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Valuing the Environment

ECONOMICS FOR A SUSTAINABLE FUTURE

David Glover

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Valuing the Environment

ECONOMICS FOR A SUSTAINABLE FUTURE

David Glover

INTERNATIONAL DEVELOPMENT RESEARCH CENTRE

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Executive Summary

The Issue

A vast number of people in developing countries depend on the natural environment for their livelihoods — on farmland or forests, wetlands or coastal areas. For these people, the environment is much more than a source of recreation — it is the basis of the economy. But poorly functioning markets, incomplete property rights, and misguided policies can drive people's behaviour in ways that are rational in the short term or from an individual's point of view, but harmful to the environment and future generations.

Economics has much to offer in understanding and influencing this behaviour. It also provides tools for decision-makers faced with difficult choices. How can we compare the value of environmental benefits to the costs of safeguarding them? How can we assess the impacts of environmental action (or inaction) on the poor? How should we share the costs of improvements?

This book shows how researchers from four of IDRC's regional environmental economics networks have dealt with questions like these in a wide variety of situations in Asia, Africa, and Latin America. It brings together insights from more than 15 years of research and assesses their impact on policy and the research community. It concludes by looking at the future of environmental economics in the developing regions of the world.

The Research

Since 1993, IDRC's environmental economics networks have investigated a wide range of problems in developing countries. This work has shed light on underlying causes of environmental degradation and has suggested solutions that benefit people and the planet, pointing the way to sustainable development.

Research has shown the value of the environment to people; illustrated principles to guide people's thinking about the root causes of environmental problems and ways to correct them; identified ways to finance environmental protection; and provided information to help design policies and to put them into practice.

Some of the results confirm expectations: Natural ecosystems provide valuable services; putting a price on scarce resources leads people to conserve them; moderate reductions in air pollution are likely to pay for themselves in reduced health costs. Other results are unexpected or negative: indirect and sometimes destructive effects of policy change; poor people being unable to pay for environmental improvements; overinvesting in pollution control. Such findings may be inconvenient if the aim is to justify more environmental protection under any circumstances. But if the goal is to make wise choices, spending money where it produces the greatest benefits, environmental economics can help.

The Lessons

Environmental economics has much to contribute to decision-making about environmental protection. Above all, it provides a way of thinking about environmental problems, identifying their underlying causes, and applying economic principles to design effective solutions. Perhaps the main lesson to be drawn from the

research described in this book is that things are not always as they seem. This is precisely why we need research. Good decisions cannot be based on lazy thinking, rules of thumb, or conventional wisdom.

Lessons for policymakers

- Research results can be surprising: Keep an open mind.
- Investment decisions need to take into account the value people put on the environment.
- The indirect effects of policies can be as important as the direct ones.
- Market-based instruments can change environmental behaviour while raising revenue.
- Good policy design includes implementation and enforcement.

Lessons for sponsors

- Networks are valuable where local institutions are weak.
- Good research draws on many disciplines, including natural and social sciences.
- Local problems should be identified by local researchers.
- Patience is essential: Building a research field takes time.
- More is achieved when donors collaborate rather than compete.

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Foreword

The physicist Steven Weinberg once remarked that when you have “seen” one electron, you have seen them all. What makes socio-ecological systems so interesting is their specificity. When you have studied one, you have by no means studied them all. Each socio-ecological system displays a blend of generality and specificity. That is why a number of us who had been concerned that academic research in the world’s poorest countries should not irretrievably lag behind, felt that environmental and resource economics might well be a promising field to nurture in developing countries. Until the early 1990s, this wasn’t an obvious point of view.

Environmental and resource economics, as the subject had developed in the United States, was almost wholly concerned with the study of amenities and not so much with household

factors of production. Nor was there much evidence that there were hidden intellectual talents in the many universities in Asia, Africa, and Latin America that were located far from major centres of learning. This is why far and away the most impressive academic progress in the field of environment and economic development in the past 15 years has been the flowering of original research on local environmental problems in poor countries by scholars residing in those countries. To make that happen has required immense imagination, dedication, intellectual subtlety, patience, and curiosity.

Since its inception, the International Development Research Centre (IDRC) has been a pioneer in creating, nurturing, and promoting teaching and research on local environmental problems in the developing regions of the world. The Centre's achievements over a 15-year period are astonishing. There was little reason to believe that, with research grants that are pitiful by Western standards, a complex world at the interface of poverty and the local environmental resource base would be opened for us.

David Glover, who has been at the heart of IDRC's innovative movement, was the obvious person to write about the history and achievements of the Centre's experience in this area. His account of the wonderful and exciting research that has been conducted by previously unknown scholars is lucid, deep, and — what is often missing from such accounts — extremely moving. The point, of course, is that you cannot administer such a program as IDRC's without passion. The chapters that follow are examples of how to write with both detachment and concern. It's an extraordinary story.

Sir Partha Dasgupta

Frank Ramsey Professor of Economics
University of Cambridge, UK

Preface

Developing countries face a formidable challenge: lifting millions of people out of poverty while protecting some of the world's most important and biologically rich ecosystems. Achieving both objectives will require finding win-win solutions and, where those cannot be found, making trade-offs based on thorough knowledge of what is gained and what is lost.

Environmental economics provides a number of tools that can help decision-makers faced with difficult choices: How can the value of environmental benefits be compared with the costs of safeguarding them? How can the impacts of environmental action (or inaction) on the poor be assessed? How should the costs of environmental improvements be shared?

Since 1993, IDRC has worked with researchers in developing countries to develop these tools and bring them to bear on environmental problems of local importance. This book tells the story

of how the field of environmental economics has taken shape in the developing world, the kinds of questions it tries to answer, and the impact it has had.

Part 1 provides an overview of environmental economics and its strengths as a way to understand and respond to environmental problems. It also traces the development of the regional networks that were established with IDRC support to address these issues in developing countries.

The heart of the book is Part 2, which tells 30 stories about environmental problems in developing countries to illustrate the kinds of questions environmental economics can help answer. (Given its brevity, the book does not provide details about the methods used in these research projects. Those can be found in the original studies, which are listed in the Bibliography and available free of charge online. This is a book about why to do environmental economics, not how to do it.)

Part 3 describes the approach IDRC has used to enhance the capability of researchers in this emerging field. This involves mentoring young researchers through regional networks. Since this approach may be useful in other emerging fields, it is described in some detail. This section then explores the impact the networks have had on their members' careers, and on the world's knowledge of the environment through the media, scientific journals, and the like.

The book concludes by summarizing some of the lessons that can be drawn from this field-building effort, and speculates about the future of environmental economics in the developing world.

I hope that this volume has something to offer a variety of audiences: members of government and non-governmental organizations who are interested in environmental economics but unsure about what practical tools it can offer; development assist -

ance agencies looking for cost-effective approaches to building capability in new fields; and teachers looking for examples of environmental problems and solutions from developing countries.

This publication, and the 15 years of work it describes, would not have been possible without the contributions of many dedicated people. Over the course of two decades in four regions, these colleagues number in the hundreds and are literally too numerous to mention by name. Foremost are the researchers who carried out intellectually challenging research under difficult physical conditions because they wanted to improve conditions in their communities. Supporting them is a group of mentors who travel from around the world to share their knowledge and who do so with a rare combination of sensitivity and insight.

The Beijer Institute and the University of Gothenburg have introduced countless researchers to the concepts and methods of environmental economics, and drawn them into a worldwide community of scholars in this field. (More about their role can be found in Part 2.) In addition, many supporting partners have helped finance these networks, some for long periods. The Canadian International Development Agency, the Danish International Development Agency (DANIDA), the Department for International Development (UK), the John D. and Catherine T. MacArthur Foundation, the Ministry of Foreign Affairs (Netherlands), the Ministry of Foreign Affairs (Norway), Norsk Hydro Ltd., the Swedish Agency for Research Cooperation with Developing Countries, the Swedish International Development Cooperation Agency, the United Nations Development Programme, and the World Bank have collaborated with IDRC in providing financial support to one or more of the environmental networks described in the book.

Finally, I would like to thank a group of people, small enough to name, who were especially close to this initiative. The four regional networks described in this book are each led by an

exceptional individual, someone able not only to plan and organize a large program but also to inspire and motivate every member of it. The advances environmental economics have made in the developing world owe a lot to the efforts of these four network directors: Herminia Francisco, Priya Shyamsundar, Francisco Alpizar, and Rashid Hassan.

The book itself has led to me to work with and learn from a highly professional group of colleagues from IDRC's Communications Division: Michelle Hibler, Bill Carman, Kelly Haggart, and Pauline Dole. Rufus Bellamy's research and creative suggestions for the book's structure have made it a more extensive and far better product than it would otherwise have been. Finally, this book would not have come about without the encouragement of IDRC's Jean Lebel to take on what seemed like an absurdly ambitious project — summarizing 15 years of research across three continents. The experience I've gained from working with these people has been one of the personal benefits of the book.

David Glover

*Program Leader, Environmental Economics
International Development Research Centre*

David Glover leads the Environmental Economics program at Canada's International Development Research Centre. He has worked at IDRC since 1982, first as director of Economic Policy and from 1993 to 2006 as founding director of the Economy and Environment Program for Southeast Asia. Dr Glover has a PhD in Political Economy from the University of Toronto and is the author of numerous publications dealing with environment, trade, and agricultural policy.

The Issues

Environmental problems often seem to have simple causes. For example, why is the rainforest in Brazil being cut down? When this problem came to the world's attention in the 1980s, blame was ascribed to the timber trade and the "burger connection." Cattle barons who cleared land to raise livestock for beef exports were the culprits. But this is by no means the whole story.

Brazil did not have an effective policy to define and manage property rights. Traditionally, acquiring title to land in remote areas was a matter of clearing a piece of forest and occupying it. Once the Amazon was opened up to colonization, land quickly became an open-access resource. Those who arrived simply exploited the forests and land, often paying little or nothing for it.

In addition, Brazil has a long history of hyperinflation. One of the few safe places to put money has been land, which was more

likely to hold its value than bank deposits. This fact, along with low rates of taxation on agricultural production, led people to clear as much land as they could. This resulted in profitable cattle, timber, and soybean production on cleared land, which led to even more clearing. A poorly designed land ownership policy, combined with a macroeconomic problem, were driving people's behaviour in ways that were rational from the individuals' point of view but harmful to the environment and wasteful of society's resources. When environmental economists showed that these failures of economic policy were a major cause of rainforest destruction, many of the subsidies and incentives for land clearing were removed (Binswanger 1991).

Insights like this make environmental economics an exciting and challenging discipline. Its power resides in identifying the underlying causes of environmental problems, as opposed to their symptoms. It does this by applying economic analysis to a broad range of environmental issues that have been neglected by economists in the past. These include the value of natural ecosystems and the cost of long-term environmental change.

This book shows how these ideas have been applied in four of IDRC's regional networks of environmental economists. It brings together more than 15 years of research and shows how this work has helped develop sustainable solutions to the environmental challenges faced by developing countries.

Basic principles

To many people, environmental economics seems like a contradiction in terms. We are used to being told that economic growth is the cause of environmental destruction. Little wonder, then, that people doubt the role of economics in solving environmental problems.

To some extent, this misperception has historical roots. Until recently, economics and the environment were treated as separate fields. The causes and effects of environmental degradation had been addressed largely by natural scientists, and the responses consisted mainly of legal and engineering solutions — “ban it or build a better mousetrap.”

Mainstream economists, meanwhile, have looked mainly at the allocation of resources through established markets. They have ignored the vital role of the environment as a source of resources and a sink for pollution and other economic by-products. When the global economy was relatively small, compared with the ecosystem that hosts it, this neglect had few practical consequences. Not so when the economy uses as many resources as it does today. This is the gap that environmental economics tries to fill.

Market and policy failures

What lies at the root of our environmental problems? Why are the things we value in the environment becoming scarcer every day, while each generation enjoys an ever-increasing abundance of manufactured goods?

A large part of the answer is that the market has been an immensely powerful force driving human ingenuity and innovation, leading to increasingly efficient applications of science and technology to production problems. Markets can be a very effective means of allocating goods and services and alleviating scarcity. If demand is growing for potatoes relative to carrots, the price of the former will rise, and farmers will grow more potatoes and fewer carrots. But this simple model does not apply for environmental goods and services, because they are generally not bought or sold in markets. As a result, scarcity increases without calling forth the necessary conservation responses.

What is it about the environment that leaves it outside the market, where its goods and services are not traded, or not traded at their true value? There are many reasons for this; we refer to them as market failures. Some of the most important ones are (Panayotou 1993):

- **Insecure ownership of or open access to resources.** These reduce the incentive to invest in the maintenance of a resource.
- **Externalities.** When a producer can shift the effects of pollution onto another agent, there is little incentive to limit the polluting activity.
- **Uncertainty.** Knowledge of many ecological processes and the human impacts on them is very poor and may never be reliable.
- **Myopia.** Individual agents may have shorter time horizons than society and pursue activities whose returns are higher in the short run but lower in the long run than more sustainable alternatives.
- **Irreversibility.** Some kinds of ecological damage are irreversible, but many decision-making processes undervalue the loss of options resulting from a decision.

But poorly functioning markets are not responsible for all environmental problems. Governments often prevent the market from functioning in cases where it would be effective. Policy failures include (Panayotou 1993):

- **Taxes and subsidies** that prevent price signals from reflecting scarcity;
- **Poorly conceived interventions** that exacerbate problems; and
- **Institutional interventions** such as public enterprises that embody perverse incentives for environmental performance.

Many government policies designed to benefit specific segments of society are designed without adequate recognition of their environmental impacts. Agricultural production (often including the water, fuel, and chemicals it uses) is subsidized, encouraging conversion of forest to farmland. Fishers are provided with subsidies for boats, gear, and credit without thought to the effects on depleted fish populations. (These errors are being repeated today in the widespread subsidization of biofuels.) Large investments in infrastructure are often carried out without proper assessment of their environmental impact. Even macroeconomic policies that, at first glance, have little relationship to the environment can have powerful environmental effects, as the Brazil example shows.

