incidents" occur in popular tourist beach areas, notwithstanding the NEAP investment? Mauritius has a good record of achievement, but performance monitoring with appropriate action if objectives are not achieved needs to be an integral part of the package. (See World Bank [1992a] for a review of the nature and performance of the Mauritian achievement.)

2. The relation between environmental investment and performance of the tourist economy.

It is possible that Mauritius could experience a deterioration in environmental quality and overcome the image problem with tourists by means of creative public relations. Alternatively, the environmental objectives may be achieved but the tourism economy collapses for other reasons, perhaps some combination of fashion change, international recession, security concerns, and price escalation. Again, Mauritius is an unlikely candidate for factors such as prices and domestic security, which it controls, but the tourist business has an element of fickleness that makes it vulnerable to change.

3. The relation between total tourism expenditure and willingness to pay to maintain a given flow of such expenditure.

The impacts of tourism on an economy flow as a consequence of expenditure on travel, accommodation, restaurants, entertainment, and other services, gifts, and so on. The backward linkage can also be important, for example, when the construction and the food supply sectors significantly depend on tourism. To analyze the significance and impact of a tourist sector appropriately, it is useful to have a model of the economy that shows the flows between sectors and the impacts of marginal changes. Many industrial countries have *input/output tables* that allow such analyses, including the direct and indirect impacts on income and employment resulting from a given change in total expenditure. These tables, however, have a number of limitations, notably that the data in the tables tend to be at least seven years old and do not adequately capture a rapidly changing situation; it is difficult to assess impacts at the margin with data derived from averages. Few developing countries, including Mauritius, have prepared such tables; the opportunity to use them does not even exist. Thus, the estimate of the relation between tourist expenditure, total effect on the economy, and willingness to pay is tentative.

10.6 An Example from Lesotho

The Swedish International Development Authority (SIDA) has supported a project called Farm Improvement with Soil Conservation (FISC) in Lesotho (Bojö 1991, 259–342). The first output attributable to the project was produced in 1986; the project is to extend to 1992. The project area covers 26,000 hectares of which 59 and 33 percent respectively are cultivated land and range. The primary aim of the project is to raise farm production. To this end, the project has rehabilitated old terrace structures and constructed new ones, rehabilitated stone-paved waterways and added new ones, promoted hybrid maize and sorghum, encouraged the growing of fodder grasses, established a nursery and planted thousands of seedlings on the mountain slopes, and promoted rotational grazing on the higher mountain sides. The project operates through the district agricultural

office; it provides training via a soil conservation engineer and a horticulturist and local counterparts, and gives incentive payments in the form of hybrid seed, fertilizer, and seedlings to farmers working on their own land. People working on communal land are given cash payments.

The analysis addressed two important issues: First, are the incentives financially attractive to the farmers in the study area, that is, is the project financially efficient from the farmers' perspective? Second, from a national and donor aid perspective, do the benefits of the project exceed the costs, that is, is the project economically efficient?

10.6.1 Financial Efficiency

The *change in output* of maize and sorghum for farmers is judged by comparing output with (high input management) and then without (traditional management) the project, deducting the latter from the former, and attributing this difference to the project. High input management is defined as using some combination of fertilizer or hybrid maize and sorghum seed or both.

Assuming that such additional inputs would achieve a 77 percent increase in output and gross revenue, table 10.11 shows the revenue and cost flows and the rate of return for maize under traditional and increased output.

In the case of maize, the additional cash and labor costs required to achieve the 77 percent output increase reduces the nominal net margin per hectare from 104 to 31 maloti (see row five). The increment in total costs—333 maloti—generates an increase in revenues before and after inflation adjustment of 260 and 226 maloti respectively, so that the intensification is clearly not a financially rational action to take.

When gross income is adjusted for inflation and the net margins are recomputed (see row nine) the net margin becomes negative, falling from 60 to -47, and the real internal rate of return likewise becomes negative. Clearly, this is not an attractive proposition for farmers. The unattractiveness is reinforced by the fact that their cash outlays go up from 19 to 240, thereby increasing the risk.

A similarly melancholy outcome emerges from financial analysis of sorghum.

10.6.2 Economic Efficiency

In addressing economic efficiency, our focus of concern shifts from the individual farmer or householder to society at large, that is, the people of Lesotho, to assess whether the project yields net returns to them. It is assumed that if the Swedish funds expended on this project are not committed to it, they will be spent somewhere else in the country, so that, even though the money is coming from outside, it is not free: other opportunities must be foregone to undertake FISC.

Table 10.11: Returns from Traditional Maize Production and Increased (77 percent) Output, Lesotho, 1990 *(maloti per hectare)*

	Traditional	Increased Output (77 percent)	Increment
	(i)	(ii)	(iii)
(1) Gross Income	338	598	260
(2) Cash Costs (Fertilizer, seed, bags)	19	240	221
(3) Gross Margin [(1) – (2)]	319	358	39
(4) Labor Cost	215	327	112
(5) Nominal Net Margin [(3) – (4)]	104	31	-73
(6) Total Cost [(2) + (4)]	234	567	333
(7) Nominal IRR [100((5) ÷ (6))]	44	5	-22
(8) Gross Increase Inflation adjusted [(1) ÷ 1.15]	294	520	226
(9) Real Net Margin [(8) – (6)]	60	-47	-107
(10) Real IRR [100((9) ÷ (6))]	26	-12	-32

Note: To derive the real IRR, the revenues are adjusted downward by dividing by 1.15 to reflect the effects of one year's inflation at an annual rate of 15 percent (shown in row eight). The real net margins are derived by deducting the costs in column six from these inflation-adjusted revenues. No other discounting of revenues and costs is necessary, as they occur in the same year.

