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Economic Analysis of the Environmental Impacts of Development Projects

John A. Dixon, Richard A. Carpenter, Louise A. Fallon, Paul B. Sherman and Supachit Manipomoke

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Tel: +44 (0)20 7841 1930
Fax: +44 (0)20 7242 1474
Email: earthinfo@earthscan.co.uk
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Volume 1

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John A. Dixon is a Research Associate at the Environment and Policy Institute (EAPI) of the East–West Center, Honolulu. He is an economist and is the leader of the Institute's applied economic analysis activities. Dr Dixon has extensive experience in Asia working with both national governments and international agencies.

Richard A. Carpenter is also a Research Associate at EAPI. He is a chemist whose principal interest is environmental assessment.

Louise A. Fallon and **Paul B. Sherman** are both Research Fellows at EAPI. Dr Fallon is an economist with a background in biology and a strong interest in resource management. Mr Sherman is also an economist and specializes in natural resource and environmental issues.

Supachit Manopimoke is an East–West Center grantee from Thailand. She is a PhD candidate in agricultural and resource economics.

Authors' Foreword

During the past several years, the East-West Center's Environment and Policy Institute, under the initial leadership of Maynard M. Hufschmidt, has undertaken the applied benefit-cost analysis project which has led to the publication of two books (Hufschmidt *et al.*, 1983 and Dixon and Hufschmidt, 1986) and other supporting materials.

In 1985 we were commissioned by the Asian Development Bank to prepare a report based on our earlier experience of this work. The authors wish to thank the ADB for its support in the preparation of the initial version of this book. Special thanks go to Burnham O. Campbell, Chief Economist, J. Keith Johnson, Economist, and Colin P. Rees, Environment Specialist, and numerous other Bank officers who gave useful comments on the draft, suggested appropriate examples of Bank projects, and provided access to Bank documents. This report was published in 1986.

Between publication as an ADB Economic Staff Paper and this commercial publication, we have received valuable help and advice from many sources. At the Asian Development Bank, Bindu N. Lohani, Head, Environment Unit, has provided a continuation of the support offered by his predecessor, Colin P. Rees. Mr George V. Liu of the Information Office and Mr E. Suzuki of the Office of the General Counsel have been supportive and helpful in the complex process of bringing this work to publication.

Numerous professional colleagues and development specialists have read and commented on the initial report, including Professor Jack Knetsch of Simon Fraser University, Vancouver, Canada, and Ms Regina Gregory of the Environment and Policy Institute, East–West Center. We welcome comments on this book and would like to hear from others who are working on the challenging topic of applying economic analysis to the environmental and resource impacts of development projects.

Preface

The past decade has witnessed a growing realization that economic development and environmental awareness are not contradictory goals. The interrelated nature of economic growth, natural resource use, and environmental protection is encompassed by the phrase "sustainable development", which describes those activities that promote the long-term, sensible use of the natural resource base. The Asian Development Bank (ADB), an international finance institution with headquarters in Manila, Philippines, has been actively involved in the effort to promote development which is economically and environmentally sustainable.

The ADB's Environment Unit has supported the development of guidelines and procedures to ensure that environmental aspects of development are given ample consideration. Realizing the importance of translating environmental concerns into monetary terms to achieve this aim, the Environment Unit has cooperated with ADB's Economics Office to commission the writing of Economics Staff Paper No. 31, *Economic Analysis of Environmental Impacts of Development Projects* by John Dixon and others of the East-West Center in Honolulu, Hawaii. This report was prepared for use by Bank staff. It has been well received and distributed to a number of Bank member countries and other international development agencies and finance institutions for training and as a reference document.

The report focuses on what can be done given varying degrees of data, manpower and financial resources. The valuation techniques presented are grouped according to their direct applicability to the types of environmental and resource effects commonly found in development projects. Obviously, this brief volume cannot cover all valuation approaches in detail. References to the published literature direct the interested reader to fuller discussions

of different techniques. The case studies illustrate the use of selected techniques and approaches.

As a result of growing interest in this topic – the economic analysis of environmental and natural resource effects of major development projects – the ADB is supporting the commercial publication of this report in the present form so that it can reach a wider international audience. To suit publication needs the authors have revised the original manuscript and have included additional material, partly in response to feedback received in various training courses and seminars in the two years since it was originally published. References to recent literature have also been added.

The Asian Development Bank is pleased to make this important and timely material available and looks forward to continuing involvement in this area.

Asian Development Bank
Manila, Philippines

Contents

1 *Development projects, their impact on the environment and the role of economic analysis*

Economic development, the ultimate goal of which is to improve human welfare, is crucially dependent on the environment and natural resources to provide the goods and services which directly and indirectly generate socioeconomic benefits. At the same time, however, economic development is often accompanied by significant adverse impacts on the environment. This has led to the belief that economic growth and environmental conservation are mutually exclusive. Many people still feel that some deterioration in environmental quality is a necessary and justifiable cost of economic growth, and also that the management of natural resources for sustainable use is a luxury which poor developing nations can ill afford. However, a growing body of opinion has gradually emerged which recognizes that degradation of the environment and misuse of natural resources will result in real losses in the long term and, furthermore, will undermine the basic objective of development – the sustainable improvement of human welfare.

