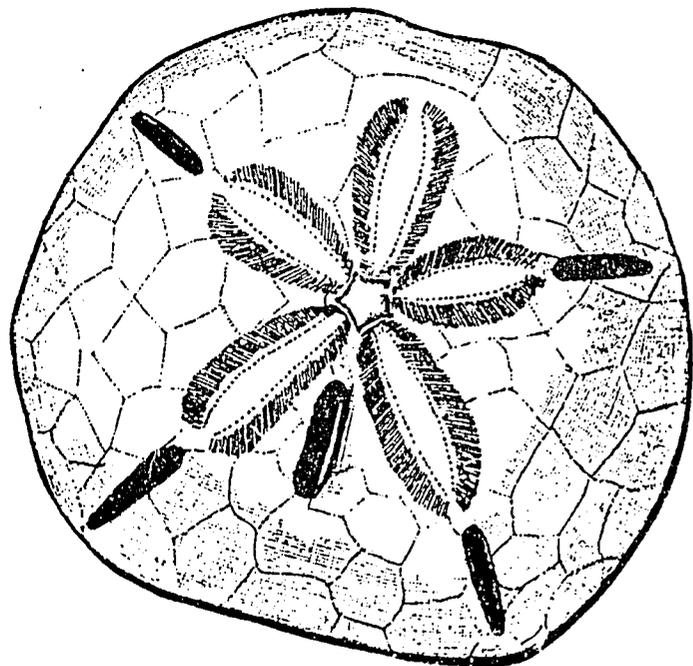


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Guide to the Field of Environmental and Natural Resource Economics

Carollyne Hutter



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**Guide to the Field of Environmental
and Natural Resource Economics** 

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World Wildlife Fund (WWF) is the largest private U.S. organization working worldwide to conserve nature. WWF works to preserve the diversity and abundance of life on Earth and the health of ecological systems by protecting natural areas and wildlife populations, promoting sustainable use of natural resources, and promoting more efficient resource and energy use and the maximum reduction of pollution. WWF is affiliated with the international WWF network, which has national organizations, associates, or representatives in nearly 40 countries. In the United States, WWF has more than one million members.

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World Wildlife Fund
Washington, D.C.



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Guide to the Field of Environmental and Natural Resource Economics
Carollyne Hutter

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FOREWORD

World Wildlife Fund's (WWF's) mission is to promote the conservation of nature through protection of natural areas, sustainable use of natural resources, and reduction of consumption and pollution. Environmental and Natural Resource Economics is an emerging discipline with great potential to contribute to that mission. This field provides essential tools to demonstrate that nature conservation and economic well-being are not in conflict but are mutually interdependent. When subjected to the critical analysis of Environmental and Natural Resource Economics, environmental destruction is often proven to be the result of short-term thinking, appropriation of public resources for private gain, and use of inaccurate economic indicators.

Recognizing the linkages between economic development and the health of natural ecosystems, WWF has developed programs and activities such as debt-for-nature swaps, the Wildlands and Human Needs Program, and the Tropical Forestry Program. *A Guide to Environmental and Natural Resource Economics* was prepared by the WWF Tropical Forestry Program,

with generous support from the U.S. Agency for International Development, to inform Environmental and Natural Resource Economics trainees about the development of this field and to assist their future research by providing information on researchers and institutions, centers for study, and useful documents.

This guide is not meant to be all-encompassing or all-inclusive. It focuses primarily on the areas considered of special importance to WWF's mission: forestry, land use, biodiversity, and national income accounting. It is based on literature review and contacts with leading professionals in the field from throughout the United States, but we certainly were not able to reach every individual or institution in this field.

The guide is composed of five sections. The first includes descriptions of the recent interest in environmental and natural resource economics; the origins of environmental and natural resource economics; comparisons of the fields of environmental, natural resource, and ecological economics; and externalities. It then discusses important issues in environmental and natural resource economics, including forestry,

land use, biodiversity, and national income accounting.

Section two is a directory of researchers in environmental and natural resource economics, and section three is a description of graduate level programs in the United States for training in environmental and natural resource economics.

Section four lists specialized journals, societies, and relevant articles.

The appendix contains excerpts of interviews with professionals in the fields of

environmental and natural resource economics.

We would like to express our appreciation to Carollyne Hutter for researching and writing this valuable guide; to Greg Corman, Barbara Rodes, and Carla Langeveld for major editorial and research contributions; to the many researchers, universities, and libraries that gave their time generously to provide the information included in this guide; and to the U.S. Agency for International Development for its financial support.