Table 10.12: Sensitivity Analyses Assumptions

Category	Base Case	Sensitivity Analysis
1. Post-1992 performance	50 percent of pre-1992 average	80 percent of pre-1992 average
2. Fruit price achieved	50 percent of retail	100 percent of retail
3. Yield pattern	1 percent annual production decline	3 percent annual production decline
4. Future grain prices	Constant (1990) prices	2 percent annual increase

The evaluation criterion applied is the NPV, but the IRR is also estimated. The net benefits with and without the project are estimated, the difference being the attributable benefit. In addition to the on-site benefits addressed in the financial analysis—increased production of maize and sorghum and production of fruit, fodder, and fuelwood—the project also aspires to improve grazing management, producing vegetables from communal gardens. Projected off-site benefits include training of personnel in community management; reduced off-site impacts caused by siltation, including lower maintenance costs for roads and bridges; less siltation of dams and damage to water supply schemes; and secondary benefits (more processing and so on) flowing from increased agricultural output.

A base case of results was estimated, and then some sensitivity analyses were done around the base case. The sensitivity assumptions and the results are presented in table 10.12. The results for the base case and the sensitivity analyses are show in table 10.13.

For the base case, the internal rate of return is negative; it follows that the NPVs are negative. By making more optimistic assumptions about post-1992 performance and so on, it was possible to generate a positive internal rate of return but none that exceeded 4.1 percent, which resulted from assuming that the rate of productivity decline arrested by the project was 3 percent rather than 1 percent.

10.6.3 Discussion

The results indicate that the project is neither financially efficient or economically efficient. This case study yields a number of important insights.

- If little interference exists in input and output markets, if the currency is valued on a market-clearing basis, and few if any off-site benefits are associated with a project, you would expect a priori that the net benefits to government intervention would be low. Under such circumstances, the private sector—in this case the farmers of Lesotho—will take up the available commercial opportunities, which will tend to coincide with opportunities that are in the national interest. Putting this in economic jargon, if there are no market failure reasons to intervene or if the intervention is not directed at correcting for such market failure, we would expect the net benefits to be low. The saying "if it is not broken, do not try to fix it" seems to apply. This appears to be the situation in the Lesotho project in which

Table 10.13: Net Present Value and Internal Rate of Return, Base Case and Four Scenarios

Category	Discount			
	1 percent		10 percent	
	NPV *(million maloti)*	IRR *(percent)*	NPV *(million maloti)*	IRR *(percent)*
Base case	-5.6	-.08	-7.0	-0.8
Sensitivity analyses				
Post-1992 performance	6.0	2.3	-6.2	2.3
Fruit price	2.6	1.7	-5.9	1.7
Yield pattern	14.7	4.1	-5.0	4.1
Future grain prices	4.6	2.0	-6.5	2.0

no off-site effects (externalities) are being addressed and the markets for inputs and outputs works reasonably well. A lesson exists here for project location and design: environment-related projects should be located where there is significant market failure, demonstrated in some combination of off-site effects, tenure deficiencies (see point two below), or price distortions, and design the project to cost-effectively correct for such market failure.

- The most striking message that comes across to me as an economist is in the problems farmers have limiting access. In the case of fruit, fodder, and fuel, their returns are diminished substantially and their choices of usable sites are limited. This is the most fundamental of market failures. Ownership of resources is fundamental to their efficient use; a definition of effective property rights must include the ability and willingness to limit access. If this is a fundamental problem, the project, instead of offering fertilizer, hybrid maize, reconstruction of terraces, and so on, should perhaps have been addressing the development and transfer of appropriate technologies to limit access, for example, a bounty for cattle found trespassing payable by the owners, and the cultural, political, and economic implications and ramifications. A new fence type, not a new seed type, seems to be needed. In other words, market failure did occur in the project area, which the project was not designed to address. In making this suggestion, I am aware that enclosing land is one of the more traumatic passages that countries need to go through to increase output significantly. I am also of the view, however, that unless access is controllable and controlled, the breakthrough to higher yields per hectare in unlikely to be achieved.

- The lack of evidence linking soil loss to productivity loss is a weak dimension of the project. This is exemplified by the sensitivity analysis, which shows that if the productivity loss is 3 percent annually rather than 1 percent, the IRR rate of return goes from 0.8 percent (base case) to 4.1 percent. The rhetorical concerns about soil erosion in Lesotho should be muted until this most fundamental of relationships has been established.

- The segmentation of the benefit categories was a great strength of the study, as it allows policy to focus on the key opportunities. Fruit and fuel do seem to have potential for expansion if the access problem can be addressed. This valuable insight would have been lost if the activities were lumped together, as was done in the Mauritius case.

- The method that this study used is a strong model to follow. It is sobering how little is known even when looking ex post (after the fact) at a well-funded and documented project. You will be dealing generally with ex ante (before the fact) projects, in which facts are scarcer and time is limited.

10.7 The NEAP Economist

When assessing a project, or a combination of projects that comprise a program, address the following:

- You need to decide early on if a cost-benefit analysis is going to be feasible. With your limited resources, it will probably only be feasible if certain conditions are met, including:

  1. official exchange rates that are close to the market rates,

  2. market clearing prices for most goods and services, that is, few if any import or export quotas, and

  3. competitive markets for most goods and services.

- If these conditions do not apply, you may get caught in a morass of shadow pricing from which after much work you emerge with results that may lack credibility. This is so because some of the shadow pricing only makes sense if it is applied throughout the economy, which you are not in a position to do, and lacks plausibility because no one understands

how you got your results. Your credibility is your most important asset. Make sure not to lose it as a result of a lot of fruitless work on your part. Remember that there are likely to be high payoffs to effort on your part in addressing other areas, including policy structure and incentives and cost-effectiveness.

- If you decide to go ahead, check if there are significant off-site effects, signifying externalities, or evidence that the project is addressing other market failure problems, such as tenure, pricing, or information deficiencies on the part of principal actors. If the project does not address these, you should suggest a redesign to include them.