In short, “the prevailing configuration of markets and policies leaves many resources outside the domain of markets, unowned, unpriced and unaccounted for. More often than not, it subsidizes their excessive use and destruction, despite their growing scarcity and rising social cost. The result is an incentive structure that induces people to maximize their profits not by being efficient and innovative but by appropriating other people’s resources and shifting their own costs onto others.” (Panayotou 1993)

The search for solutions

This book contains many examples of market and policy failures. It also suggests ways to correct them, thereby improving the effectiveness of markets and policies in dealing with environmental problems.

The water problem facing many developing countries illustrates these principles. Asia faces water shortages almost everywhere, yet shortages in some areas coexist with overuse in others. (In many places, excessive irrigation has led to soil salinization.) Elsewhere, water is being put to inappropriate uses (growing low-value crops) while water for high-value uses (household consumption) is rationed.

What causes such inefficient use of a crucial resource? An important factor is that the prices governments charge for water are often a fraction of the cost of supplying it. This exacerbates water scarcity by encouraging overuse and does nothing to encourage conservation. It also jeopardizes the long-term sustainability of communities and livelihoods that rely on a water supply that cannot be guaranteed in the long run.

If environmental economics were used to assess the full cost of supplying water, including the effect that water extraction has on the environment, governments could charge prices that fully cover costs. Higher prices would discourage waste and provide incentives to develop water conservation technologies. The revenues could be used to maintain water infrastructure. Transfer payments could help the truly needy without creating harmful environmental side effects.

This is one example of environmental economics pointing policymakers toward effective solutions. Sometimes these options involve changing prices, often through environmental taxes, so that consumers get a true picture of a good's scarcity. Water and energy are two commodities particularly susceptible to underpricing. (So is pollution, though we don't often think of it that way. Taxing harmful environmental impacts requires producers to pay the full cost of their activities, including waste disposal. This will cause them to be more economical in producing waste in the first place.)

Other solutions involve creating secure property rights to previously unowned and unmanaged resources — the “tragedy of the commons.” When people own a resource, they have an incentive to maintain it and so to enjoy its benefits into the future.

In general, this approach relies more on incentives and local solutions to local problems than traditional regulations. Much of the pollution control mandated for firms in developed countries,

for example, has taken the form of technology standards: Firms are required to install clean-up equipment prescribed by legislation. If firms are required to meet emission standards (a limit on the amount of pollution they can emit), the same standards are usually applied to all firms.

Both types of standards ignore the fact that firms differ widely in their age, size, technical expertise, and so on. For a 20-year-old plant to install new equipment when it is due for overhaul anyway is cheap. For a new plant to scrap its current equipment is costly and wasteful. A less expensive approach is to create markets for pollution (for example, through tradable permits). In that way, firms that can reduce pollution cheaply will reduce it a lot, while those that can do so only at great cost will reduce it less. The same overall reduction can be achieved at lower cost to society. Since the main argument against tough environmental legislation is the cost it imposes, any approach that minimizes these costs should be welcomed.

Designing such policy instruments is an interdisciplinary task. Expertise from natural science and engineering is important to understand environmental impacts and control options. Economists can make important contributions as well — for example, estimating the monetary value of environmental benefits like improved health so that these can be intelligently weighed against the costs of safeguarding them; comparing the costs of alternative policies; assessing the impacts of environmental action (or inaction) on the poor; and showing how environmental policies can be financed. Part 2 of this book (beginning on page 13) shows how IDRC-supported researchers have addressed problems such as these using the tools of environmental economics.

Environmental economics in developing countries

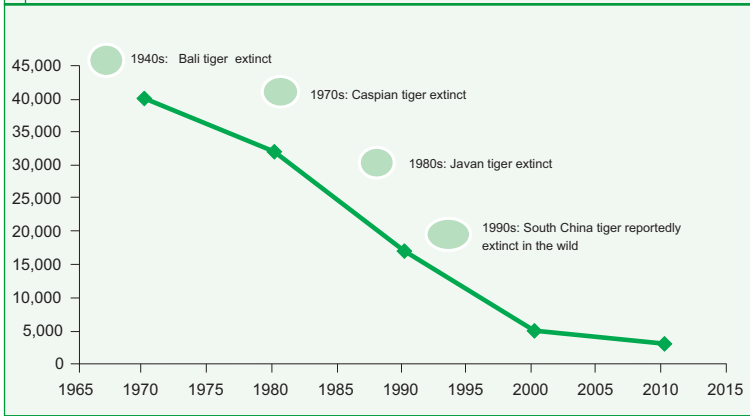
IDRC's decision to support environmental economics in developing countries was conditioned by the special relevance of this field for emerging economies. A vast number of poor people in developing countries depend on the environment for their livelihoods — from farmland and forests, wetlands and coastal areas. For these people, the environment is much more than a source of recreation — it is the basis of the economy.

This has two major implications. First, environmental degradation has a massive impact on people, making environmental protection vital. Second, rural people need to be involved in the environmental management of the land they use and live on. This means that good environmental policy must take into account not only the well-being of the poor, but also their participation.

The world is rapidly losing its biodiversity as species become extinct at an unprecedented rate (for example, see Figure 1). Much of this loss is occurring in the developing regions of the world, where the expansion of agriculture in frontier areas, poaching, and weak enforcement of protective measures are widespread. These losses affect not only local people, but also the rest of the world. Charismatic species like the tiger are part of humanity's heritage, from which everyone benefits.

But how should the costs of protecting such species be shared? As incomes grow in many developing countries, it is natural to wonder to what extent these countries will be able to finance measures to pay for endangered species protection. How do citizens of developing countries feel about conservation? Are they willing to make personal contributions toward it? If so, what mechanisms might be put in place to mobilize such contributions? How effective would the revenue collected be in meeting conservation needs? These are among the questions IDRC-supported environmental economists are probing.

Figure 1. World tiger population, 1960–2010.



Source: *Straits Times*, Singapore, February 13, 2010.

At the same time, many developing countries are rapidly urbanizing and industrializing — tackling in a massively truncated time period problems that the industrialized countries have taken decades, if not centuries, to deal with. The problems resulting from this are easy to see. City dwellers suffer serious health problems from unchecked pollution (even though the resulting medical bills often amount to more than it would cost to avoid the pollution). Inflows of foreign capital are discouraged when tourist sites become despoiled. Polluted water and traffic congestion reduce quality of life and raise the cost of doing business.

Environmental economics gives developing countries a unique tool to make development sustainable and to leapfrog over many of the mistakes that industrialized nations have made. They can do so by investing upfront in green technology to avoid clean-up costs later; setting up regulatory regimes that encourage innovation and efficiency; and giving businesses incentives to use environmental resources in a sustainable way.

Recognizing a gap

Environmental economics has existed as a discipline for more than 50 years, but its value has been recognized globally only since the 1992 Earth Summit in Rio de Janeiro. The need for an economic perspective was signalled by the summit's chair, Maurice Strong, who said, "We came into the conference believing it was about the environment; we left realizing it was about the economy."

The conference reached agreement on the need to act to protect the environment. But it also raised questions about which actions would be cost-effective, who would benefit from them, and how their costs should be shared. It was clear that these questions would be on the international agenda for many years and that insights from environmental economics would be crucial in answering them.

In 1992, however, this discipline was relatively unknown in developing countries. It was taught in few universities; indeed, neo-classical economics of any kind was just starting to be taught in China and Vietnam. IDRC felt that one of its most important contributions to a post-Rio world would be to help develop the capability in developing countries to analyze environmental issues from an economic standpoint.

From Rio to reality

IDRC realized that building capability on the scale needed would be a large effort. For this reason, and because other development organizations would probably want to be active in this area as well, IDRC invited like-minded donors to create a Sponsors Group. Its members would jointly finance a large capability-building project in environmental economics. This would both increase the amount of money available and avoid the duplication and competition that multiple projects would entail. Some of the first sponsors to join the group were the Swedish

International Development Cooperation Agency (Sida), the Danish International Development Agency (Danida), the Canadian International Development Agency (CIDA), and the John D. and Catherine T. MacArthur Foundation.

This effort began in 1993 with the Economy and Environment Program for Southeast Asia (EEPSEA).¹ It was hoped that if this initiative proved successful, it would be followed by similar projects in other regions. Asia was chosen as the launch pad because of its size and rapid economic growth. These make its environmental problems important globally as well as locally, through their contributions to transboundary problems such as acid rain, climate change, and biodiversity loss. As Maurice Strong put it, “The battle for sustainable development will be won or lost in Asia.”

At the same time, scientific organizations in other countries launched complementary efforts that paved the way for subsequent networks in other regions. Sweden’s Beijer Institute of Ecological Economics offered a series of short courses, writing workshops, and lectures that spread the perspective and methods of environmental economics. The University of Gothenburg, also in Sweden, provided places in its PhD program and carried out much collaborative research between Gothenburg faculty and alumni overseas. These activities were supported by many of the sponsors mentioned above, particularly Sida. Some of the participants in these activities went on to become leaders of the other regional environmental economics networks that ensued. Beijer and Gothenburg faculty continue to play important roles in the networks as advisors and resource persons.

By the late 1990s, EEPSEA had trained researchers from every country in the region and produced a large body of research, some of which had begun to influence environmental policies. The program attracted attention in the donor community, and as many as seven agencies sat on EEPSEA’s Sponsors Group.

¹ As of 2010, Sida and CIDA remain important members of EEPSEA’s Sponsors Group.

Encouraged by EEPSEA's success, other networks were soon established. The South Asian Network for Development and Environmental Economics (SANDEE) was created in 1999, and the Latin America and the Caribbean Environmental Economics Program (LACEEP) in 2005. A pre-existing African organization, the Centre for Environmental Economics and Policy in Africa (CEEPA), launched a capability-building program in 2007. IDRC and Sida are the principal sponsors of these networks.²

This book describes the work of the networks and the remarkable people they support. It shows how the principles of environmental economics have provided valuable guidance to researchers, raising important questions and suggesting sometimes surprising answers. It brings together insights from more than 15 years of research and assesses its impact on policy and the research community. It concludes by looking at the future of environmental economics in developing countries.

Environmental economics is not a silver bullet that will solve all environmental problems. But this book provides a picture of what it has achieved so far in developing countries and its potential to help shape a sustainable future.

² A fledgling network with a smaller budget and mandate was started in the Middle East in 2008 by the Economic Research Forum, with financing only from IDRC. As of early 2010, it has not yet produced research findings and so is not discussed in this book.

Environmental Economics in Action

Since 1993, IDRC's environmental economics networks have investigated a wide range of problems throughout the developing regions of the world. This work sheds light on the underlying causes of environmental degradation and suggests solutions that benefit people and the planet, pointing the way to sustainable development.

This chapter presents research findings from Asia, Africa, and Latin America. Since the Asian networks are much older than the others, most of the examples come from that region. But as we shall see, people in developing countries face many of the same environmental problems and react to them in similar ways. These stories have been chosen to show how the ideas and principles outlined in Part 1 can be applied to real world problems and the influence they have had on decision-making.³

³ All the research discussed in this chapter was done by network researchers. The original working papers from which these summaries are drawn are listed under the authors' names in the Bibliography at the end of the book.

Valuing the environment

Environmental economics helps in understanding how valuable the goods and services provided by the environment are to people. This is probably the contribution for which this field is best known. The concept of value used by economists is fairly straightforward: It can be measured by how much of one thing people are willing to give up to get something else. The simplest way to express this is in money terms — how much a person is willing to pay for something.

This is an admittedly limited view; it does not pretend to express intrinsic values or values to other species. (Of course, the knowledge that other species do benefit from a forest or coral reef can itself be valuable to people.) This is at once a limitation and a practical advantage. Expressing the value of the environment in money terms helps in making difficult trade-offs, particularly between environmental and non-environmental goods.

As noted in Part 1, environmental goods and services are usually not bought or sold in markets, so we can't observe prices for them the way we can for potatoes or automobiles. The amount people would be willing to pay needs to be inferred (for example, by seeing how a forest's ability to prevent soil erosion increases the productivity of downstream farmers) or established by asking directly. Environmental economists have developed a number of techniques to tease out these values. Later, we will see how they have applied those methods to come up with knowledge useful for decision-making.

What will we lose?

Development is largely a matter of converting the capital nature has given us into physical capital (farms, factories, infrastructure) and human capital (science, education, knowledge). Without converting some natural capital, we would still be living in the

Table 1. The effect of mangroves on mortality during the 1999 cyclone in Kendrapada, India.

Number of deaths caused by 1999 cyclone	392
With no mangroves: predicted mortality	603
With mangroves at 1950 level: predicted mortality	31

Source: Das (2007).

Stone Age. Yet some conversions are wasteful, causing us to give up more than we gain. The challenge, therefore, is to distinguish between productive and damaging changes to the environment.

Valuation plays an important role in such research because, while the benefits of converting a forest or wetland to other uses can be fairly easily quantified, it is harder to know what we are giving up. Sometimes it takes a tragedy to make us think deeply.

In October 1999, the state of Orissa in India was battered by a super cyclone that killed almost 10,000 people and caused a massive loss of livestock and property. Controversy ensued over whether the impact of the cyclone had been made worse by years of destruction of mangrove forests in the area. Many argued that a healthy barrier of mangroves might have buffered the effects of the storm and minimized the damages it caused.

Saudamini Das, a researcher from SANDEE, assessed the factors that affected the impact of the storm. She found that mangroves do provide important storm protection to people, livestock, and buildings. Her study also found that, had the mangrove forests been intact, more than 90% of the deaths due to the 1999 cyclone would have been avoided (Table 1).

To put an economic value on the protective role that mangroves play, Das looked at the mitigating effects of standing mangroves in the area, at government compensation payments, and at

uncompensated losses. She calculated that a hectare of mangrove forest land stopped damage worth \$43,000 in the district during the super cyclone.⁴ Of course, such severe storms do not occur every year. But even allowing for the fact that mangroves have no storm protection value during non-storm years, Das found a long-term protection value of about \$8,700. At the time, a hectare of cleared land was fetching \$5,000. Thus, Das showed that leaving mangroves as storm buffers generates more value to society than clearing them for development.

It is not surprising that Das's work attracted widespread interest. A workshop convened in Orissa to discuss her research drew 175 officials, parliamentarians, media representatives, and NGOs. Her study was distributed by the Food and Agriculture Organization at a meeting about Cyclone Nargis, which struck Myanmar in 2008, and has been used in many other deliberations on coastal conservation issues.