Governments in developing countries are becoming increasingly aware that environmental and natural resource degradation endangers the potential for long-term development. As a result, they are becoming more receptive to the implementation of measures which ensure that development projects take both the environment and natural resources into account.

Many countries have experienced instances where the degradation of their natural resource base has resulted in the impairment of long-term growth. One common instance is that of fisheries, both inland and marine, damaged by water polluted by domestic and industrial effluents. In some areas this damage has reduced the traditional primary source of protein. Another example is the deforestation of upland regions produced by both

shifting agriculture and excessive timber extraction for fuel and wood products. This has led to the disruption of the hydrological cycle of major watersheds and has caused erosion, siltation of rivers and reservoirs, and increases in both the incidence and severity of flooding. The result of all this has been a significant reduction in the productivity of many forests, agricultural lands, and fisheries. It has also decreased the returns from major investments in hydroelectric power and irrigation schemes.

Most people in developing countries work on the land and are directly dependent on natural resources for their food, shelter, and employment. Their welfare in both the short and the long term is inextricably tied to the productivity of natural systems. Thus the socioeconomic effects of degraded environments often hit the poor hardest. It is clear that successful economic development depends on the rational use of environmental resources and on minimizing, as far as possible, the adverse impacts of development projects. This can be done by improving project selection, planning, design and implementation.

Both bilateral and multilateral institutions devoted to funding development projects and programs see their role as promoting the most efficient use of available resources within the context of the socioeconomic priorities of the individual developing countries. Economic analyses of alternative development projects must therefore assess both the direct and indirect benefits and costs of proposed actions. Such analyses require a broader perspective – one that includes the whole range of benefits and costs involved in the proposed activity.

Most lending institutions feel that the direct economic costs of a project are relatively easy to quantify, except where significant externalities such as environmental impacts are involved. Even in these cases, they realize that the costs of such effects should be quantified as far as possible, but the difficulties involved in this process have prevented this quantification; hence environmental effects have often been described and evaluated only in qualitative terms. The real question, therefore, is: How can the environmental impacts of development projects be identified, quantified, and valued?

There are two major elements in assessing environmental impacts: first, they have to be identified and measured; second, ways must be found to place monetary values on these impacts so that they can be included in the formal analyses of projects. Only when a monetary value cannot be given to

a particular environmental impact should it be dealt with qualitatively within the analyses.

Both components are reviewed in this book, and suggestions are given as to how economic measurement of environmental impacts generated by development projects may be undertaken. The approach and techniques presented are based on work done over the past five years by researchers at the East–West Center Environment and Policy Institute (EAPI) in Hawaii, with collaborators in the United States and Asia. The techniques themselves have been developed by economists around the world; the EAPI contribution has been to synthesize existing information and provide a practical application of the techniques to handle environmental quality effects of development projects.[1]