- Concerning the "with/without" situation, what is the net difference the project is going to make? This involves finding out what effects the project is expected to have—the goods and services to be delivered—or, putting it another way, defining the production function. This is invariably the most difficult part of the exercise. You are depending on experts to give you their best judgments and to validate these with reference to research or other country experience. It is important in making your judgments to focus on what is likely to happen, not on what people would like to happen or hope will happen.

- Identify the principal areas in which adjustments will be required in market prices to yield appropriate "shadow prices" that reflect opportunity costs to society.

- Where relevant, start your work with a *financial analysis* of the project or subsets of them. This involves compiling the estimates of the cash costs and returns of the project as experienced by the main beneficiaries and assessing whether on financial grounds the returns exceed the costs. This not only lets you know the principal issues in the project in general but provides invaluable information on the incentives facing the main actors, which can be fed into your analysis of incentives, and their policy implications, which were treated in chapter 5.

- Estimate the volume and value of the inputs required. Shadow pricing of some of these will be necessary, especially if import duties are imposed.

- Estimate the volume and value of the outputs with shadow pricing where necessary.

- Compute the NPV and the IRR.

- Use sensitivity analysis to test the robustness of the results for changes in principal assumptions.

- Discuss the results and the general insights the analysis has yielded.

Discussion Questions

1. Why has cost-benefit analysis gone out of fashion as a test of project-funding viability?
2. What is shadow pricing?
3. Why is it important to ensure that costs and revenues are all in real or in nominal terms?
4. When should the internal rate of return *not* be used as a criterion for evaluation?
5. A farmer is considering two alternative crops for the production of firewood on the only hectare of land available to him. The following net revenue streams (in real AF$) are expected from these two mutually exclusive options:

Year	Crop A	Crop B
0	-20	-40
1	-5	-10
2	-1	-5
3	20	35
4	20	45
5	15	50

If the real interest rate is 10 percent and given that:

$$(1.10)^1 = 1.10$$
$$(1.10)^2 = 1.21$$
$$(1.10)^3 = 1.331$$
$$(1.10)^4 = 1.464$$
$$(1.10)^5 = 1.6105,$$

which option should he choose? Do you feel that 10 percent accurately captures his rate of time preference? What nonfinancial considerations might influence his decision?

Further Reading

Bojö, Jan. 1991. *The Economics of Land Degradation: Theory and Applications to Lesotho.* Stockholm: Stockholm School of Economics.

International Institute for Environment and Development and London Environmental Economics Centre. 1992. *Natural Resource Management in Southern Africa: a Primer for Policy Analysis.* Prepared for Southern African Development Coordination Conference. London: IIED.

Little, I. M. D., and J. A. Mirrlees. 1990. "Project Appraisal and Planning Twenty Years On." Proceedings of the World Bank Conference on Development Economics. Supplement to the World Bank Economic Review and the World Bank Research Observer. Washington, D.C.: World Bank. 351–396.

Ruitenbeek, H. J. 1989. *Social Cost-Benefit Analysis of the Korup Project, Cameroon.* London, U.K.: Worldwide Fund for Nature.

Ward, William A. and Barry J. Deren. 1991. *The Economics of Project Analysis: A Practitioner's Guide.* Economic Development Institute Technical Materials. Washington, D.C.: World Bank.

World Bank. 1992. *Mauritius: Expanding Horizons. A World Bank Country Study.* Washington, D.C.: World Bank, 156.

Chapter 11

Institutional Development and Cultural Dimensions

The expression "policy wonk" is used to signify individuals who think, talk, and write using terms such as "options," "policy-relevant choices," "optimization," "economic efficiency," "zero-sum games," "win-win options," and so on. They are obsessed with policy formulation, its processes and implementation. In other words, they talk and think the way in which this book is written. The term as used is slightly pejorative, implying that a policy wonk is limited, lacks the ability to talk to the common man or woman, and lacks spontaneity. In the United States thousands of policy wonks, as long as they do not find each other boring, live a contented life in a "policy-relevant" cocoon. Your situation is different. You cannot afford to become the only policy wonk in your country, as it would imply an unhealthy degree of professional and possibly social isolation.

Economics is not only about options, incentives, quantification, and structured analyses. It is also about understanding the cultural norms and influences that shape your country and its regions, what is important to people, what motivates them, and what does not. If you do not understand the distinctive motivations characteristic of your country and its regions, you may advocate methods on paper that seem to be "pure Pareto improvements." They meet all the tests that the economics literature suggests, but still nothing happens; the critical ingredient is missing. Remember that "action" is the most important word in a NEAP. It is also important to understand the cultural influences that shape the behavior of your fellow professionals. I use the word "culture" to characterize all those things that we take as given—the assumptions on which we base our lives and our behavior.

As societies become more wealthy, they seem to become more analytical, more and more needing to justify and to rationalize; less and less of the matrix that comprises life is taken as given. This applies at the levels of individuals and societies. Thus, with rising incomes we observe the development of what is popularly called the culture of narcissism, the preoccupation with self, an absorption in analyses of both psyche and physique, a searching for causes, answers, and options. At the level of society, we see the emergence of economics and the other social science disciplines as they attempt to apply analytical processes to causes and choices. Of course, affluence allows choices and their indulgence. But it is possible that the ability and willingness to analyze choices, to address differing outcomes, and to identify causes, is itself partly an explanation for successful development. Regardless of the direction of cause and effect, my own unquantified observation is that affluence and its attendant analytical processes, while yielding enormous material benefits, induces a certain caution, a deliberateness that results in the atrophy of spontaneity, of the intuitive, and often of fun.

You as an economist will be firmly in the analytical mold, but you will be dealing with cultures and cultural reflexes that are not steeped in this analytical process. There will be problems of language and understanding as the intuitive person, who makes most of the decisions, meets with you, the deliberative, who do not. For example, the idea of formalizing self-interest as a driving force in shaping performance and out-

comes may be anathema to many people; at the same time evidence exists on the ground that it is already a force to explain behavior.