EEPSEA researchers led by Lourdes Montenegro were similarly motivated to assess a proposed land reclamation project in Cordova, Cebu, in the Philippines. Their study showed that the costs of reclaiming the land would outweigh its benefits when environmental damages were factored in.

Montenegro found that the project would have serious impacts, in particular reduced fish catches and a decline in tourist revenues resulting from damage to the coral reef. The study recommended that a section of coastline that had healthy coral cover should be excluded from the reclamation project. As a result, the town reduced its reclamation plans to a much smaller 46-hectare area away from the coral zone. In addition, the local government looked into expanding an existing marine sanctuary and establishing a new one.

⁴ Unless otherwise indicated, all dollar values expressed are US dollars.

What will we gain?

Researchers have looked not at avoiding losses from ill-advised development projects, but at the gains we could achieve by improving our environment. Such gains are easiest to see when it comes to improving people's health by reducing air pollution.

Sri Lanka's largest cement plant, at Puttalam, provides an example. A SANDEE study found that about 14% of the people living near the factory have respiratory illnesses linked to the air pollution it produces. By assessing the cost of these health problems, the study found that if the pollution from the plant were reduced by half, residents would benefit from lower health costs worth almost \$26,000 a year.

The study, by Cyril Bogahawatte and Janaranjana Herath, was one of the first attempts to understand the links between industrial air pollution and health in Sri Lanka. It provided a powerful argument for investing in pollution reduction technology at the plant. It also highlighted the need to review Sri Lanka's air pollution standards, which currently allow air pollution from industrial plants to exceed levels allowed under World Health Organization standards.

Many pollution problems — from arsenic water poisoning in Bengal to air pollution from cars in Colombo — have been assessed by IDRC's environmental economics networks. The results show again and again that the health benefits of reducing high levels of pollution generally exceed the costs of doing so — a bargain for society.

Finding out what people want

Projects to help the poor too often proceed without input from the people affected about what is important to them. Agencies that deliver water projects compete for aid budgets with those that deliver vaccines or mosquito nets. But rarely do we find out



what importance local people give to water supply versus cholera versus malaria. To proceed with development projects in the absence of such information is not only ethically questionable, but inefficient. Most projects eventually come to rely on financing from local people to become self-sustaining. If the projects do not address people's priorities, the chances of successful local financing are dim.

Cory Naz faced this problem in the Philippines when the national government passed a law requiring local municipalities to upgrade their solid waste management services — and to pay the costs themselves. Naz wanted to know if there were any services that people in the municipality felt strongly enough about to actually pay for.

The research team worked with the Tuba municipal government in Benguet province to see what features of garbage collection were most important to households and how much they would be willing to pay to obtain those services. They used choice modelling — a technique originally developed to help private companies assess demand for new products — to present households with a variety of attributes of waste collection and trade these off against prices (see Figure 2). These features included the frequency of waste collection and the type of equipment used to take away the garbage.

Naz had to deal with the possibility that people would respond strategically, signalling a lower willingness to pay than was actually the case, in the hope that this would lead somebody else to pick up the bill. It is difficult to eliminate this problem entirely, but the researchers took steps to minimize it. They stressed that the new law requires local financing of waste management. They also excluded the status quo from the options available to respondents.

Figure 2. Block C, Choice Set 1 for waste management services in Benguet province, Philippines.

Attributes of an ecological solid waste service	Options	
	1	2
A. Collection of waste	Municipal workers with garbage truck 	Barangay workers with hired vehicle 
B. Waste segregation required?	Yes No segregation, no collection	Yes No segregation, no collection
C. Frequency or number of times per week of waste collection	Twice	Once
D. Garbage fee per sack of waste, in Philippine pesos (PhP)	15 PhP per sack	8 PhP per sack
Please check your choice:	<input type="checkbox"/>	<input type="checkbox"/>
Why did you choose this option?		

Source: Naz and Tuscan (2005).

Naz found out that households' expressed needs – and their willingness to pay to have them met – were relatively modest. While people were aware of the state of the waste management system and its negative impacts, they had other priorities. Even the least costly package on offer would cost more than most people would be willing to pay. This provided evidence that the municipality should aim for fairly simple improvements in service.

Finding hidden benefits

Another role for economic analysis is to itemize the benefits from an environmental improvement and show who will enjoy them. Doing so may mobilize support from the beneficiaries.

Cao Jing looked at the situation in Guiyang, the capital of China's Guizhou province. With a population of more than two million, the city is a key industrial base for southwest China. It suffers from severe air pollution, mainly from old, inefficient coal-fired power stations, steel plants, and cement factories.

Cao wanted to find out how measures to reduce the amount of carbon dioxide from these sources would affect other pollutants in the city's air. Previous studies had shown that greenhouse gas reductions can bring substantial decreases in associated emissions, such as sulphur dioxide and particulate matter, which are hazardous to human health and the natural environment. Cao's goal was to value any such benefits to see if they could tip the balance in decisions about reducing greenhouse gas emissions. Unlike the climate change benefits of reducing pollution, the health benefits are directly experienced by Chinese citizens. If these benefits are larger than the costs of pollution control, then it should be in China's own interest to take action.

That is exactly what Cao found. Moderate reductions in greenhouse gases would produce health benefits that exceed the cost of achieving the reductions. Achieving very large reductions could be justified only by the climate change benefits that would result, benefits that would be shared between China and the rest of the world. Cao's approach thus identifies environmental measures that are in China's best interest, while suggesting a basis for sharing the costs of actions that benefit the whole world.

Finding hidden costs

Although it is conventional wisdom among development agencies that effective resource management must be based on local participation, this participation takes time — attending meetings and courses, sitting on committees, monitoring fellow villagers to see that they follow the rules, imposing penalties on those who do not. Time spent on these activities is unavailable for earning

income, so it has a real cost to people. These transaction costs are often neglected when community projects are designed. Governments tend to assume that they are minimal or that communities can easily absorb them.

To see how transaction costs affect the success of community-based resource management, an EEPSEA study from the Philippines examined one of the country’s most important coastal conservation programs, in San Miguel Bay. The researchers, Zenaida Sumalde and Suzette Pedroso, found that these costs were substantial and that community groups shouldered a large proportion of them, generally without financial compensation (see Table 2). It also found that these costs were key determinants of the program’s success or failure. (Athula Senaratne and Kalpa Karunanayake drew similar conclusions about the transaction costs of community-based aquaculture projects in Sri Lanka.)

Table 2. Transactions in community-based aquaculture in village irrigation tanks (San Miguel Bay, Philippines).	
Type	Transactions
Searching and information	Accessing scientific methods and species for culture
Collective decision-making	Organizing meetings, reaching agreements, coordinating with authorities
Enforcement and monitoring compliance	Organization of tank preparation actions, stocking, etc.
Prevention of free rider activity	Protection from poaching
Distribution of benefits	Organizing harvesting, monitoring the distribution of benefits

Source: Sumalde and Pedroso (2001).

Sumalde and Pedroso recommended that seed money be provided during the early stages of the project — the time when set-up costs are high but the benefits from improved management have not yet begun to flow.

Applying the principles

Part 1 outlined the key principles of environmental economics, particularly the ways that market and policy failures can lead to environmental degradation. This section looks at how IDRC-supported researchers have examined the role of prices and property rights in creating the conditions for sound environmental management.

Putting a price on scarcity

An important market failure occurs when resources are under-priced (or not priced at all). In such situations, increasingly scarce resources are overused and wasted while recycling and reuse are neglected.

This can be seen in forest management. The way timber companies pay to use forests can have a profound effect on sustainable forest use. A well-designed pricing policy can help ensure the efficient utilization of forest resources, a long-term sustainable harvest, and minimum ecological and environmental damage. A 2003 study by Awang Noor Abdul Ghani and Mohd. Shahwahid Haji Othman showed that peninsular Malaysia's pricing policy produced neither optimal financial returns for the government nor the best incentives for sustainable forestry practice.

The study looked at logging concessions in several areas and showed that the government was collecting a relatively small share of the total possible commercial value of peninsular Malaysia's forests. The authors warn that this could contribute to rapid depletion of forests, wasteful extraction practices, illegal

logging, and a bias against conservation. They recommended that the government switch to a competitive bidding system or a fixed royalty and premium price system pegged to the hypothetical value of logging sites.

Since 2003, the researchers have continued a close working relationship with the government, which has continued to study the pricing problem. Their work has helped the government set new royalty rates for timber, ones that more closely reflect the scarcity of this important resource.

Another example comes from Brazil, where LACEEP researcher José Gustavo Féres looked at whether new water-pricing legislation was doing anything to encourage water recycling by the country's industrial sector. Brazil has recently implemented wide-ranging water sector reforms, including the introduction of quality- and quantity-related water charges in its regulatory framework. Charges were first implemented in March 2003 in the Paraíba do Sul River Basin.

Féres's results showed that water reuse decisions were affected by water and capital prices. Paraíba do Sul's water charges do encourage firms to reuse water. Furthermore, firms sometimes try to evade pollution standards based on concentrations (that is, parts per million of pollutant) by diluting their waste water. Higher water charges would also discourage this practice and encourage genuine pollution prevention.

A Chilean study highlighted the power of prices in achieving environmental goals related to air pollution. Jessica Coria looked at a government program from the late 1990s that encouraged firms to use natural gas, rather than dirtier fuels, to reduce Santiago's severe air pollution. The program involved a rather complicated system of permits and inspections, which Coria found to be relatively ineffective in encouraging fuel switching. Nevertheless, many firms did adopt natural gas during this period. Why?

An economist's first instinct would be to look at what had happened to gas prices — and, indeed, natural gas did become much cheaper when imports of the fuel from Argentina became available starting in 1997. In fact, natural gas soon became the cheapest clean fuel available. What should we conclude from this? That governments cannot implement environmental regulations and that market forces are all-powerful? Perhaps the lesson is that governments should look for simple solutions before resorting to complicated ones. This story shows that people are responsive to changes in fuel prices. If Argentine gas had not fortuitously come on stream, policymakers could have achieved the same result by taxing dirty fuels, making gas relatively cheaper.

Creating a level playing field

Sometimes distortions in markets can arise from government policies. This can have unforeseen consequences for the environment, a problem highlighted by many IDRC researchers.

In China, Mao Xianqiang and Guo Xiurui investigated the factors affecting the supply and demand of natural gas to find out why it is not used more extensively. They found that, indeed, cost is a factor — natural gas is considerably more expensive than coal in most uses. Potential gas consumers also face fees for installation and distribution. But the price of coal does not include the harmful environmental effects of mining, transporting, and burning it.

The researchers also found that remnants of central planning introduced barriers to the efficient functioning of the market for fuels. For example, while some industrial consumers with large natural gas quotas were unable to use up their allocations, others consumers faced shortages but were unable to buy more on the market.

In light of their analysis, Mao and Guo argued that China should focus on creating a market-oriented system for natural gas production and retailing. They advised that foreign and private capital should be attracted to finance the infrastructure to produce, transport, and distribute natural gas. In addition, pollution charges should be levied on coal to create a level playing field for clean fuels.

The importance of property rights

Uncontrolled access to common resources is a fundamental market failure. The rights to use a resource can be private or shared, but in either case they need to be well defined, well understood, and enforced. If they are not, people will lack the incentives to conserve scarce resources and invest in their maintenance.

The importance of this topic, and the contribution economics can make to its study, was brought to the public's attention in 2009 when American scholar Elinor Ostrom won the Nobel Prize for Economics for her work in this field.

SANDEE has examined many facets of this subject and published the results in a book (*Promise, Trust and Evolution: Managing the Commons of South Asia*). The studies reveal a rich variety of experiences.

Rucha Ghate looked at three different arrangements aimed at promoting good management of common property: self-initiated efforts, NGO-promoted efforts, and the Indian government's joint forest management program. She shows that no single governance system best ensures sustainable forest management. Self-initiated efforts improve members' understanding of rules, leading to compliance. But problems emerging from the absence of well-defined community boundaries and those that require technical or financial help are best tackled with state support. Her study recommends a pragmatic mix of centralized and decentralized approaches.

Purnamita Dasgupta's work adds a dynamic aspect to the subject. We tend to think that people use common property to produce goods for household use — firewood, for example. But increasingly, farmers are selling the produce they obtain from common land. How does this affect the cohesiveness of community management?

Dasgupta looked at cooperatives in Himachal Pradesh, India, that collect fruit from nearby forests, then package and market them. These activities provide important benefits in terms of income, business experience, and access to markets. But do they provide incentives to maintain the common land on which the fruit trees grow?

The research findings were ambiguous. Wealthier households tended to shift their efforts to planting and maintaining fruit trees on their own land. Poor households lack this option and take all the produce from the common property. Since fruit trees provide an important source of income to the poor, they have a strong incentive to maintain the plantations. But can the system survive when the wealthier and more powerful villagers have little incentive to participate in its management — and might even like to see it converted to private property?

María Alejandra Vélez is particularly interested in the social impact of collective property. Over the past decade, the Colombian government has assigned collective land titles, covering more than 5 million hectares, to Afro-Colombian communities along the Pacific Coast. More than 150 communities have received collective titles in six departments of the country, benefiting more than 60,000 families. This process differs from traditional agrarian reform because the redistribution of land has not been to private individuals but to those communities that have a historical presence in those territories. Community members do not receive individual property rights but share in the collective titles assigned to each community.

Vélez found that the collective titling has changed the region's political landscape and local environmental governance in the Afro-Colombian communities. Her research showed that formal property rights created the incentives and legal tools to guard against encroachment by external intruders and promoted the definition of new procedures to manage the resources. What is more, the process of titling seems to have fostered a sense of empowerment that, among other things, has impressed local leaders with the importance of carefully managing their territory.

Financing conservation

Paying for benefits

One of the most practical applications of environmental economics is to identify ways in which environmental protection can be financed. Disagreement over environmental goals is much less prevalent today than in the past, but reaching agreement on how to pay for improvements is still hard to achieve. Developing countries face the additional challenge of providing livelihoods to the poor, many of whom live in environmentally sensitive areas. Are there ways to accomplish these objectives together, raising revenue from those most willing and able to pay for it, while supporting people who depend on natural resources for their way of life?