—ROBERT BUSCHBACHER

*Director,
WWF Tropical Forestry Program
World Wildlife Fund*

I. OVERVIEW OF THE FIELD OF ENVIRONMENTAL AND NATURAL RESOURCE ECONOMICS

Recent Interest in Environmental and Natural Resource Economics

In economics, environmental problems such as pollution are labeled "externalities," occurrences external to the system. The field of environmental economics, for the most part, has been analogously treated by the economics profession as a side area of inquiry. In the last five years, environmental economics has received greater academic attention; however, as David Pearce, Edward Barbier, and Anil Markandya note in Sustainable Development:

At the time of writing (1990)...there is not a single graduate course in environmental economics in the U.K. Environmental economics as a discipline applied to problems of developing countries remains a specialism of fewer economists still; this may be due to its interdisciplinary nature. The need to know something about environment, about the developing world, and about economics makes it a fairly daunting subject to pursue. It may also be due to the generally 'fuzzy' nature of the subject. There are no neat solutions, such as those that appear in the professional economics journals in respect to more abstract questions, and there are formidable problems of obtaining data and even greater ones of assessing the reliability of what there is.¹

Until recently, economic inquiry into environmental problems in developing countries has been lacking. Traditional environmental economics and natural resource economics have not dealt with the developing world, and international economics has studied issues including trade and monetary policy but not the environment. Generally, in economic development classes economic growth was the main concern in developing countries and such issues as environmental quality were luxuries; moreover, environmental destruction was the price one paid for development.²

With the publication of Our Common Future (Oxford University Press) in 1987, the notion of "sustainable development," which had been discussed since the early 1980s, gained greater attention from academic, environmental, and development circles. It was recognized that, for a country to develop economically on a long-term basis, it should not deplete its natural resource base or destroy the environment. This interest in sustainable development also translated to a heightened interest in environmental and natural resource economics.

What is environmental economics or natural resource economics? And what is an externality in economic terms? What is ecological economics? Is ecological economics a new field or just a reaction? What are the implications for tropical forests? To answer these questions we need to briefly look at the roots of economics in general and environmental and natural resource economics in particular.

The Origins of Environmental and Natural Resource Economics

Classical economics is usually traced back to the writings of Adam Smith (1723-1790), Thomas Malthus (1766-1834), David Ricardo (1772-1823), and John Stuart Mills (1806-1873). Adam Smith wrote that through the mechanism of the "invisible hand" of the market, individuals seeking to satisfy self-needs and desires would ultimately serve society's interests as a whole. He stressed the importance of the free competitive market. Smith, Malthus, Ricardo, and Mills were all basically pessimistic about the prospects for long-term growth due to physical limits. Malthus and Ricardo believed the limits to good-quality agricultural land would ultimately result in diminishing returns in agricultural production. John Stuart Mills was slightly more optimistic than the other classical economists and argued that technical progress would eventually provide for society's needs.³

In the nineteenth century, new patterns of thought emerged from classical economics: neoclassical, humanism, and Marxism. In the twentieth century, institutional economics and coevolutionary economics evolved.⁴

Pearce and Turner⁵ show that environmental economics is the intellectual derivation of neoclassical, institutional, Marxist, humanistic, and coevolutionary economics. Tom Tietenberg stated⁶ that other schools of economic thought, such as institutionalism, humanism, and Marxism, have influenced and enlarged environmental and natural resource economics, but its core remains neoclassical economics. However, Pearce and Karl-Goeran Maeller wrote that environmental economics' "theoretical underpinnings lie mainly in 'welfare economics'--the prescriptive analysis of how economics should be organized so as to optimize human well-being."⁷ They further explained that environmental economics did not emerge as a coherent body of thought until the 1970s, and only in the last decade has it been applied to developing countries.⁸

Although the focus is no longer on agricultural land, the debate the classical economists posed on the issues of the physical limits to economic growth (and Mills' hypothesis on the use of technical change to alleviate this limitation) is still relevant. In the 1970s this debate surfaced between those who held a "pessimistic" view and those who were considered "optimistic."

Jay Forrester's model on the limits to growth represented the pessimistic perspective that society will run out of nonrenewable resources and the economic system will collapse due to a limited resource base and a growing population.⁹ Herman Kahn counter-responded with an optimistic view in The Next 200 Years: A Scenario for America and the World (Morrow), which relied on continuous technological progress to remove natural limitations and control the forces of nature.

The works on "sustainable development" also look at these basic questions concerning the long-term prospects for economic growth, not, however, from the vantage point of whether it is possible but rather "how would it be possible." Many believe environmental and natural resource economics can provide some of the answers. Others believe major problems with economics require it to be modified or altered to be effective.

In the post-World War II period, economics in the United States became more mathematical and tried to emulate physics.¹⁰ Herman Daly and John Cobb target this transition, which they believe began at an earlier date, as one of the flaws of present-day economics.

The problem with economics is that it has succeeded all too well by the standards of the academic world. It is a successful discipline, and it has succeeded much better than any other social study in becoming a deductive science. These successes have involved a high level of abstraction, yet the whole ethos of the university in general, and of the department of economics in particular, discourages the full realization of the extent of the abstracting that has gone on. The result is that conclusions are drawn about the real world by deduction from abstraction with little awareness of the danger involved.¹¹

In the same work, Daly and Cobb criticize economics for concentrating

...on money and the market rather than on physical goods, with the concomitant decision to model itself on the methods (but not the content!) of physics, has been characteristic of the whole modern economics. This paved the way for the primacy of deduction and the focus on mathematical models and computer simulations that are the hallmark of current practice in the discipline. Such elaborate and beautiful logical structures heighten the tendency to prize theory over fact and to reinterpret fact to fit theory.¹²

A Comparison of Environmental, Natural Resource, and Ecological Economics

The type of criticism of economics by Daly and Cobb outlined above may have led Robert Costanza, David Pearce, Anne-Marie Jensen, and Herman Daly to found, in 1988, a new society, journal, and a possible new field of inquiry: ecological economics. In every issue of Ecological Economics it is stated that

ecological economics is concerned with extending and integrating the study and management of 'nature's household' (ecology) and 'mankind's household' (economics). This integration is necessary because conceptual and professional isolation have led to economic and environmental policies which are mutually destructive rather than reinforcing in the long term. The journal is transdisciplinary in spirit and methodologically open.