11.1 Not Forgetting the Nonphysical Environment

The NEAPs tend to confine their attention to the physical environment, whereas people frequently are most committed to the nonphysical aspects of their lives—language, dance, music, oral tradition, and literature. In extreme cases, people may be willing to die to conserve their language and its associated cultural forms. They are rarely willing to die to reduce soil erosion. Most of the signals on what environment is and what is of value come from industrial countries. But conserving biodiversity may rank much lower in the region than the conservation of language and dance, which may also be unique and endangered. And, of course, in many situations the conservation of the physical is an integral part of conserving the nonphysical. The point is not to expand your already overloaded work menu beyond the breaking point; but you do have a responsibility to help your country identify the real priorities, to communicate with societies in ways in which mutual dialogue and understanding develop, and to help uncover the inspirational wellspring that will achieve commitment and animate behavior. What good is it for the economist to gain the kudos of the analytical world, if he loses his soul because he cannot communicate with his fellow citizens?

There is a dearth of economics-specific help in this area. I hope that over time NEAP economists can synthesize their experiences and perhaps contribute to general understanding in this crucial area. Indeed, it can be argued that a primary rationale for the development of indigenous capability in environmental economics is to capture this sensitivity to local nuance and value systems, which are difficult or impossible for the visiting economist to understand and appreciate.

11.2 Professional Reflexes

Most professions also have a culture, a set of reflexes that characterizes their behavior and ability to contribute. Because you will be working closely with these professionals, it is important to know how they are likely to react. These remarks are based on personal observation; I exaggerate their cultural proclivities to make a point. If you pose a problem, for example, flooding or transport, to professionals, the following will characterize their responses:

A *forester* will want to plant trees. Foresters view tree planting as an all-purpose solution to a variety of problems. They regard the clearance of forest that is not under their direct control as bad under all circumstances.

An *economist* will look for a pricing solution to find a price that will internalize Pareto-relevant costs, clear the market, signal scarcity, and so on. I've seen economists search desperately for "the price" in a situation with no markets, no exchange, and no infrastructure.

An *engineer* will propose a structural solution: widen the river, build a dam, put up a retaining wall, and so on. A certain can-do attitude seems to characterize the profession, which others interpret occasionally as arrogant machismo.

A *planner* will propose the development of a land use plan, the central plank of which will be the zoning of land into different uses. Flooding is solved by keeping uses not compatible with flooding out of flood-prone areas.

An *ecologist* will decide after some study that nothing should be done, the *status quo* should prevail.

A *lawyer* will propose a law to regulate behavior and deal with the ensuing damage.

I could go on but the general point is clear: most professions have a cultural reflex to issues that, not surprisingly, reflects their own expertise and comparative advantage.

All professionals will complain that they are too far removed from decision-making processes, they are not listened to; and if they had more influence over decisions, they would be listened to more. With the possible exception of the economist, they do not dwell on the cost implications of their preferred solution.

The point is not to make glib judgments or to make fun of professions. If they did not have a central core idea, they would not exist and would not be useful. The point is to indicate that you need to be aware that they each come to a problem with a particular perspective. This under-

standing is important because much of a NEAP economist's work requires integration of information, the synthesis of disparate material into a structure suitable for analyzing choices.

11.3 Institutional Development

Because, in most African countries, little or no institutional capability exists to develop and then implement environmental policy, a central element in most NEAPs is to provide it. You may be involved in the evaluation of options in this regard. An environmental agency will typically have the following responsibilities:

- Develop guidelines for undertaking environmental impact assessments and evaluate their implementation.
- Provide pollution licenses regulating emissions to air, water, and land for existing and new industry.
- Monitor environmental performance.
- Engage in providing and encouraging environmental information and education.
- Undertake and sponsor research.
- Advise local and national governments on environmentally appropriate action.

The following are criteria by which you can help judge the options in this regard.

11.3.1 Criteria for Evaluating Institutional Proposals

A number of criteria for evaluating institutional proposals may be identified.

Coherence and independence. In evaluating applications for emission licenses, it is important that the agency involved have a coherent structure that sets standards and norms and that it is immune from political interference in evaluating individual cases. Investment abhors uncertainty. If individual decisions are not and are not seen to be fair, investment will be discouraged.

Use of incentives. The agency should be allowed to use emission charges and other incentive and revenue-generating mechanisms to encourage environmentally positive performance.

Information dissemination. In addition to the usual general information dissemination activities, the agency should generate targeted information that encourages positive environmental performance. This could include: a toxics release inventory in which individual plant performance is published; the costs imposed by environmental degradation by sector; and price series for key inputs and outputs of environmental significance, for example, the price of water, firewood, fertilizers, pesticides, erosion-inducing crops, and so on.

Environmental economics research. As noted above, environmental research will often be a responsibility of such an agency. Such activity, however, is usually assumed to be focused exclusively on the scientific and engineering aspects. It is important that the brief give explicit attention to the social sciences in general and to economics in particular.

Performance over possession. The promotional procedures and the general ethos of the organization should be seen to encourage performance and not simply possession of titles.

Cost-effectiveness. Given a menu of assignments, which structure is most likely to achieve these at least cost? A critical consideration in this regard will be the extent to which the agency draws on existing expertise and infrastructure, rather than duplicating it.

Application of such agreed-on criteria can help reduce the sterile debate over turf. By raising such issues, a positive contribution may be possible and help ensure that the institutional arrangements work in harmony with economic imperatives.

11.4 Monitoring and Evaluation

Monitoring and evaluation should be an integral part of the NEAP process. Economists should be centrally involved. In addition to the traditional skills already addressed in other chapters that

economists can apply in this area, the following can make an important contribution.