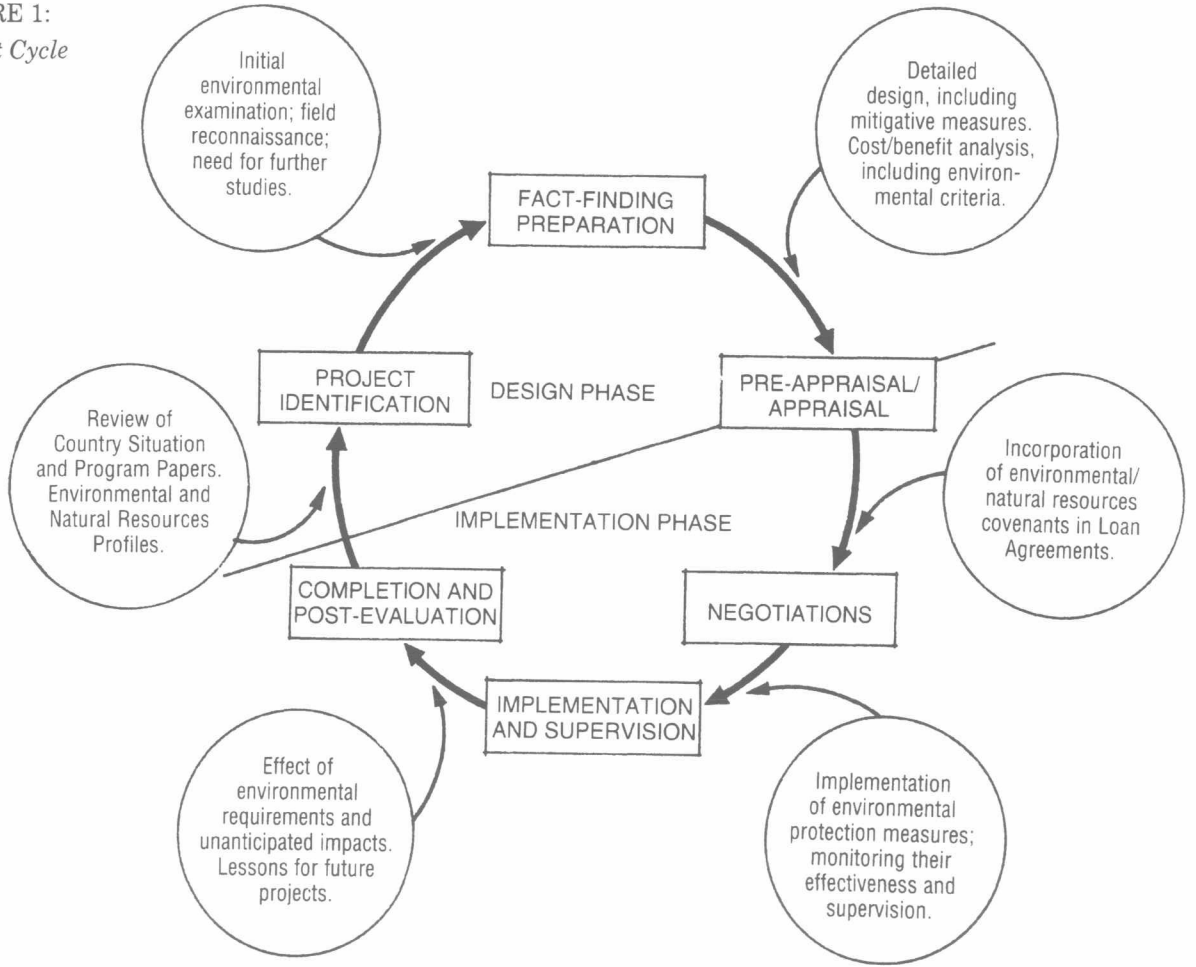
This book focuses on the better analysis of *projects* and their environmental or resource impacts. We do not deny the major importance of macro-level government policies on the patterns of resource use. Such policies as pricing of fertilizer, pesticides, and water have major impacts, both good and bad, on resource use and the environment. Similarly, trade policies, foreign exchange rates, the use of taxes or subsidies all have far-reaching impacts. Nevertheless, the development, analysis, and funding of discrete projects is a major form of economic development in all parts of the world. These projects are the focus of this work.

The Analytical Sequence

Projects are frequently identified and developed in a process known as the project cycle. Figure 1 illustrates the main components of the project cycle used by the Asian Development Bank, but similar patterns are used by the World Bank and other major regional development banks (Rees, 1983). There are numerous places within the project cycle where environmental and resource concerns may be injected. It is crucial, however, that these concerns are taken into account early in the cycle, during the design stage. Only in this way can alternatives be considered before too much time and

[1] The work has resulted in the publication of a book: M.M. Hufschmidt *et al.*, *Environment, Natural Systems, and Development: An Economic Valuation Guide* (Johns Hopkins University Press, 1983), referred to in this volume as the *Guide*. A case-study workbook illustrating the techniques has also been published: J.A. Dixon and M.M. Hufschmidt (eds), *Economic Valuation Techniques for the Environment* (Johns Hopkins University Press, 1986).

FIGURE 1:
Project Cycle



Source: Asian Development Bank (1986), *Environmental Planning and Management*

effort have been invested in one concept. The project designers must work in a multidisciplinary team to design projects that consider a variety of goods and services – economic, social, environmental – at the same time.

The purpose of this book is to demonstrate the use of this new analytical approach and to provide a range of techniques with which to determine the monetary values for the impacts of projects on the environment. The use of environmental assessment procedures, valuable at the early stages of project identification, are discussed in Chapter 2. The remaining chapters of the book deal with attributing monetary values to the environmental impacts. The basic theoretical assumptions underlying our proposed approach to valuation are outlined in Chapter 3. The techniques themselves are presented in Chapters 4, 5, and 6; Chapter 4 focuses on techniques that are generally applicable to project analysis, while Chapters 5 and 6 concentrate on techniques which are more difficult to apply and whose use in project analysis has therefore been limited. Chapter 5 covers potentially applicable techniques that rely on the existence of surrogate markets or the use of cost-analysis approaches. Chapter 6 presents the use of survey-based techniques and introduces macroeconomic, mathematical models. The limitations of the economic measurement of environmental impacts are discussed in Chapter 7.

In the interests of brevity we summarize each technique, discuss its applicability and illustrate its use. Several case studies, which illustrate complete economic analyses as well as the use of individual techniques, are presented in the Appendix.