Thanks to the joint efforts of several institutions under the leadership of EEPSEA's Herminia Francisco, an approach that could achieve this is being implemented in one of the Philippines' most important nature conservation areas.

The Makiling Forest Reserve is an important nature reserve and watershed area 100 kilometres south of Manila. More than 50% of its area is still forested, and its soil is well suited to fruit and annual crops. Not surprisingly, the area is home to about

250 households and cultivated by 1,000 farmer-claimants. The reserve is also open to forest-product gatherers for whom the forest is a source of food, building materials, and other essentials.

Francisco and her colleagues have worked in the area to design market-based instruments (MBIs) for the reserve. These are policy measures that rely on prices and incentives rather than regulations to influence behaviour. Researchers see them as a promising tool to reconcile some of the conflicting demands on resources, such as forests.

Francisco's team divided itself into task forces to look at potential MBIs for water resources, recreation and ecotourism, land resources, and minor forest products. The task forces began by conducting consultative meetings with resource users. Their assessments revealed a high potential for MBIs. For example, the water task force discovered that domestic water users were willing to pay for watershed management on top of the water fees they currently pay. The group looking at recreation and ecotourism found that the current entry fee for the Makiling Botanic Gardens could be doubled or tripled, as could fees for other amenities.

Many of the team's recommendations were subsequently implemented. For example, fees for the use of the swimming pool within the reserve were doubled, and a fee was charged for access to points of interest. Fees collected in the reserve doubled the following year, and the project secured pledges of support for sustainable development in the reserve. Plans were drawn up to draft legal agreements with major stakeholders for the payment of watershed protection fees.

Ideas such as those explored in Makiling have much in common with an approach known as "payments for environmental services" (PES). These provide a way to compensate rural people for any income they might forego when their farming or forestry practices are restricted in a protected area and to reward them for contributing to the common good.

The underlying premise of PES is that ecosystems such as forests provide useful services to people, including erosion control, climate stabilization, and maintenance of biodiversity. Many of these benefits are enjoyed by people living outside the forest. But people living in the forest must refrain from damaging it in order to maintain the flow of services. Doing so will often require them to forego income from fuelwood extraction, land clearing for agriculture, and so on. Off-site beneficiaries may find it worthwhile to persuade the forest dwellers to maintain the forest by compensating them for this foregone income. The essence of PES, then, is a bargain between those who benefit from environmental services and those responsible for maintaining them.

The appeal of such schemes is obvious, and they have attracted much attention in recent development literature. One of the first experiments with PES in Asia was done by EEPSEA researchers Bui Dung The and Hong Bich Ngoc in 2004–2005. The study undertook a PES pilot scheme in the country's upland province of Thua Thien Hue, using actual payments to villagers. It lasted two years and involved 89 farmers. An annual payment was made to those farmers who adopted a forest management regime designed to protect the region's watersheds. This involved selective timber harvesting that maintained adequate vegetation cover and prevented soil erosion. The scheme also provided farmers with a more regular income flow and a stable supply of firewood.

The results were promising. The participation rate was high and the project had positive environmental impacts. These included a reduction in soil erosion (by almost 10 tonnes/hectare/year for the first four years) and in the extraction of natural forest products. These environmental improvements were achieved at very low cost: The average payment that households required to participate was about \$15 a year. Households were willing to join the project largely because other options to earn money from the land they work are limited.

The findings from a more recent study in Costa Rica were also encouraging. Rodrigo Arriagada examined a series of PES contracts undertaken between 1998 and 2004 and found that they appeared to contribute to an overall trend toward reforestation in the country.

Tapping the tourist market

Protected areas in developing countries are often undermanaged because of inadequate financial resources. High and growing demand for unique tourist experiences often coincides with low or non-existent entry fees to national parks. And wealthy foreigners willing to spend thousands of dollars in airfares to visit these sites often pay no more than local visitors with limited incomes.

Many researchers interested in financing wildlife conservation have looked at the economic benefits that protecting an area, such as a national park, can bring. Such studies often assess the economic value of the tourist traffic attracted to the area (using willingness to pay studies and other assessments).

IDRC-supported researchers have looked at this question in many countries, with similar findings. Their surveys show that tourists are often willing to pay substantial amounts in entry fees, particularly if they know that their money is going to protect the park and improve the facilities that help visitors enjoy it. The amounts involved can be significant: Himayatullah Khan found that even an entrance fee of \$0.25 to Pakistan's Margalla Hills National Park would generate annual revenue of about \$140,000, equivalent to 4% of the government's environment budget.

Studies of the value of sites to tourists can also justify the creation of new protected areas. For example, Thang Nam Do's study of the value of wetland conservation in Vietnam was used in preparing the document nominating the Tram Chim National Park as a Ramsar site. (The Convention on Wetlands of

International Importance, called the Ramsar Convention after the city in Iran where it was negotiated, is an intergovernmental treaty for the conservation and wise use of wetlands and their resources.)

Information for policy design

Putting things in perspective

In 1997, forest fires, caused mainly by land clearing for agriculture, engulfed 5 million hectares of land in Indonesia. The fires also produced a thick haze that spread throughout the region and affected about 70 million people. The problem received worldwide attention and the media reported numerous cases of respiratory illness, lost business from tourists, and threats to fragile ecosystems and endangered species. But the overall size of the catastrophe, which kinds of damage were most severe and which countries suffered most, was anybody's guess.

What contribution could environmental economists make in such a crisis? EEPSEA decided to mount a rapid response with a six-week study that estimated the total cost to humans and ecosystems from the fires and haze. The idea was, in part, to assess the severity of the event by putting a dollar value on the damages it caused. Surely even the most jaded politicians, ones unimpressed by the plight of trees and birds, would be upset by economic losses. Perhaps more important was to provide a breakdown of the damages and put them in perspective. It is hard to do this with physical measures alone — who's to say whether a million hectares of fires is worse than a thousand cases of respiratory illness? Putting the damages into a common unit of measurement — dollars — makes such comparisons more practical.

Indeed, the study revealed some surprising results. It showed that by far the largest damages from the haze were to people's health, not to business (as earlier media reports had implied). It also

Table 3. Summary of haze-related damages from the 1997 Indonesian forest fires (1997 US dollars, millions).

Type of loss	Lost to Indonesia	Lost to other countries	Total
Short-term health	924.0	16.8	940.8
Tourism	70.4	185.8	256.2
Other	17.6	181.5	199.1
Total	1,012.0 (72.5%)	384.1 (27.5%)	1,396.1

Source: Glover and Jessup (1999).

showed that 85% of the combined fire- and haze-related damages were suffered by Indonesia itself, giving the country a strong incentive to avoid future fires. (Indonesia's damages were equivalent to its entire foreign aid receipts that year.) The results were quoted widely in the international press and used in negotiations to develop regional plans to prevent future outbreaks (see Table 3).

The problem Prabodh Illukpitiya has looked at is more localized, but is important to countless people living near forests in developing countries: their reliance on non-timber forest products and the pressure this can put on the health of the forest. He focused on small farmers in the Badulla district of Sri Lanka. Pressure on natural forest reserves in the area is high, partly because people overharvest items such as firewood, food, and medicinal products. At present, they have little choice — their cash income is insufficient to buy substitutes for these products. At the same time, property rights are such that the careful collective management of the resource is not encouraged.

The author wondered how much villagers would have to raise their standard of living, and by what means, in order to reduce their dependence on the forest. The key seemed to be raising the productivity of small-scale farming in the area. Harvesting non-forest timber products takes time and effort. If agriculture were more

remunerative, would rural people invest their time in farming and leave the forest alone?

The researchers found that agricultural efficiency levels needed to improve by 10%–25% if local people were to make enough money to break their dependency on fuelwood from forests. The study suggested measures to help farmers improve the efficiency of their farms and to augment their incomes in other ways. More generally, it gave planners a picture of how big a change was needed in the rural economy before forest degradation might be reversed, and helped set priorities between this and other development problems.

Looking at the big picture

The insights provided by environmental economics can extend to the national level and illuminate the workings of the economy as a whole.

An EEPSEA study by Cao Jing looked at the potential impact of two environmental tax regimes on the movement of rural people to China's cities. Cao used a computable general equilibrium model to examine the impact of a fuel tax versus an output tax on the country's economy. She wanted to get a full picture of how the taxes would affect people's livelihoods and welfare, and how these would, in turn, affect rural-urban migration. Such migration is a central element of the Chinese economy, powering much of the growth in labour-intensive industries. But until Cao did her study, discussions about the use of environmental taxes ignored their impact on this crucial feature of Chinese society.

Her study found that both the taxes examined would discourage the flow of migrants from China's countryside to its cities. This would therefore exacerbate the current distortions in the country's labour market, in which there is a surplus of rural labour. A comparison of the impact of the two tax policy regimes showed that

the fuel tax is more efficient in terms of reducing pollution emissions and their associated environmental and health impacts; it also distorts the rural–urban migration process less than the output tax. The study thus identifies this as the preferable policy – the one with the best combination of benefits to the economy and the environment.

Another example of this kind of work comes from Indonesia, where excessive pesticide use during the 1970s and 1980s created serious environmental problems. These included pesticide poisoning, contamination of agricultural products, destruction of beneficial pest predators, and the development of pesticide resistance in pests. In response, the Indonesian government has been promoting integrated pest management (IPM) since 1989. By 2000, this policy had helped farmers reduce their pesticide use by about 10%. Despite this success, little analysis had been done on the impact of the IPM program on Indonesia’s overall economic development. This made it difficult for policymakers to decide how much to invest in the program in the face of competing demands for funds.

To provide the information needed to assess the impact of IPM, Budy Resosudarmo used a computable general equilibrium model to look at the impact of several scenarios on income distribution and national economic growth. These included halting the IPM program, doubling spending on the program, and increasing taxes on pesticides.

Resosudarmo concluded that IPM reduces pesticide use. He also found that, because the program improves efficiency in agriculture, it stimulates higher output in some non-agricultural sectors. (Without IPM, farmers tend to spray pesticides whether or not there actually are pests in their fields. With IPM, farmers control pests by releasing natural enemies and synchronizing planting seasons, resulting in reduced pesticide costs. Farmers trained in IPM also tend to acquire better knowledge about farming in general.)

Since implementation of the IPM program stimulates most sectors to produce more, he argues that it induces a higher rate of GDP growth. The more farmers adopt the program, the higher the country's economic growth will be.

According to Resosudarmo, the evaluation was influential in persuading the World Bank that the Indonesian IPM program is producing economy-wide benefits. "The Indonesian government cited our results in their proposal to the Bank for a new IPM loan program," he explains, adding that the research also led the government to include an economist in the national committee that plans and evaluates the IPM program.

Filling in the details

In Part 1, one of the most appealing features of pollution taxes was noted. By taxing the emissions of firms, rather than telling firms how much they can pollute or prescribing particular clean-up technologies, decisions about how much to clean up and how to do so are left to the firms that know their own operations best. Firms will compare the costs of paying taxes with the cost of preventing the emissions in the first place and, in most cases, do a bit of both. Firms that can reduce pollution cheaply will reduce it a lot, while those that can do so only at great cost will reduce less. The reduction desired by the authorities can be achieved at lower cost to society than would be the case through a uniform regulation.

Of course, the regulators will need to consult experts about how much pollution is safe to allow. Economists can provide advice about how high to set the tax — enough to cause firms to cut emissions by the desired amount, without unnecessarily increasing their costs.

A team of economists led by Jagath Edirisinghe from the University of Sri Lanka did just this for the country's rubber-processing industry, most of which does not comply with national water

pollution standards — or treat its effluent at all. They looked at the treatment costs of a large sample of firms and found a wide range of costs — precisely the conditions under which a tax is likely to achieve cost savings, compared to a standard. They concluded that a tax of \$0.23 per 100 grams of Chemical Oxygen Demand should lead enough firms to clean up to achieve the desired level of water quality.

Comparing options

Coal is king in South Kalimantan, Indonesia. Fuelled by growing energy demand in the region, coal mining accounts for much of the island's economic activity — and much of its environmental degradation. Strip mining causes erosion and loss of forest cover, while transporting the mineral to port damages roads and spreads dust as it goes.

Luthfi Fatah used a social accounting matrix to analyze the impact of the coal-mining industry on the economy of South Kalimantan province. He also used it to test the impact of five possible policies to regulate the coal industry and to identify the policy choices that would support economic development and environmental sustainability in the province.

The social accounting matrix allowed a detailed analysis of the mining sector and its interaction with other sectors: an appraisal of how important mining is to the provincial economy of South Kalimantan; how much of the money it generates gets to individual households; and what percentage of the benefits leaks to other provinces of Indonesia or other countries. It also assessed the differences between large- and small-scale mining companies.

Fatah simulated the effects of five hypothetical policies (see Table 4). Of these five policies, two stand out. Scenario 3 is economically the most favourable but results in increased environmental destruction. Scenario 1 produces the most favourable environ-

mental impacts for all indicators but has some negative economic effects. Thus, an initial analysis does not reveal a win-win solution but rather a trade-off between an economy-friendly policy and an environmentally friendly one.

However, the social accounting matrix allows us to look in more detail at these impacts. After all, it is not only the direction of the impacts but their magnitude that matters. On the whole, the negative impacts of Scenario 1 are relatively mild and may be an acceptable price to pay for significantly improved environmental performance. Although coal mining dominates the economy of South Kalimantan in terms of value added and output, this sector, together with other mining activities, absorbs only 2% of the

Table 4. Coal mining in South Kalimantan: a summary of simulation policies				
Policy	Government expenditure	Tax	Subsidy	Investment/capital
Stricter regulation of the small-scale miners	+5% on small-scale coal industry	-10% on small-scale coal industry	—	—
Enforcing more stringent codes of mining management practices on all miners in the region	+15% on coal industry	+10% on coal industry	—	—
Redistributing royalties and other revenues to lower-income families in the region	—	+20% on coal industry	+15% on lower-income households	—
Implementing land rehabilitation programs	+5% on land rehabilitation	+15% on coal industry	—	+10% on forest and agriculture
Introducing mine rehabilitation bonds	+5% on land rehabilitation	—	—	10% from coal industry

Source: Fatah (2007).

working population. The contraction of the industry that Scenario 1 would produce would affect a very small number of workers. And the households most affected by the contraction would be the relatively rich ones.