11.4.1 Shortening the NEAP Menu

Every NEAP program I have seen has been much too ambitious to have any chance of comprehensive success. The incentives encouraging such expansiveness are obvious. Everything is connected to everything else; political considerations argue for being as inclusive as possible. The ability to manage, to source funds, to make political decisions, and to bring communities along, however, is limited, often already stretched beyond the breaking point. Choices have to be made. By constantly dwelling on this theme and arriving at a feasible set, you can also help the monitoring process, because a manageable set of activities and programs can be addressed.

11.4.2 Focusing on Outputs

Most monitoring of public programs focuses on inputs: was the budget spent? were the employment slots filled? were the necessary forms and authorizations completed? were the necessary meetings and consultations held? and so on. The economist, however, focuses on the output: was the wood produced? did crop yields increase? was siltation reduced? and so on. Focusing on a few key performance indicators early in the NEAP process should facilitate the development of the organizational "performance culture" noted earlier.

11.5 The NEAP Economist

The NEAP economist should be mindful of the following points in his or her work:

- Make explicit efforts to identify local priorities and value systems and integrate these into your professional calculus.
- Try to maintain the ability to communicate with decision makers and community leaders in a fashion that does not confuse and intimidate. Keep jargon, which is essential for communicating with fellow economists, to a minimum when dealing with noneconomists.
- Be aware of the imperatives that drive your fellow professionals in other areas, and use their diverse impulses to achieve integration.
- When new institutions are being proposed, participate in the discussions on design, focus on the criteria that should characterize effective organizations, and evaluate options in this context. Make sure that economic instruments and environmental information dissemination and economics research are part of the organizational brief.
- Have access to relevant environmental data bases via computer and on hard copy; examples include the U.S. EPA Pollution Prevention Information Clearinghouse and the World Bank data base ENVSTARS.
- Help achieve effective monitoring by shortening the NEAP menu as much as possible and by focusing on achievement (outputs) via a few important performance indicators.

Appendix A

Key Literature and Data Sources

Every environmental economist working on African issues should be aware of certain core data, issue, and topic specific data and analyses and books.

Core Data

A number of continent-wide general sources exist that embrace a range of useful country data and concepts. These appropriate sources will change over time. The following are relevant to environmental economists working in Africa and should be part of his or her library:

- *African Development Indicators*. World Bank and United Nations Development Programme. Washington, D.C. 1992.

This report provides the most complete time-series coverage available by country on: national accounts, prices and exchange rates (official and parallel market rates), money and banking, external sector (balance of payments and commodity trade by product), external debt flows, government finance, agriculture (including prices, production indexes, volume, and value of specific crops, areas, and yields), industry (structure, value added, and earnings per employee), public enterprises, labor force and employment (including age structure and minimum wage, aid flows, and social and environmental data. A particular strength of these data is the fact that they are presented as annual time series, typically from 1980 to 1989, so that it is possible to examine trends.

- *Social Indicators of Development 1991–92*. World Bank. Washington, D.C. 1992.

This book is issued annually; the data are also available on diskette. It provides information for each country on human resources (population and labor force), natural resources (agricultural and forest land, deforestation rate, and access to safe water), income and poverty, expenditure (on food, calorie intake, housing, transport, and communication), medical care, and education. A short appendix includes environmental data, presented in three categories (most recent, 15–20 years ago, and 25–30 years ago).

- *Sub-Saharan Africa from Crisis to Sustainable Growth: A Long-Term Perspective Study*. World Bank. Washington, D.C. 1989.

Provides detailed data on the economic and social performance of African countries with analyses of the causes of weak performance and means of improvement and numerous examples.

- *Development and the Environment. World Development Report 1992*. World Bank. Washington, D.C. 1992.

In 1992 the World Bank devoted its annual World Development Report to the issue of development and environment, which comprised an important input into the U.N. Conference on Environment and Development (UNCED) in Rio de Janeiro in June 1992. This report provides detailed analysis of the links between economic performance and environmental management, outlines environmental priorities for development, discusses the uses of markets and the decision-making processes, and deals in some detail with sanitation and clean water, energy and industry,

rural environmental policy, international environmental concerns, and the costs of a better environment. It is worth getting each of these reports as they are issued, because they typically deal with a theme that has substantial relevance for environmental policy. For example, the 1991 report focused on the challenge of development.

- *World Resources 1992–93.* World Resources Institute. Washington, D.C. 1992.

Each year the World Resources Institute produces this report in cooperation with the U.N. Environment Programme and the U.N. Development Programme. It comprises the most complete country-by-country assessment of environmental performance available. Data by country are provided on basic economic indicators, population and human development, land cover and settlements, food and agriculture, forest and rangelands, wildlife and habitat, energy and materials, freshwater, oceans and coasts, atmosphere and climate, and policies and institutions. It is also available on diskette.

- Various publications from the Environmental Economics Unit of the United Nations Environment Programme (UNEP). Nairobi, Kenya. Phone: +254-2-623372/624051: Fax: +254-2-624268.

UNEP annually publishes the *Environmental Data Report,* in effect a companion volume to the World Resources Institute annual report, together with a range of other materials. Since its establishment, the Environmental Economics unit has started a program in the following areas: economic policy instruments, environmental impact assessment and cost-benefit analysis, valuation of environmental goods and services, environmental and natural resource accounting, and international economic relations.

Issue- and Topic-Specific Data and Analyses

A large and rapidly growing literature exists on most issues of relevance to environmental economics, policy, and management in Africa. The number of sources of such work will grow over time. You should keep abreast of developments and get on the mailing list of new sources as they emerge. Those noted below are sources I have found of value.

- The Beijer Institute, The Royal Swedish Academy of Sciences, Box 50005, S-104 05 Stockholm, Sweden. Phone: +46-8-160490: Fax: +46-8-152464.

This organization publishes a working paper series in environmental economics with an emphasis on theoretical development combined with some empirical work in the context of global and developing country issues.

- CSERGE, University College, London, Gower St., London WCIE 6BT, UK. Phone: +44-71-380-7874: Fax: +44-71-916-2772/ 380-7778; and

- School of Environmental Sciences, University of East Anglia, Norwich, NR4 7TJ. Phone: +44-603-593175: Fax: +44-603-507719.

This organization is involved in a variety of economic analyses on a wide range of issues. The work is characterized by a practical, empirical method to the analysis of choice.

- Environmental Economics Unit, Gothenburg University, Viktoriagatan 30, S-411 25 Göteborg, Sweden. Phone: +46-31-116168; Fax: +46-31-773-1326.

This unit advises SIDA—the Swedish overseas aid agency—on the use of environmental economics and issues a working paper series.

- IIED/UCL London Environmental Economics Center, IIED, 3 Endsleigh Street, London, WC1H ODD, England. Phone: +44-71-388-2117: Fax: +44-71-388-2826.

This organization publishes a series of papers on environment and economics, almost all of them devoted to issues in developing countries.

- The Organization for Economic Cooperation and Development (OECD), 2 rue André-Pascal, 75775, Paris CEDEX 16, France

The OECD is an organization whose members comprise the richer countries of the world. OECD is important for two reasons. First, its Development Assistance Committee (DAC) is influential in bringing issues to the fore and in arriving at a consensus among the donors regarding their policies concerning developing countries. Second, a wide range of publications is issued. Relevant examples include OECD (1989a and 1989b). The organization also fulfills a role in advancing conceptual methods and policies in regard to environment in both industrial and developing countries; characteristic examples include OECD (1975, 1986, 1989c, 1991b, 1992, and 1993).

- Resources for the Future, 1616 P St. NW, Washington, DC, 20036, USA. Phone: +202-328-5000.

This is the largest concentration of economics research expertise applied specifically to environmental and resource issues but does not emphasize developing countries in particular. The quarterly publication *Resources,* available free on request, provides details on ongoing research, publications, and so on.

- World Bank, 1818 H St. NW, Washington, DC 20433, USA. Phone: +202-477-1234.

The World Bank produces publications from a number of sources on environmental economics. I have found the Environment Department's Working Papers (which are distributed free to those on their mailing list) and Environment Paper Series and the Africa Technical Department's Environment Working Paper Series of particular interest. The World Bank's capability-building initiative in environmental economics in Africa is administered by Jan Bojö, AFTES, Phone: +202-473-4429: Fax: +202-473-7916

- World Resources Institute, 1709 New York Ave. NW, Washington, DC, 20006, USA. Phone: +202-638-6300. The Washington address of the International Institute for Environment and Development (IIED) is at the same location.

This organization publishes the World Resources report annually (see reference to the 1992–93 report above) in cooperation with IIED and the U.N. Environment Programme and also issues a number of economics-related publications. A free publications list is available on request.

Some Books

There are numerous books on environmental economics, both extant and emerging. The weekly magazine *The Economist* almost always has an interesting piece on the interface between environment, economics, politics, and development and is the best way to keep up with emerging trends. Frances Cairncross, the environmental editor of the magazine, takes an admirably ecumenical view of her assignment and pays particular attention to evidence rather than rhetoric.

The books listed below are a few that I have found accessible and worthwhile.

- Bojö, Jan, Karl-Göran Mäler, and Lena Unemo. 1992. *Environment and Development: An Economic Approach.* Second ed. Dordrecht, Netherlands: Kluwer Academic Publishers.

Of the books listed here, this is the one that most specifically addresses developing countries. It deals with the sustainability issue, distortions in the economic system that lead to environmental degradation, and the need for a special economics. The theory and practice of accounting for environmental degradation in national income accounting is addressed, and the theory and practice of cost-benefit analysis are analyzed. The book concludes with a discussion of nine case studies, which account for almost half of the volume's length and provide a practical dimension.

- Gittinger, J. Price. 1972. *Economic Analysis of Agricultural Projects.* Washington, D.C.: World Bank.

This book is a model of a book that strikes the right balance between rigor and applicability; its aptness in this regard is demonstrated by its numerous printings since original publication. The author shows how to identify costs and benefits of agricultural projects, how to value the inputs and outputs, and then compare them. He discusses practical issues such as sensitivity analysis and the treatment of sunk costs and salvage values, addresses financing issues, and concludes with a case study of a cocoa project in Côte d'Ivoire. It does not address the incorporation of environmental dimensions to projects.

- Munasinghe, Mohan. 1993. *Environmental Economics and Sustainable Development.* Environment Paper No. 3. Washington, D.C.: World Bank.

Part I of this volume presents the analytical framework—definitions of sustainable development, linking economics to environment, and mobilizing economics to aid decision making. Part II summarizes a series of case studies in valuation. African readers will be especially interested in cost-benefit analysis of land improvement in Lesotho, economic analysis of a water supply and health program in Zimbabwe, the value of viewing elephants on safaris in Africa, and the willingness to pay for improved sanitation in Kumasi, Ghana.

- Pearce, David W. and R. Kerry Turner. 1990. *Economics of Natural Resources and the Environment.* Hertfordshire, England: Harvester Wheatsheaf.

This book addresses general issues in economy and environment, including the sustainable economy, then deals with the economics of pollution, including the uses of taxes and marketable permits, the measurement of economic damage, and global issues. Sections deal with ethics and with the economics of renewable and exhaustible natural resources. The book concludes with a review of issues in development and environment, including issues specific to developing countries.

- Pearce, David, Anil Markandya, and Edward Barbier. 1989. *Blueprint for a Green Economy.* London: Earthscan Publications Ltd.

This book was prepared initially as a report for the Department of the Environment of the United Kingdom. It addresses issues of sustainability and accounting, project appraisal, and the uses of prices as incentives for positive environmental behavior. It is an important book for NEAP economists because it demonstrates that economists can communicate their ideas effectively to the public and to politicians; it played an important role in the debate in the United Kingdom on the uses of incentives in environmental policy.