As much as we like to believe in win-win solutions, in the real world such cases are scarce. More often we must be willing to make hard trade-offs between desirable but incompatible outcomes.

Fatah's analysis makes the choices clear and points us toward Scenario 1 (regulation of small-scale mining). It produces the best environmental performance of the five options investigated. It does have economic costs, but these would be borne by those most able to afford them. And in the long run, the province may be able to attract investment into new activities, ones that provide healthier and less dangerous jobs. Implementation of this policy could be a first step in that direction.

A follow-up study by Fatah's co-researcher, Udi Udiansyah, provided policymakers with more targeted options. These would not solve all the environmental problems of the coal industry, but they would address some of its most immediate impacts, such as damage to roads and the spread of coal dust en route. Udiansyah's recommendations, supported by several local organizations, were heeded by the local government, which issued a regulation limiting the number of coal trucks using public roads as of July 2009.

Balancing costs and benefits

It is common sense that we should only do something if the benefit we get from that action is greater than the cost of doing it. This idea dates back at least as far as Benjamin Franklin, who described his own method of taking difficult decisions as follows:

“My Way is to divide a Sheet of Paper by a Line into two Columns, writing over the one Pro and the other Con. Then during three or four Days of Consideration, I endeavour to estimate their

respective weights...Thus proceeding, I find at length where the Balance lies... I have found great Advantage from this kind of Equation, which may be called *Moral or Prudential Algebra*.”⁵

Surprisingly, Franklin’s simple procedure is frequently ignored when passing laws or planning public investments. Lack of information is a common justification, especially for activities with environmental impacts. But as environmental economists develop techniques to value environmental services and put them in the balance sheet, this justification is becoming less persuasive.

Many IDRC-supported researchers have used cost-benefit analysis to assess environmental policies (before or after they are implemented) to see if public money for environmental protection is well spent. They have found many cases of policies and projects whose results more than justify their costs. But this is not always the case. Varaporn Punyawadee found that the pollution clean-up systems that had been installed in power plants in northern Thailand were too expensive for the modest benefits they produced. Cheaper options could have been employed and the resources saved invested in other environmental actions.

This is the sort of message environmental advocates are sometimes uncomfortable with. But the role of economists is not to justify environmental protection at all costs; it is to identify efficient uses of scarce resources.

⁵ Quoted in Boardman, A. et al., *Cost-Benefit Analysis: Concepts and Practice*. Prentice Hall, NJ: 2001.

Putting ideas into action

Focusing on enforcement

EEPSEA's work on the Indonesian forest fires gave the world a picture of the relative importance of different kinds of damage, hoping this would provide the parties most affected with an incentive to act. Another way that research can help policymakers set priorities is in applying policies. Passing laws is one thing; enforcing them is another. With limited staff to detect and deter lawbreakers, where should governments concentrate their efforts?

This was the problem facing authorities in Ghana, where many fishers were flouting regulations that banned them from using fishing equipment that used light to attract fish. This kind of illegal activity is one of the reasons behind Ghana's fishery crisis. In recent years, fishing has expanded and destructive methods have become widespread, threatening Ghana's inshore fisheries with collapse.

Wisdom Akpalu found that fishers who place the most value on short-term benefits from fishing are more likely to fish illegally. He found that they would be discouraged from using illegal light-attraction equipment if enforcement efforts and penalties are increased. The study also found that middle-aged fishers and those with the largest boats are the worst offenders. It therefore recommended that these categories of fishers should be targeted as surveillance is improved, enforcement is tightened, and penalties for using light-attraction equipment made more severe.

Barriers to policy success

Sometimes policies that appear to be well designed fail to take off, even when they offer improvements that seem to be in people's self-interest. Identifying barriers to change is another useful role for economists. Such studies can help redesign the policies, or identify necessary conditions for success, so that future policies can be applied in situations where they stand a chance of catching on.

An example of this kind of work comes from China, where — as in many parts of the world — farming, industry, commerce, and urban communities compete for dwindling water supplies. Some countries have tried to deal with this problem and share water efficiently and fairly by using tradable water use quotas. Such systems have not, however, been easy to implement.

Junlian Zhang looked at the performance of China's first tradable water use rights system in the city of Zhangye, Gansu province. The research was carried out to see how well the system performs in terms of its impact on water conservation and redistribution, and to see what barriers stand in the way of its successful implementation.

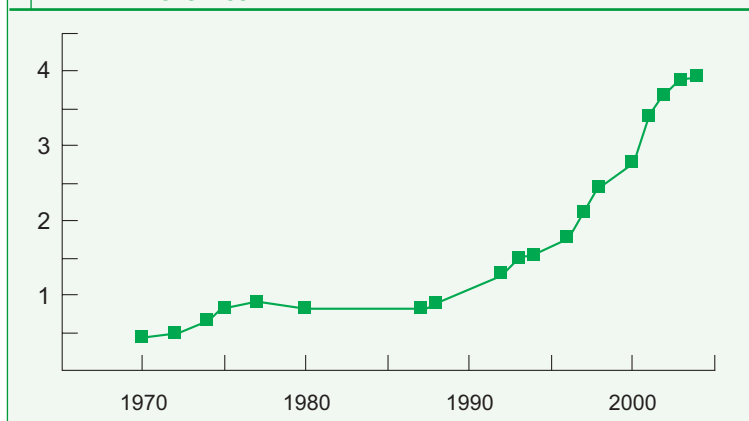
Under this system, every water user gets a water quota fixed by the government. Water use rights can be sold, temporarily or permanently. The system was set up because Zhangye is severely short of water. It is located in one of the driest area in the world and is mainly watered by the Hei River. Almost all the water from the Hei is currently extracted for irrigation and this has caused widespread desertification.

The study finds that the water use rights system is encountering significant problems. Farmers routinely ignore their groundwater quotas, drawing down the region's aquifer (see Figure 3), while water quota trades are few and far between.

Why is the system not being implemented? There were no geographical or technical barriers; good infrastructure allows water to be easily redistributed to almost all water users. Nor did farmers object to the system in principle. More than 96% of those surveyed by Zhang welcomed it, provided the government did not reduce their quotas.

The main barriers seem to be the farmers' poverty and risk aversion. This is understandable in a situation where there is no social security system for farmers, and non-agricultural jobs

Figure 3. Irrigation wells per village in the Zhangye study area: 1970–2004.



Source: Zhang (2005).

come and go. Accordingly, more than 98% of farmers said they were unwilling to adhere to water quotas if they did not get enough water for their crops (that is, if it meant switching out of agriculture into other occupations).

Even making changes within a farming system was a cause for concern. Farmers worried about the financial risks associated with less water-intensive cash crops, such as alfalfa. It was also found that water buyers had trouble buying water use rights from farmers with small land parcels (the norm in this region). Moreover, farmers were reluctant to sell water to the government, fearing that it would reduce their quotas and divert irrigation water to other sectors.

As a result of these fears, farmers exceed their groundwater quotas (where cheating is harder to detect) and adhere only to their surface water quotas. The system may thus be creating conditions for depletion of the aquifer.

Another problem is that local government agencies charge fees to manage water use. Because of budget constraints, all the expenses of these agencies, including salaries, depend on the fees charged —

which are, in turn, related to the amount of water used. The water agencies therefore have no incentive to force farmers to adhere to groundwater quotas.

Creation of an effective social security system would go a long way toward reducing the anxieties and increasing the flexibility of China's farmers. Their confidence in the system might also be increased if water quotas could be fixed for a longer term.

The problem of short-run costs as a barrier to long-term improvements is a common one. In Bangladesh, many hill communities are in trouble because their traditional slash and burn agriculture is becoming increasingly unsustainable. Farmers in these communities have to farm more intensively and this is causing a host of environmental and social problems. To help find a solution, SANDEE researchers looked at the economic and social feasibility of replacing shifting cultivation in the hill district of Khagrachari with settled agriculture and new soil conservation techniques based on orchards.

M.A. Monayem Miah and S.M. Fakhru Islam found that soil conservation can be profitable and that it brings significant environmental benefits. However, several things stop local farmers from adopting it. These include high initial costs, the time that it takes for the new system to become established and profitable, and problems associated with unclear land rights. In particular, the study found that poor farmers cannot afford to invest in an approach that will benefit them only in the distant future. The study concluded that there is a strong case for such farmers to receive loans and technical assistance to get them through the early lean years.

Looking out for the poor

A common concern about any environmental policy (environment taxes, in particular) is the impact it will have on the poor. A growing field of study in environmental economics deals with the impact of such policies on people at different income levels.

This is particularly relevant in discussions about climate change, where there are legitimate fears that poor people — who are already likely to suffer much of the impact of climate change — will bear a disproportionate share of the burden of averting it.

Most studies of this problem have been done in developed countries, where the employment and consumption patterns of poor people are quite different from those in developing countries. Some studies have ignored the second-order effect of tax changes. (It is not just a matter of rising transport costs — the relative profitability of large parts of the economy will change.) Finally, the possibility of redistributing carbon tax revenue to the poor is often neglected.

An EEPSEA study from Indonesia has helped to fill these information gaps. Arief Anshory Yusuf looked at the social impact of two policies that could be used to reduce greenhouse gas emissions in Indonesia: a carbon tax and a restructuring of fuel prices designed to reduce fuel use. This was the first research in Indonesia to explicitly assess the impact of climate-change policies on income distribution and poverty. The complexity of the problem called for a comprehensive assessment tool. Like Cao and Resosudarmo, Yusuf used a computable general equilibrium model to look at the big picture. It allowed him to see the indirect, knock-on effects of changes in carbon prices, as well as the immediate effects.

In contrast to some studies from developed countries, Yusuf's research found that the impact of these policies would not necessarily be regressive. In general, the better-off members of society would be most affected. This is largely because energy-intensive industries would contract as a result of higher carbon prices. These industries employ capital and skilled labour that are concentrated among higher income households and in the cities. The largely rural poor population gets most of its income from employment as informal agricultural or unskilled labourers. Sectors that employ

this sort of labour would experience less contraction or even expansion as the result of fuel price increases. As a result, the distribution of income in Indonesia would shift in favour of the poor as a result of these policies.

These findings provide a powerful rationale for developing countries like Indonesia to play a greater part in tackling climate change. This research was cited in a presentation by the Indonesian Ministry of Finance in January 2007 about policies to combat climate change. Subsequently, Yusuf was invited to several meetings with the Ministry of Finance, the Indonesian Planning Agency, and other bodies. He is now working closely with the Ministry of the Environment to investigate strategies to put Indonesia on a low-carbon development path.

A similar example comes from South Africa, where road transport is one of the most serious causes of air pollution, fossil fuel consumption, and associated environmental degradation. The country is already heavily dependent on road transport. Its rapid rate of urbanization, economic development, and population growth will make traffic-related problems even more severe in the future.

CEEPA researchers led by Emmanuel Ziramba assessed a tax on gasoline as a possible response and found it a viable option for reducing the amount of fuel used and the pollution it produces. They also found that a fuel tax would not necessarily impose an unfair burden on the poor. Indeed, when all forms of fuel use are taken into account, the study finds that such a tax could actually be progressive.

Providing a basis for compensation

The Fanjingshan National Nature Reserve in Guizhou province, China, was set up in part to safeguard the existence of the endangered snub-nosed monkey. But safeguarding the monkey will make life more difficult for people living near the reserve

who harvest products from the forest, particularly firewood. Under the new conservation plan, their rights to do so will be greatly restricted. People living elsewhere will enjoy the benefit of knowing that the snub-nosed monkey is protected without giving up anything to achieve it. This seems neither equitable nor likely to succeed in the long run. Unless local people are compensated for the income they forego, they will not be willing partners in the scheme.

Gong Yazhen set out to see if this gap could be bridged. She first surveyed people using forest resources and found that these accounted for about 8% of their income — income that would be lost under a strict conservation plan. She then surveyed people from a neighbouring area (Longli county), where people value the existence of the monkey but do not use the forest. She asked them how much, if anything, they would be willing to pay as a tax to compensate forest users for lost income and to cover some of the operating costs of the protected area. About 85% of respondents voted in favour of the proposed tax, which would yield about \$380,000 a year in revenue — almost enough to finance the conservation program. If applied to Guizhou province as a whole, with its population of almost 40 million people, the revenue would be enough to more than cover local people's compensation and the project's implementation costs.

Compensation is so important in environmental policy — and its principles so subject to misunderstanding and dispute — that EEPSEA felt it important to provide a course on this subject for Southeast Asian judges in November 2008.

Judges are increasingly faced with demands for compensation for oil spills, mining accidents, and other environmental damages. But many lack experience in this field and have to resort to ad hoc methods to make damage assessments. Furthermore, the concept of value used in economics differs in some respects from that used in jurisprudence. (For example, concepts such as replacement

value and restoration costs are common in the courts, but doubted by economists. The cost of restoring a broken egg to its original state would be astronomical; the value of the egg is not.)

As this field develops, economic arguments are likely to be brought into litigation, as they have been in North America. Courses like EEPSEA's will help judges understand these arguments and base compensation awards on sound principles.

The long and winding road

Environmental policy development is a technically complex and politically charged process. Objective information and analysis can help, but patience and persistence are essential. Sometimes it takes years before research findings are translated into action.

In 1997, EEPSEA supported a study by Sitanon Jesdapipat and Siriporn Kiratikarnkul to explore the upgrading and output pricing of small-scale hydroelectric plants near Chiang Mai in northern Thailand. The study was motivated in part by the country's search for sustainable forms of power, since more than 85% of its power supply was at the time derived from fossil fuels. The study's main conclusion was that, given adequate backing, micro-hydro projects could usefully complement the existing grid. The authors argued that benefits like forest conservation made investment in this form of renewable energy more attractive than conventional electricity production. They recommended that the government invest in connecting small-scale hydro plants to the national grid, while keeping open the option for villages to buy from the grid.

For years, little happened. Ten years later, the Thai government took up this recommendation and, in the 2007 fiscal year, committed \$4 million over three years to commercialize the electricity supply from micro-hydro plants.

Economics: Helping in the search for solutions

This chapter could not discuss all of the hundreds of studies that IDRC-supported environmental economists have undertaken. But we have tried to show the variety of problems the researchers have addressed. These affect people in urban, rural, and coastal areas, and are the responsibility of decision-makers at the household, municipal, national, and international levels.