- Pearce, David W. and Jeremy J. Warford. 1993. *World Without End: Economics, Environment and Sustainable Development.* New York: Oxford University Press.

This book gives a thorough and numerate articulation of most of the issues. Part I develops the issues of sustainability and its measurement. Part II examines the causes of environmental degradation and policy responses, with especially useful treatments of population, poverty, and income distribution in this context. Part III focuses on international issues, with extensive treatment of the trade environment issues and transfrontier pollution.

- Tietenberg, Tom. 1988. *Environmental and Natural Resource Economics.* Second ed. Glenview, Illinois: Scott, Foresman and Co.

This book's strength is in giving detailed methods for addressing specific resources with good case studies. It provides a historical context, addresses the conventional issues of market failure, and then tackles specific issues, including population, resource depletion of oil and gas, recycling, and renewables, including water, food, forests, and fisheries. It analyzes pollution control in the context of air, water, and toxic substances, and concludes with a review of the growth issue.

- Winpenny, J. T. 1991. *Values for the Environment: a Guide to Economic Appraisal.* London: Her Majesty's Stationery Office.

This is a practical overview of theory and application with most of its focus at the project level. Successive chapters address environmental problems of major habitats, the techniques of economic valuation, economic valuation in practice (with many case studies summarized), appraising projects, and policy appraisal and adjustment.

Appendix B

Choices for the African Farmer

Let us take the case of an ambitious, relatively well-informed and articulate African farmer, growing maize for food and perhaps a little for market, managing a small vegetable garden, and also growing annual cash crops such as cotton and groundnuts when the market justifies it. He does this in an environment in which the weather is precarious; disease of both humans and animals is widespread; availability of sound, practical advice is limited; and availability of imported inputs such as fertilizers, dips, vaccines, and so on is erratic at best. He is not meant to be in any sense typical or representative but to show how to articulate some concerns relating to the development of his operation and its implications for environment.

In the following monologue, this farmer reflects on the choices he faces for the coming year:

What Crops to Grow

"Every year, I try to grow the combination of crops that I estimate will yield for me and my family the greatest net benefits, comprising some combination of food security, cash income, shelter, and other benefits.

"With regard to food security, the likelihood of drought is an important consideration: I can plant a relatively drought-resistant variety of maize, but the yields are low. The more water-demanding varieties will wither if rainfall is low, but produce much more than the drought-resistant varieties rainfall is adequate. If I can get a mixture of varieties, I will hedge the risk by planting them. The Coop is pushing a hybrid maize that is supposed to double yields, but it needs fertilizer that I cannot afford. Anyway, they often do not get it into the store in time. I gather from my cousin in the civil service that something called structural adjustment is likely to push the price of all imports through the roof.

"The storage facilities in my village are reasonably satisfactory in the sense that they are dry, secure from rodents, and theft; I know from experience, however, having gone to the trouble in the past to keep stocks available to see me and my family through the drought when times got bad two years ago, I was more or less obliged to share my stored food with the entire community, much of which had not gone to the trouble and expense that I incurred to provide such insurance. I'm not inclined to put that much into store this year.

"Once I feel that my family's minimum food needs have been secured as best I can, I want to generate as much cash as possible.

Expected Crop Prices

"What prices are likely to be on offer for different crops? In the past, the government-controlled food prices to the extent that it did not make much sense to devote effort to the production of food for sale; however, food can now be sold freely in the cities and towns. The big questions are: what will the prices be like and will transport be so erratic and expensive that it is impossible to get to market?

"For the past few years, I've been growing tomatoes and cabbage in my vegetable garden. Transport is especially important in the case of fruits and vegetables, which achieve profitable prices only if they are in good condition. I conclude that the prices are so unpredictable and the roads are so bad that I'll skip trying to produce perishable food for market, although I will grow enough for my family's needs.

"For the past two years, a parastatal has been offering a price for cotton that makes this a

money-making proposition if I can get sufficient labor to harvest the cotton every two weeks. (If it is harvested less frequently, the cotton gets dirty and less valuable.) The women will work at it, but they may be deflected to the production of groundnuts. I expect that the market for groundnuts will be quite good; because the returns from groundnut sales are kept by the women, who, of course, also do the work, I'm not that keen to encourage this, especially because it will detract from the labor available to harvest cotton. I will try to get some help from the local school with the cotton harvest.

Trees

"Everyone these days is talking about planting trees. As usual, there is far more talk than action. I can see the logic of planting a few guava trees around the house; they provide shelter and fruit are easily looked after. Protected from livestock and thieves, they do not require much maintenance or labor, the seeds are free, and the payoff comes after five or six years. I'm less convinced about the need to plant other kinds of trees, especially trees for firewood.

"In theory, you should be able to protect them and sell the wood. But the payback is way in the future, if it comes at all, and the quality of the firewood produced is not great. In my situation, with a large, hungry family, every day extra you have to wait for a return on the investment hurts; I reckon that I need to discount returns in the future at an annual net of inflation rate of about 30 percent; trees do not produce those kinds of returns. Indeed, given the fact that it is almost impossible to protect young trees from the attention of hungry livestock and that our culture encourages the idea that firewood is free, I would be lucky to get any return from my investment. Finally, the wood is collected by the women; I do not think they mind the extra distances they now have to go that much.

"What might be of more interest is the suggestion to plant tea crops. The price for tea at the moment is good. Those farmers lucky enough to already have an existing plantation are doing well. My problem is that if I plant this year, I'll have to wait at least five years for my first harvest. As I've already said, I'm under such pressure that I just cannot wait that long for a return. Furthermore, I do not have any experience with this crop; who can say what prices will be like five years from now? It would be just my luck to have a price collapse as my tea went to market.

Inputs

"The nitrogenous fertilizer that is best suited to most of my needs is urea. The question is, will it be available at all, and if so, will it be at a price that makes financial sense to pay? My best estimate is that it will be available but that the price will be such that it makes sense to buy and apply only a small amount.

"With the prevalence of Corridor disease reducing the numbers of oxen, I'm not sure that I'll be able to plow. This is a blow to the prospects of expanding my operation. It looks like cultivation will once more have to be by hand. I will burn the land as usual to get the following benefits: clearance that makes it easier to cultivate by hand; a second (slight) grass growth for my few remaining cattle; additional nutrients released for the crops, and better visibility for hunting and to spot trespassers.

Land

"As far as I know, I can keep the lands I'm now cultivating in my family as long as we want to farm them; however, I cannot transfer or sell the land without permission, which I know would be extremely difficult to achieve. When I went to get a loan a few years ago (when such things were still possible), the bank wanted to hold the title to some assets as collateral and I was not able to oblige. (This was probably just as well; many people who borrowed heavily at that time got caught by a combination of drought-induced poor production and low prices because of government-price controls; the bank, however, will be lucky if it can sell off these farms, as it will take a brave man to take up this land at any price.

"There are rumors going around it will be possible to sell land but that the seller must have formally registered, written title. I do not have written title to the land that I'm cultivating. If it exists at all, it is held by the headman in my village. If he were offered a good price for the land by some rich town dweller, I would trust him to

protect my interests. But can I trust his successors?

"Up until recently, it was relatively easy to get new land to cultivate when you needed it. You identified what you wanted, and asked the headman for permission to proceed. If this was forthcoming—which it usually was—then you could go ahead to burn and clear it. Now, it is not so simple. The good land, relatively near to the village, is all spoken for. Even land some distance away has had such a short time to recover that it is not fertile; it is hard to justify the time and effort involved in farming it.

Population

"Because everything from carrying water and firewood to cultivation and harvesting is done by hand, you need a lot of hands to do the work. This is why, until recently, I have not paid much attention to the family-planning people. But now good land is getting to be in short supply and most of the services, such as schools and health clinics, which were built up after independence, just do not seem able to cope; we're having to pay for medicine and for school, which we never did before. Suddenly, children are becoming a cost instead of an asset. I'm still not wild about family planning, but maybe the women should look into it.

Crop Protection

"One of my biggest problems is protecting crops from livestock. Goats are a menace, pigs are impossible to keep out of the garden, and cattle (encouraged by their owners) think that they have a God-given right to graze wherever they please.

"Barbed wire fencing is expensive and does not do much to keep pigs out in any event. I know that the law is on my side, but in practical terms, it is difficult to enforce, because, for some reason, animals still have 'status.'

The Original Forests

"The original forests are almost gone, destroyed by fire, logging, and grazing. As a result, it is not worth my while to hunt there. We cannot depend any more on the bush meat, which provided a useful addition to the diet, as well as providing good sport. The remaining forests are still yielding some fruits and herbs of medicinal value, but the yields and variety are declining. It is a pity to see this resource being destroyed, but because no one seems to really own it—notwithstanding the government's claims in this regard—I cannot see the destruction stopping.

"I've heard that in some countries, tourists come to see these areas and spend money, but we do not have the large animals, beaches, and dramatic scenery, which I'm told they like. Anyway, I'm not sure that I'd be keen on having a lot of probably unhealthy strangers wandering around, corrupting our culture, and not doing much for the economy.

Conserving the Environment

"Everyone is suddenly talking about the 'environment,' as if it were a new product discovered only yesterday. From what I hear, the main interest is in conserving what the experts call 'biodiversity.' It is amazing the enthusiasm there seems to be internationally to protect our wildlife. I have not observed the same enthusiasm for conserving humans, but maybe that's because we're not disappearing.

"So we're being urged to protect the remaining forests, to protect the soil by planting trees, planting something called Vetiver grass along the contour, and building terraces. The experts also want us to produce compost so that we can maintain the organic content of the soil.

"Everyone is full of suggestions, but who is going to do the work and who is going to pay? I estimated that it would cost me at least $500 per hectare to establish terraces, even assuming that I could find the labor needed for the job, not to mention the money. There is no way that I would get a good return on this investment, at least not as long as I can move onto new land that does not cost me anything.

"We're being urged not to burn now so that the vegetation can protect the soil against erosion when the rains come, and improve the structure and tilth by providing it with organic matter. I can see the logic of that, but how am I going to clear the land if I'm not to burn it?; With fertilizer so expensive, how am I going to replace the nutrients that burning now provides free?

"I cannot see investments in tree growing, either for firewood or commercial crops, paying off.

"If I keep out of the remaining native forest, I'm pretty sure that some others will not; I might as well get what I can out of it while it is still there.

"I'm too poor to subsidize protection of the environment. If I'm to play my part, it has got to pay me to do so.

Prerequisites for Behavior Change

"If I could generate enough of a net return that I did not have to spend everything I earned immediately, this would simultaneously give me the resources to make an investment and perhaps provide the financial justification for doing so. If the positive gap between prices and costs would widen a little, if the costs of going onto new land increased, and if my security of tenure were somehow formalized in a manner acceptable to my neighbors, then some investments in conservation might begin to make sense.

"But it has to pay me to protect the soil by planting tea and trees for firewood. It has to pay me to build terraces to prevent erosion. It has to pay me to conserve existing remaining native forests, and I need to be sure that the others feel likewise. It would help if the security of tenure that I now have in fact were formalized, although this would have to be acceptable to the community in which I live. Although I would not want to admit it, it would also encourage conservation if I had to pay for access to new lands. It would also help if the attitudes of my neighbors caught up with the law in regard to animal trespass; if I could be sure that my land would be free of trespass, I could justify a number of investments that do not make sense at present."

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