The examples cited also show the wide range of applications to which environmental economics is suited. Research has shown the value of the environment to people; illustrated principles to guide our thinking about the root causes of environmental problems and ways to correct them; identified ways to finance environmental protection; and provided information to help design policies and to put them into practice. The examples also give a sense of how this research has influenced policy.

Some of the results confirm expectations: Natural ecosystems provide valuable services. Putting a price on scarce resources leads people to conserve them. Moderate reductions in air pollution are likely to pay for themselves in reduced health costs.

Other results are unexpected: The indirect effects of a policy change can be the most significant ones, so it is important to look at the big picture. Some studies had “negative” findings — that poor people are unwilling to pay for five-star environmental improvements or that it is possible to overinvest in pollution control as well as underinvest.

Findings like these may be inconvenient if our aim is to justify more environmental protection under any circumstances. But if our goal is make wise choices, spending money where it produces the greatest benefits, environmental economics can help.

Pioneers of Change

As we saw in Part 2, IDRC-supported environmental economics networks have shaped people's thinking about environmental problems, produced useful insights, and improved environmental policies. Equally important are the indirect effects the networks have had through the people they have supported. This chapter focuses on some of the talented individuals who have carried environmental economics forward into new areas, expanding its role in education, the media, and academic literature.

First, however, we look at how the networks have developed the skills of their members. Getting involved in an IDRC network can make a big difference to a researcher's career. The networks provide a great deal of support, tailored to individual needs. They also have tough standards for admission and demand high-quality results. It is, therefore, natural that they attract ambitious and dedicated people. By putting high-potential individuals into a supportive environment, the networks have led many researchers into important roles.

Competitive awards support high-quality work

To encourage research and provide practical support to researchers in the field, the networks provide research awards of between \$10,000 and \$30,000 for periods of 12 to 24 months. These are granted through a competitive process and are carefully reviewed and revised to meet strict criteria of quality and relevance.

Once a grant is approved, researchers generally return to subsequent network meetings to present an interim and a final report. This may not be practical in every case (for overseas PhD students, for example) but a written report every six months is always required. The output of the project is a report of between 20 and 40 pages for the network's working paper series.

Final reports are edited, then published in print, online, or both, with an accompanying policy brief that presents the findings in a digestible way and highlights their policy relevance. Authors are encouraged to submit a version to journals and the media. The networks provide technical support, contacts, and incentives to help them do so.

A model for building skills

How do IDRC's environmental economics networks operate? Each began with slightly different practices and each retains some unique features. (One of the advantages of maintaining programs like these over many years is the scope for experimentation, fine-tuning, and sharing experience.) Over time, a model has evolved that is similar for each network.

The approach emphasizes personalized support to promising young researchers. This is an alternative to the "big push" institution-building programs of the 1970s and 1980s in fields such as agricultural economics, which posted full-time advisors from the North in the South for years at a time, and financed full PhD fellowships at universities in developed countries.

The networks' approach is based on the premise that small doses of support, applied at the right times and tailored to individual researchers' needs, can be a cost-effective way to enhance research capability. This individual-centred approach is particularly useful in environmental economics, where researchers often need to gather information through specialized in-person survey techniques.

Short courses produce well-rounded researchers

Short courses, lasting from a day to a month, give busy professionals concentrated training designed specifically for their needs. The courses cover a variety of topics relevant to environmental economics:

Basic concepts in environmental economics: This is a core course of three to four weeks. It caters to researchers with previous training in mainstream economics and shows them how to apply economic thinking to environmental problems.

Specialized research methods: Many of the things that are most important to us, such as clean air and the beauty of the natural world, are not bought or sold, and thus have no price. How, then, do we assess their value? Environmental economists have developed indirect methods to infer how much people value such things, for example, by observing how much time and money they are willing to spend to visit a scenic site. These methods can involve as much art as science. Experienced teachers provide advice about how to apply these tools and interpret their results with care.

Environmental science for economists: Understanding how the economy and the environment interact requires a wide range of skills, and multidisciplinary teams are needed to tackle most problems. But such collaboration is easier if team members speak the same language and can critically assess each other's contributions. These courses have introduced economists to subjects such as forest ecology, marine biology, and climate science.

Emerging issues in environmental economics: New research topics arise continually as discoveries are made in climate science, for example, or as new issues emerge in international negotiations. Talks by people at the forefront of these fields inspire young researchers to make their own contributions to these debates.

Practical skills: Success as a researcher requires a wide range of practical skills, including the ability to design a useful and cost-effective research project, to raise money for it, and to convey the results persuasively to a variety of audiences. Universities emphasize the scientific aspects of research but generally expect students to acquire practical skills on their own. This is not necessarily efficient. Courses by writers, journalists, fundraisers, and others have helped develop well-rounded and effective researchers.

Trying to learn these techniques from textbooks is a bit like learning the theory of swimming. At some point, one needs to get in the deep end with an experienced coach and actually try to do it.

Furthermore, environmental economics is a small field. In its early days in developing countries, its practitioners tended to work in isolation. Rarely could an environmental economist walk

Workshops bring it all together

Twice-yearly workshops provide opportunities for practitioners to share experience in applying environmental economics so that they can carry out research of international calibre.

At the workshops, **plenary sessions** acquaint researchers with new topics or methods in the field, often demonstrating how a method was applied in an actual project, including practical problems that arose.

Concurrent **working group sessions** provide researchers with feedback from peers and experts about how to design and implement the research projects they have submitted. The reports presented in these sessions can be proposals, interim reports, or final reports. Often, researchers do dry runs of their working group presentations on the first day to make sure they are clear and complete.

The last day of the workshop includes a **wrap-up session** between each researcher and advisor. These meetings establish a personal contact between the two, which they can pursue by email over the coming months. These sessions also bring focus to the freewheeling discussions in the working groups, during which many ideas are tossed out and conflicting advice is sometimes offered. This is normal in environmental economics, a difficult field where first-best methods rarely apply and many second-best methods are available to choose from. The wrap-up sessions allow the researcher and advisor to weigh the options from the previous days' discussions and arrive at a plan.

down the hall to talk over a research problem with a colleague. The networks were designed to provide individuals with the kind of collegial support they lacked in their home institutions.

Today the networks provide a variety of services to their members. Each researcher is assigned an experienced advisor who offers suggestions from the early stages of a proposal through to the completion of a final report. Researchers and their mentors communicate through email and also face-to-face at network meetings. Training is provided through short courses and twice-yearly workshops (see boxes for further details). In each network, a small secretariat plans and manages the organization's activities. Each is based in a regional institution and draws on advice from a steering committee of local and international experts and policymakers.

The process is not a quick or easy one — environmental economics is not an easy field. But in the end it does provide rewards in terms of intellectual advancement and membership in an exciting and growing profession.

Developing careers

The careers that researchers pursue vary, depending on individual interests and circumstances. Malaysia's Grace Wong finished her PhD after her EEPSEA project and joined the NGO Conservation International as advisor for Corridor Economics and Strategies. Nghia Dai Tran became team leader for a mid-term review of Vietnam's Five-Year Natural Resource and Environment Plan (2006–2010). Reynaldo Cancio is now an economist in the Political, Economic, Trade and Public Affairs Section of the Delegation of the European Commission to the Philippines.

Even the most junior researchers benefit. “The advice and support I received was very stimulating and valuable not only for my research project but also for my formation as a young researcher,” says LACEEP researcher María Alejandra Vélez. “Furthermore, this grant helped me to open a new research agenda, which in turn helped me to consolidate my application for the academic job market.” Vélez is currently assistant professor at Los Andes University in Bogota, Colombia.

Other LACEEP researchers have received international recognition for their work. In 2009 alone, three researchers were recognized at the Annual Global Development Network (GDN) Awards and Medals, the world's largest annual international competition on development research, which honours completed research as well as innovative research proposals.

Catalina Trujillo received the First Prize Award in the Societies and Natural Resource Management category. Rocío Moreno and Jorge Maldonado received recognition in two categories:

- ➔ The First Prize Award for Outstanding Research on Development, for the proposal, “Governance and Adaptability of Fishing Communities in a Marine Protected Area in the Colombian Caribbean.”
- ➔ The Third Prize Medal in the Governance and Political Economy of Natural Resource Management category, for the paper, “Can Co-management Strategies Improve Governance in a Marine Protected Area? Lessons from Experimental Economic Games in the Colombian Caribbean.”

In addition to these GDN awards, Sebastián Villasante won the Karl-Göran Mäler Scholarship at the Beijer Institute of Ecological Economics and Stockholm Resilience Centre (Sweden). He also won the INESMA (Marine Studies Institute for Nutrition and Well-being) prize for scientific research in marine ecosystems in Spain.

Perhaps more revealing than a list of network alumni is an in-depth look at a few success stories, each individual coming from a different background and making a distinctive contribution to development. Below, we look at four women who are making a difference for people and the environment in different parts of the world.

From home to the policy arena: Saudamini Das



Part 2 began with a look at Saudamini Das's work on the storm protection value of mangroves in India ("What will we lose?"). A few years ago, Das would have seemed an unlikely candidate for such high-profile research. From a different generation than most network researchers, she was a homemaker who returned to her studies after 16 years away from research. A

member of SANDEE's advisory committee told Das about the organization and suggested she apply for an award to finance her PhD research.

At the time, Das had neither a computer nor access to the Internet. Working from a printout of SANDEE's guidelines, she submitted a proposal. The topic she chose reflected her own experience: "I was born in a small coastal village in the state of Orissa in India that used to get frequented by cyclones. I have vivid childhood memories of how we all, sisters and brothers, parents and grandparents, used to hole up in one room during the cyclones. We feared in our minds that trees might fall on our house and the roaring sea might engulf us."

A few months later, she found herself at a SANDEE workshop. This was the first time Das had ever made a presentation, but it persuaded the reviewers that she had what it takes to tackle a difficult project. The economics were challenging enough, but she also needed to understand the physical science of cyclones. For this, she consulted experts in wind patterns, meteorology, fluid dynamics, and storm surges, using their help to interpret information about the physical impacts of storms.

The SANDEE grant was helpful in two ways. First, detailed meteorological information covering a long time period is not cheap; Das would not have been able to obtain it without financial support. Second, SANDEE's advisors helped her make sense of the data by using state-of-the art techniques. Using the most advanced methods gave the study credibility, and helped it stand up to scrutiny when it attracted worldwide attention.

In the two years after the study was completed, Das presented her findings at 24 events (16 in India and 8 abroad), including workshops organized by the Food and Agriculture Organization, the International Union for the Conservation of Nature, the Government of India's National Disaster Management Authority, Land-Ocean Interaction in the Coastal Zone, and others. Her work has been published in the most prestigious scientific journals, including Proceedings of the National Academy of Sciences, where her findings stirred a lively international debate. Her study was also showcased in a short movie by the American Museum of Natural History. Through her careful work in demonstrating the protective role of mangrove forests, Das has laid the foundation for a promising career.

Pursuing academic excellence: Jane Kabubo-Mariara



Jane Kabubo-Mariara was among the first people to receive a research award from CEEPA and is now one of Africa's leading environmental economists. Her first connection with CEEPA was through short courses with its partner, the Beijer Institute of Sweden, beginning in 1997. She has undertaken three projects with CEEPA, on climate change, poverty among forest-dwellers, and

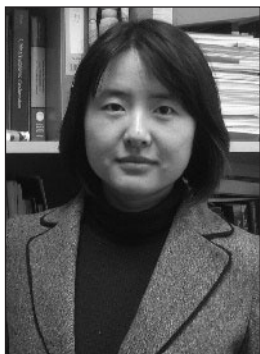
institutional problems in conservation. She has also been a Visiting African Scholar with CEEPA.

Her work with CEEPA has been presented at several international events, including the Third World Congress of Environmental Resource Economists (Kyoto, 2006); the Global Development Network's ninth annual Global Development Conference (Brisbane, 2008); the 16th annual conference of the European Association of Environmental and Resource Economists (Gothenburg, 2008); and the 10th biennial conference of the International Society for Ecological Economics (Nairobi, 2008). Her research has been published in leading regional and international journals, including *Ecological Economics* and *Natural Resources Forum*. She is a member of the editorial board of *Environment and Development Economics*.

Her productivity as a researcher has made her a valuable asset in teaching and supervising students at the University of Nairobi, where she is currently an associate director and senior lecturer at the School of Economics.

In addition to her CEEPA activities, Kabubo-Mariara has become one of the most competitive researchers within the African Economic Research Consortium and the Poverty and Economic Policy Research Network, for which she now serves as a resource person.

China's brain gain: Cao Jing



Cao Jing is another young researcher who has done several projects with her network, in this case EEPSEA. She began when she was an MA student by attending EEPSEA's one-month core course in 2000. This gave her the experience she needed to prepare the first research proposal of her career, which led to her first research project. (That work is described in Part 2, "Finding hidden benefits.")

Cao's mid-term report formed part of her application to the prestigious Kennedy School of Government at Harvard University, where she received a fellowship and pursued a PhD. Her thesis fieldwork, financed by EEPSEA, looked at the effects of environmental taxes on rural-urban labour migration (see Part 2, "Looking at the big picture").

Returning to China, Cao secured a teaching position at the School of Economics and Management, Tsinghua University, in Beijing. Her most recent EEPSEA project looks at the carbon intensity of China's energy use. Her strong research record has helped her compete successfully for several research grants from domestic and international sources, including the Chinese National Science Foundation and the Department of Education.

Cao's work looks at the big picture — policies and trends that affect the entire economy in sometimes unexpected ways. China's policymakers have found this very useful. Her decade of work on the joint benefits of reducing greenhouse gas emissions while achieving the domestic benefits of pollution control has influenced the government to take a more coordinated approach to pollution control and climate change. Her work on environmental tax reform has also attracted attention through the influential Chinese Economists 50 Forum.

Cao is also a valuable resource to EEPSEA, teaching in the network's 2008 course for Chinese researchers in Beijing and acting as resource person for the small research grants that followed. She likes to use interactive teaching materials from EEPSEA courses, including a game that gives students experience with emissions trading. Her use of novel teaching methods, her first-hand knowledge of Chinese policy issues, and her unique perspective on macro-environmental issues all resonate strongly with her students.

Bringing experience to the least developed countries: Cory Naz



Corinthia (Cory) Naz's work with the Tuba municipal government in the Philippines on solid waste is described in the previous chapter ("Finding out what people want"). While Cao Jing has brought much-needed analytical capability back to her home country, Naz has used her experience in the Philippines to help communities in two of the world's poorest countries: Cambodia and Afghanistan.

Naz first joined the Cambodia Development Resource Institute in Phnom Penh to help develop its 2006–2010 strategic plan for Natural Resources and Environment. The framework she used for the plan was economy–environment linkages and the role of market and policy failures as causes of environmental degradation. She also provided technical assistance to the institute's research project, "Managing Natural Resources for Poverty Reduction."

Next came a challenging assignment in Afghanistan in 2007, as institutional development and management advisor to the Balkh provincial governor. Her work, financed by the United Nations Development Programme (UNDP), contributed to the country's first provincial development plan. This involved consultations with government ministries, NGOs, international organizations, the private sector, and the newly elected provincial council to find out about their needs and priorities.

Solid waste management is a growing problem in Balkh province so Naz's experience in the Philippines was invaluable. Again she explored the practical aspects of solid waste management that matter to people: methods and frequency of waste collection, the

payment of user fees, and so on. Among the suggestions that came out of the consultations was using religious leaders to spearhead an information campaign on solid waste management.

From Afghanistan, it was back to Cambodia to work as lead technical advisor with the Ministry of Environment for a World Bank-financed project on strengthening environmental management capacity.

Naz is now in the Philippines, where she teaches courses on quantitative methods for policy analysis, and ethics and accountability in the public service at the University of the Philippines' National College of Public Administration and Governance. Most of her students are senior government officials and staff of congressmen and senators. She often uses EEPSEA materials in her courses.

Moving on to bigger things

Sometimes the relatively small projects financed by the networks are springboards to larger ones. SANDEE researchers Joyashree Roy and Indrila Guha received a \$135,000 grant from the South Asia-Pacific Network for Global Change Research for a three-year research project on improved management of coastal systems in South Asia. This work built on Guha's SANDEE research on the Sundarbans wetland in India and Bangladesh.

A consortium headed by Rajendra Pachauri won a £250,000 grant from the UK Natural Environment Research Council to undertake an analysis of the connection between poverty and the environment in India and the Hindu Kush Himalayan region. Eight of the 25 key people in the project are associated with SANDEE.

Contributing to the world's knowledge

The environmental economics networks encourage and assist their researchers to publish their work in leading scientific journals. One motive is to get the findings and recommendations out to

wider audiences. Another is to enhance the authors' credibility: Policymakers tend to listen more seriously to academics who have established solid reputations for themselves through publication. The researchers have shown a keen interest in publishing. In a typical year, the networks produce about 25 journal publications.

Evidence shows that people read this work. A marketing review by Cambridge University Press of the journal *Environment and Development Economics* showed that three of the top 10 articles viewed online between May 2005 and May 2006 were the results of SANDEE-supported research. A paper by SANDEE author Bhim Adhikari occupied the top spot as the most-viewed article. *Environment and Development Economics* is not only a prestigious journal. It is also one of the most effective channels to reach people interested in applying economic approaches to environmental problems in developing countries.

Drawing in the media

As important as reaching academics through scientific journals is reaching the general public and policymakers through the media. However, academics are sometimes reluctant to be interviewed, for fear of being either grilled by aggressive reporters or misquoted. They may not know how to present their work in a way that catches a reporter's attention. The networks work hard to help their researchers overcome these hurdles.

For example, a "meet-the-media" session is often a part of EEPSEA's biannual workshops. This began in 1999, when researchers were briefed on how best to market their work to TV and newspapers and how to work comfortably with reporters. In parallel, some regional journalists were briefed on environmental economics and helped to develop stories based on EEPSEA research.

Climate change: Getting the media's attention

Even if the world takes decisive action today to reduce the emission of greenhouse gases, past emissions will lead to some changes to the world's climate. Knowing where the most serious impacts might occur is valuable information. In 2009, EEPSEA launched a study to identify the areas of Southeast Asia most vulnerable to climate change, presenting the information in a map (see Figure 4).

The research, which covered 530 sub-national areas in seven countries, generated hazard maps for five climate-related risks: cyclones, floods, landslides, droughts, and sea-level rise. The project also considered the human and ecological sensitivity of an area, and the adaptive capacity of its population. The study showed that Jakarta is the region's most vulnerable area. Also found to be particularly at risk were Bangkok; Kelantan and Sabah in Malaysia; Vietnam's Mekong River Delta; and all of the Philippines.

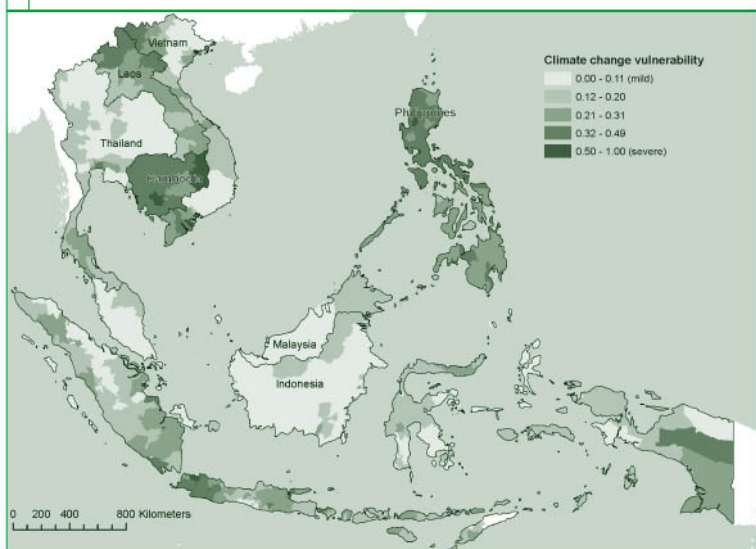
Following publication of the report, an article on the vulnerability map appeared in the *Jakarta Post*. Since then, interest from the media and policymakers has been remarkable. By the end of 2009, a Google news search returned more than 172 citations for the report. One of the Philippines' national daily newspapers, the *Business Mirror*, dedicated a centre spread to it. The article highlighted the urgency of the problem and called for action.

Several other online dailies have featured the map and interviews with EEPSEA's director. The map's Indonesian launch in May 2009 stirred international interest. A United Nations Television production crew documented the event and interviewed the researchers. Similarly, Indonesia's national dailies and online news websites (such as the *Jakarta Post*, *Bisnis Indonesia*, and *Tempo Interaktif*) featured articles that highlighted the significance of the study for Indonesia.

The maps have subsequently had a significant impact on policymakers. State senators and former members of the Philippine Congress and Senate have supported the use of the map to change the country's perceptions of climate change.

Such work has borne fruit, and research carried out by the networks is frequently quoted in the media. This usually results from researchers contacting local media. In October 2008, Udi Udiansyah appeared on an Indonesian television station, TVRI, in a one-hour interview about the impacts of coal mining on the economy and environment (see Part 2, "Looking at the big picture"). The program was interactive, with the station opening telephone lines so that viewers could call in and ask Udiansyah questions.

Figure 4. Climate change vulnerability in Southeast Asia.



Source: EEPSEA (2009).

Most of the callers gave positive feedback and affirmed the research findings. Many encouraged the local government to use the research findings to make the changes needed.

Educating students

One of the most important ways to ensure that a new field takes root and spreads its ideas throughout society is to introduce it into schools and universities. When the environmental economics networks began in 1993, only a handful of universities in developing countries offered courses on this subject. In Vietnam and China, neo-classical economics courses of any kind were close to non-existent.

Today the situation is very different. Environmental economics courses are available in most countries in Asia and Latin America, with Africa catching up by offering joint courses shared by small countries. In many cases, the courses were introduced through the efforts of network researchers, usually using teaching materials developed for network courses.

For example, Shabib Haider Syed has introduced environmental economics into the curriculum at Forman Christian College (a chartered university in Pakistan), basing the course on the one he took at SANDEE. Syed was recently promoted to chairman of the department of economics and has submitted a proposal to the university authorities to add more courses related to environment, natural resources, energy, and sustainable development.

Selliah Thiruchelvam has introduced three environmental economics courses at the Vavuniya sub-campus of the University of Jaffna in Sri Lanka (Environmental Economics and Resource Management; Research Methods for Environment and Resource Management; and Sustainable Development and Environmental Policy). Thiruchelvam also developed a new course on Water Resource Economics at the Postgraduate Institute of Agriculture, University of Peradeniya, Sri Lanka.

The networks' biggest contribution to teaching has probably been in Vietnam. Some of this has taken place through assistance to individual courses and teachers. Perhaps more significant was a program developed in response to the Vietnamese government's decision to make environmental economics a required course in all of the country's economics and business universities. The implication of this decision was that many professors who had never studied, let alone taught, environmental economics would soon find themselves responsible for developing courses on this subject.

EEPSEA's response was to offer a three-week course to the prospective teachers. It not only provides a model curriculum, but also teaching materials suitable for Vietnam (many based on publications from EEPSEA research in Vietnam) and suggestions for modern, interactive teaching methods. The result has been better-designed and better-taught courses throughout the country.

Applying research to development

In many cases, research findings or the methods employed by network researchers have been applied in research or development projects elsewhere. For example, Tran Dinh Thao's research on the benefits of soil conservation in the mountainous regions of northern Vietnam was included in the training materials of a project to build capacity in natural resource economics and management, supported by the governments of Australia and Vietnam. The materials were distributed nationwide to extension workers. This resulted in local authorities extending assistance to farmers in Hoa Binh and Ha Giang provinces. Each farming household received 5 million Vietnamese dong (about \$400 at the time) to build terraces.

An EEPSEA paper — “What Makes a Good Policy Paper? Ten Examples” — was translated into Lao and used in a World Bank short course at the Policy Research Center of the National Agriculture and Forestry Research Institute under the Lao Ministry of Agriculture and Forestry.

Even the capacity-building model used by the networks has been spread by network researchers. EEPSEA researcher Billy Manoka of Papua New Guinea is a member of the Oceania Development Network, a group formed to help researchers in the Pacific region interact, share knowledge and skills, foster team research, and build and update regional databases. The group has adopted many aspects of the network model and used EEPSEA teaching materials on “How to Design a Research Project” at its inaugural workshop in Port Moresby.

Country-to-country collaboration

The Vietnam–Philippines connection

The networks' member countries differ widely in terms of income, economic systems, and research capacity. This is a challenge when designing a program of interest to each, but it can also provide opportunities. While the countries differ, they generally have more in common with each other than they do with developed countries. Developing countries with higher incomes have gone through many of the same growing pains as those at a prior stage of development. In many cases, the research capacity in the higher-income countries can be used to transfer experience to people in lower-income countries.

EEPSEA first exploited this advantage extensively in a series of collaborative activities involving researchers and trainers in Vietnam and the Philippines in the mid-1990s. The approach is still being used successfully today.

When EEPSEA began in May 1993, identifying participants from Vietnam was not easy. Few Vietnamese spoke English, and those who had studied economics had generally done so in universities in Russia or Eastern Europe. The Marxist economics they learned there provided little or no preparation for the kind of analysis used by environmental economists elsewhere.

EEPSEA identified two Vietnamese university professors who had recently completed master's degrees in agricultural economics at the University of the Philippines at Los Banos: Do Van Xe and Phan Thi Giac Tam. They became EEPSEA's first links with Vietnam, organizing the first of two five-week courses in environmental economics in Ho Chi Minh City. Two of the instructors were from the Philippines.

The courses were followed by a five-day project development workshop in 1996. Resource persons worked with the course graduates to develop projects on the environmental economics of forests, mangroves, agrochemicals, and urban pollution. Again, two Filipinos were among the resource persons. Some of the graduates of the program went on to pursue advanced degrees at the University of the Philippines at Los Banos. Those from the National Economics University were influential in establishing an environmental economics department. They also played a role in the subsequent decision to make environmental economics a required course in the core economics curriculum at Vietnamese universities (see below, “Institutionalizing environmental economics”).

Other linkages promoted the application of research results. Agnes Rola, resource person to the research project on health impacts of agrochemicals, visited Vietnam to discuss with local policymakers the findings of the study and the Philippines’ experience in limiting the excessive use of agrochemicals. Today, many national institutions are building local research capacity by managing training and small research grants for local researchers, with network support. Programs similar to the Vietnamese one have been sponsored by EEPSEA in China, Lao PDR, and Indonesia. The resource persons for these in-country programs are usually alumni of previous EEPSEA activities.

Creating demand

Decision-makers can hardly be expected to use environmental economics if they are not aware of it or the contributions it can make. With this in mind, SANDEE took the lessons from its research to parliamentarians in 2007. Invited by UNDP and the Inter-Parliamentary Union, SANDEE’s program director presented some of the network’s work to a pan-Asian group of parliamentarians and acted as a resource person to this group.

SANDEE's analytical approach to poverty and environment was much appreciated, but the meeting highlighted how much more needs to be done. SANDEE organized a workshop on poverty, economic development, and environmental change for 25 policy-makers from South Asia in December 2007, in collaboration with UNDP and UNEP in Bangkok. The workshop helped identify areas for analysis and reform. Prospects are good for more work with this group, thereby increasing governments' demand for research.

Institutionalizing environmental economics

A sign that governments find environmental economics research useful is their willingness to identify research needs and finance or conduct the research themselves. Ultimately, it is this sort of institutionalization of the discipline that the networks strive for.

Years of collaboration between EEPSEA, Vietnamese researchers, and the Vietnamese government have led to a breakthrough on this front. The Vietnamese government has recently established a unit that, among other things, carries out environmental economics research, particularly valuation of environmental services.

Much of the impetus for this has come from EEPSEA researcher Do Nam Thang. A long-time staff member of the Ministry of Natural Resources and Environment, Thang went on academic leave in the mid-2000s to pursue a PhD at the Australian National University. His thesis research, supported by EEPSEA, assessed the non-market values of wetlands in Vietnam. Thang was awarded a PhD and became one of the five Young Water Scientist Award finalists at the International Rivers *symposium* 2008 in Australia.

On returning to his home country, Thang found his research well regarded by colleagues at the Ministry. His findings have been used as input for policy discussions on the costs and benefits of

alternative management plans. Following his recommendations, the Ministry has launched several environmental economics research projects. One involves valuation of the Tam Dao National Park; another estimates the damages from air pollution and oil spills. Each project stresses the adaptation of valuation methods to the local context.

This work is conducted under Thang's direction by the newly created Environmental Science Division in the Ministry's Institute of Science for Environmental Management. The division has also launched a program to mainstream market-based instruments into environmental policy. More environmental valuation projects are planned to assist environmental policymaking in Vietnam.

This is not the only case where environmental economics has been institutionalized in Vietnam. Of similar importance was the creation of the Vietnam Association of Environmental Economics in 1999. Many of the association's leaders are EEPSEA alumni. Its annual conference brings together researchers and policy analysts from universities and government to discuss the country's environmental problems and the role of economics in addressing them. The association receives a small grant from EEPSEA to finance the travel of participants from remote areas of the country, but is otherwise self-financing. It also publishes a journal that features, among other things, policy briefs from EEPSEA projects from around the region, translated into Vietnamese.

These developments in Vietnam are among the most encouraging impacts of the networks' efforts. They hint at what the future might hold for environmental economics in developing countries — a subject to be explored in Part 4.

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Lessons and Future Directions

The state of environmental economics in developing countries is very different today from its beginnings in the early 1990s. The subject is widely taught in universities, and researchers from the South make significant contributions to the scientific literature. These contributions are noticed, as shown by the high profile of SANDEE's researchers in *Environment and Development Economics* and the attention EEPSEA's work has received in local and international media.

The profession has also shown that it has much to contribute to decision-making about environmental protection. Above all, it provides a way of thinking about environmental problems, identifying their underlying causes and applying economic principles to design effective solutions.

Of course, there are areas where its applicability is limited. For one thing, economic analysis can only be as good as the physical science on which it is based. Where information is scarce or highly uncertain, the best any analyst can do is provide a range of possible outcomes. Projecting costs and benefits into the distant future is difficult and putting monetary values on human life is always controversial. Economists can best ensure that their analyses are used wisely by being explicit about the methods and assumptions they employ and the degrees of uncertainty they face.

Perhaps the main lesson to be drawn from the research described in this book is that things are not always as they seem. Conventional wisdom holds that energy taxes hit the poor more than the rich — except, apparently, when they do not, as Arief Anshory Yusuf showed in Indonesia. Reducing air pollution is always a good thing — except when it is carried too far, and the costs exceed the benefits it produces, as Varaporn Punyawadee's case study in Thailand showed. This is precisely why we need research. Good decisions cannot be based on lazy thinking, rules of thumb, or conventional wisdom.

Lessons for policymakers

The stories in Part 2 suggest several conclusions about the use of economic principles in environmental policymaking.

First, the environment provides valuable services to people. The value of these services needs to be taken into account when the costs and benefits of policies and investment projects are assessed.

Second, it is important to find out what people want and can afford when designing development projects.

Third, the knock-on effects of a policy can be as important as the immediate effects in determining the policy's impact, including who gains and who loses in the long run.

Fourth, market-based instruments, such as environmental taxes, can be an effective way to change environmentally damaging behaviour. Often these provide opportunities to raise revenue at the same time.

Fifth, it is not enough to design policies based on good principles. Implementation and enforcement are equally important.

Lessons for policymakers

- ➔ Research results can be surprising: Keep an open mind.
- ➔ Investment decisions need to take into account the value the environment has to people.
- ➔ The indirect effects of policies can be as important as the direct ones.
- ➔ Market-based instruments can change environmental behaviour while raising revenue.
- ➔ Good policy design includes implementation and enforcement.

What other lessons can be drawn from this 15-year experience in field-building, particularly for agencies interested in applying this sort of approach?

First, good environmental research usually draws on contributions from many disciplines. In particular, social and economic analysis needs to be based on a good understanding of the physical environment and how it reacts to the stresses people put on it.

Second, agencies sponsoring development research should trust their partners when it comes to identifying research topics. The networks play a useful role in acquainting researchers with methods and topics at the cutting edge of the field, and in helping researchers ask policy-relevant questions. But researchers generally have good intuition about what problems are important in their countries. Many of these problems affect the communities they live in, and researchers often have, or can establish,

contacts with local decision-makers. Part 2 contained many examples of environmental problems that would probably not have been addressed if they had not been identified by local researchers.

Third, building a field is a big job. It takes time. These networks took years to develop efficient ways of operating; to build up their researchers' skills; to establish contacts with media and policy-makers and learn how to communicate effectively with them. Once the start-up phase is over, the benefits such programs produce can be very high. This is the time to stay with them, not declare success and move on.

Fourth, a task like this is more than one agency can do on its own. IDRC has worked with many like-minded agencies over the years. Sida, the University of Gothenburg, and the Beijer Institute, all in Sweden, have been particularly effective in sharing their resources and expertise. This experience shows that donor collaboration is feasible. It is something to bear in mind whenever many donors start to encourage work on a popular topic: Collaboration is likely to be more productive than competition.

Lessons for sponsors

- ➔ Networks are valuable where local institutions are weak.
- ➔ Good research draws on many disciplines, including natural and social sciences.
- ➔ Local problems should be identified by local researchers.
- ➔ Patience is essential: Building a research field takes time.
- ➔ More is achieved when donors collaborate rather than compete.

Future directions

What is IDRC's long-term goal for these networks, and how close are we to achieving it?

One way to answer this question is to look at the environmental economics profession in developed countries, which do not have networks like the ones described in this book. And yet the profession there is, if not thriving, relatively healthy. How does it maintain itself and train new generations of researchers and teachers?

It does so largely through the voluntary contributions of its members. University professors are, of course, paid to teach and carry out research. Supporting universities is an important role for national governments; without it, little can be done to advance knowledge. But in countries where universities have adequate funding, much of the work that maintains quality standards and brings new researchers on stream is self-organized. Professors mentor their PhD students. Students get their first research experience by working on their professors' projects. Conferences and journals provide places for researchers to see and criticize each other's work. Professors try hard to get their work published in top journals, because universities require them to do so in order to get promotions. Authors rely on their colleagues to comment on draft papers before they submit them.

Some of these activities are organized through professional societies. Most countries in Europe have national associations for environmental economics. There is also one for the continent — the European Association of Environmental and Resource Economics — which holds well-attended annual meetings.

The IDRC networks encourage developments like this, as discussed in Part 3. Researchers who have gained experience through the networks' training and research programs not only expand and improve university teaching in their own countries, they also

teach people from other countries in courses offered on a regional or national basis. Researchers act as discussants for each other's work at most of the biannual workshops, developing the ability to offer constructive criticism diplomatically. In general, the aim is to develop a professional culture in which people rely on their own informal network of colleagues for advice and support.

How close is that goal to being achieved? The answer varies considerably from place to place. India is a large country, well endowed with universities and domestic sources of support for research. For that reason, SANDEE's role in the country has been to draw on senior Indian academics as teachers and resource persons and to support researchers from exceptional backgrounds, like Saudamini Das, or ones in disadvantaged regions.

India has many of the ingredients for a self-supporting environmental economics community. Cambodia and Lao PDR clearly do not. They have only recently established universities. In any case, they are so small that they cannot expect to develop their own journals and professional associations. Many small countries in Africa, Central America, and the Caribbean are in a similar situation.

For these countries, regional collaboration is essential, so that they can supplement the support they get from colleagues at home with expertise from neighbouring countries. This is, of course, immeasurably easier today than it was before the Internet, when the first of these networks was established.

The success of the Vietnamese Association of Environmental Economics, described in Part 3, is an important step in this direction. So was the establishment of the Latin American and Caribbean Association of Environmental and Natural Resource Economists. (ALEAR, its Spanish acronym, is also a Spanish verb meaning "to form an alliance.") As a regional organization, ALEAR has the potential to offer its smaller members the benefits of a large pool of advice and expertise. Its close collaboration with LACEEP has been a source of strength for both organizations.

Into the mainstream

Could we go beyond the establishment of a strong environmental economics community in developing countries? The ultimate goal, after all, is not simply to increase the number of environmental economists; it is to see economic analysis applied wherever it can help make action to protect the environment more effective, more equitable, and less costly. This means more than economists talking to each other. It is the reason the networks spend so much effort reaching out to policymakers and the media.

It is also the reason for this book, which has tried to present a novel way of looking at the causes of environmental problems and at the sorts of solutions that way of thinking suggests. Many examples have been given of questions faced by environmental decision-makers that economics can help with.

In developed countries, where environmental economics is relatively well established, economic analysis is often ignored when policies are designed. Environmental economics has a long way to go before it is clearly part of the mainstream.

Could things be different in developing countries? Again, Vietnam offers encouragement. The space created for environmental economics in the Ministry of Natural Resources and Environment is a sign that Vietnamese policymakers believe the profession has something to offer. Let us hope that this example will be followed elsewhere. And let us hope that environmental economists will be up to the challenge, as they add their efforts to those of others to create a sustainable future.

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Glossary

Capital-intensive^a – A production process that uses a high proportion of capital among its inputs compared with other factor inputs such as labour

CEEPA – Centre for Environmental Economics and Policy in Africa

CGE model – Computable General Equilibrium model. A model is a set of equations used to represent the workings of the economy (see *general equilibrium analysis*).

Choice modelling^b – A survey-based technique that assesses willingness to pay by having respondents choose between alternative options, where each option has a particular set of features and a price

Command and control^b – Controlling pollution through government-mandated legal restrictions

Common pool resource^b – A resource that is shared among several users

Common property regime^b – A property rights system in which resources are managed collectively by a group

Contingent valuation – A survey method used to estimate an individual's willingness to pay for goods, services, or environmental amenities. It is typically used in situations where the goods cannot be bought in markets and their prices, therefore, cannot be observed.

Cost-benefit analysis^c – The appraisal of an investment project that includes all the costs and benefits to society and to the investor that accrue to the project. The process involves weighing the total expected costs against the total expected benefits of one or more actions in order to choose the best or most profitable option. The formal process is often referred to as either CBA (Cost-Benefit Analysis) or BCA (Benefit-Cost Analysis). Benefits and costs are usually expressed in money terms, and are adjusted for the time value of money. In this way, all flows of benefits and flows of project costs over time (which tend to occur at different points in time) are expressed on a common basis in terms of their present value.

Earth Summit^c – The United Nations Conference on Environment and Development (UNCED), also known as the Rio Summit, Rio Conference, or Earth Summit. It was held in Rio de Janeiro June 3–14, 1992, with 172 governments participating and 108 sending heads of state or government.

EEPSEA – Economy and Environment Program for Southeast Asia

Ecological economics^c – A transdisciplinary field of academic research that aims to address the interdependence and co-evolution of human economies and natural ecosystems over time and space

Environmental economics^b – The area of economics concerned with issues relating to human use and abuse of natural resources

Externality – A condition in which the welfare of a firm or household depends on the activities of another agent. An externality can be positive (for example, when vaccinating a large number of people against an infectious disease also reduces the health risk of unvaccinated people) or negative (for example, when a firm avoids paying waste-disposal costs by releasing waste into the environment).

General equilibrium analysis^a – The study of the behaviour of economic variables, taking full account of the interaction between those variables and the rest of the economy. The purpose is to assess not only the immediate impacts of a change in the economy, but also indirect and longer-term effects. These may occur in different sectors than those in which the original change took place.

Hyperinflation^a – Very rapid growth in the rate of inflation in which money loses its value to the point that alternative mediums of exchange (for example, barter or foreign currency) are commonly used

Labour-intensive^a – A production process that uses a high proportion of labour among its inputs compared with other factor inputs such as machinery.

LACEEP – Latin American and Caribbean Environmental Economics Program

Market-based instruments (MBIs) – Environmental policy instruments that rely on prices to influence the behaviour of firms or households. These include taxes, subsidies, user fees, and tradable emissions permits (also known as *economic instruments*).

Market failure^c – A market failure exists when the production or use of goods and services by the market is not efficient. That is, there exists another outcome where market participants' overall gains from the new outcome outweigh their losses (even if some participants lose under the new arrangement). Market failures can be viewed as scenarios where individuals' pursuit of pure self-interest leads to results that are not efficient – that can be improved on from society's point of view.

Myopia^b – Nearsightedness, used metaphorically to describe narrow-sighted decision-making characterized by excessive concern for the present

Non-timber forest products (NTFPs)^c – Commodities obtained from the forest that do not require cutting down trees. These include game animals, fuelwood, peat, nuts and seeds, mushrooms, berries, and medicinal plants.

Open access resources^b – Common pool resources with unrestricted access. Depletion of resources is common in such circumstances.

PES – Payments for environmental services, typically from a party that benefits from the service to one that maintains it

Policy failure – An outcome whereby a government policy fails to achieve its stated objective and may even worsen the situation it was intended to correct

SANDEE – South Asian Network for Environmental Economics and Development

Social accounting matrix^a – Presentation of national income and expenditure accounts in a form showing the transactions during a given period between different sectors of the economy. The tabulations are set out in the form of a matrix showing the source of inputs into each sector or part of a sector and the distribution of their outputs.

Standard, ambient^b – A legal limit placed on the concentration level of specific pollutants in the air, soil, or water

Standard, emission^b – A legal limit placed on the amount of pollutants an individual source can emit

Subsidies^b – Payments or tax breaks from the government, which make the cost to the buyer lower than the marginal cost of production

Substitution^b – Replacing one resource with another. This may occur, for example, when the original resource is no longer cost-effective or is diminishing in quantity or quality.

Sustainability criterion^b – A criterion for judging the fairness of allocations of resources among generations. This generally requires that resource use by any generation should not exceed a level that would prevent future generations from achieving a level of well-being at least as great.

Transaction costs^a – Costs associated with the process of buying and selling. These commonly include the cost of reaching and enforcing agreements.

UNDP – United Nations Development Programme

UNEP – United Nations Environment Programme

Valuation – The attribution of a monetary value to an environmental good or service

Willingness to pay, marginal^b – The amount of money an individual is willing to pay for the last unit of a good or service

Sources : ^a Graham et al. (2003); ^b Teitenberg and Lewis (2009); ^c Wikipedia: all others, the author.

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