In the opening chapter of the forthcoming book Ecological Economics: The Science and Management of Sustainability¹³, the authors describe the field as a new transdisciplinary field that attempts to integrate and synthesize different academic disciplines. The emphasis of ecological economics is on the problem or issues rather than on a specific model, intellectual tool, or approach. The authors call for a pluralistic approach to solving problems, and for use of appropriate tools--whether from conventional economics, ecology, or elsewhere. They proclaim the need "to transcend the focus on tools and techniques so that we avoid being 'a person with a hammer to whom everything looks like a nail.'"¹⁴

In interviews, Tom Tietenberg, Robert Costanza, and Richard Norgaard provided descriptions of environmental and natural resource economics and ecological economics.¹⁵

Tom Tietenberg:

Regarding the field of environmental and natural resource economics, Tietenberg clarified that environmental and natural resource economics generally go together and are considered one field. Economists in the field are usually trained in both areas, although later they may specialize in one area. Courses at a university are sometimes offered in just environmental or natural resource economics, or both. Tietenberg explained that there are two major components to environmental and natural resource economics: economic policy and its instruments and the valuation side (e.g., benefit-cost analysis). According to Tietenberg, environmental and natural resource economics are primarily derived from neoclassical economics. Other schools of economic thought such as institutionalism, humanism, and Marxism have influenced and enlarged environmental and natural resource economics, but their core remains neoclassical economics.

Ecological economics, Tietenberg believes, is trying to bring ecologists and economists together to deal with pertinent issues. Traditionally, ecology and economics have approached issues from very different perspectives. The hope of ecological economics is to have the sum of these two disciplines greater than the parts; that is, the value system of ecology will seep into economics, and the tools of economics will be used to preserve ecological systems.

Robert Costanza:

One of the major distinctions between ecological economics and conventional environmental economics is that ecological economics places a greater emphasis on having a pluralistic approach. We in the field of ecological economics don't believe that there is a correct theory that should guide everything we do. In the field of environmental economics, they have reached a consensus on the approach.

Costanza went on to explain the differences between ecological economics and environmental economics.

There is a difference in the domain of what we are trying to cover. Conventional economics looks at exchanges between conventional economics sectors. Environmental economics looks at output, still within the standard economy, but looking outward to what the economy is exporting into nature, such as pollution. Resource economists are looking at the inputs from nature into economy. Ecological economics has a broader perspective by looking at the ecosystem itself.

In other words, conventional, environmental, and resource economics treat the environment as a passive thing; a place where you get resources from and a place into which you dump pollution. Whereas, ecological economics views nature as an active partner. Nature is just as much an economic activity as the steel industry. It is an active partner doing things on its own, and even if we were not around, it would still be functioning.

From the point of view of the ecological economist, it is not enough to take the standard neoclassical perspective and look outward. They support activities that are a more radical departure than that, although as of now there is no general consensus.

Richard Norgaard:

Environmental and natural resource economics are both neoclassical economics. Environmental economics is concerned with environmental systems; natural resource economics tends to be concerned with the use of natural resources, such as coal, water, and oil. Generally, environmental economics has more of an ecosystem orientation, but it's still trying to be neoclassical economics. Both of these disciplines never question economics itself. Their assumption is that economic thinking is correct and, furthermore, that economic thinking can be merged with other thinking without any inherent conflicts between those patterns of thinking.

People working in these areas may ask 'what if the markets are not working this way or that way,' but they do not question 'what if markets are a figment of economists' imaginations.'

Norgaard explained that there is a neoclassical tendency to try to make everything fit into the same framework (e.g., to give valuation for nonmarket goods). "This is neoclassical in the context that it is presuming that economic problems are problems of inefficiency."

From Norgaard's perspective, neoclassical economics is one way of thinking and "it's foolish to use only one way of thinking." He advocates not replacing it, but using other approaches as well.

Norgaard also discussed ecological economics.

One of the things that holds ecological economics together is that there isn't a right way to think. Within economics there are different ways of thinking, but people tend to be of one school or another. My viewpoint is that large, intricate, complex systems cannot be understood using one pattern of understanding. Every pattern of understanding is a simplification of the complexity.

In theory, there is an obvious distinction between ecological economics and environmental and natural resource economics. The major distinction is that ecological economics extends beyond traditional academic boundaries. In practice, the distinctions become more difficult to distinguish. This does not negate the importance of ecological economics since one of the main hopes of its founders is for more pluralistic approaches and interdisciplinary discussions of issues and problems--not necessarily for replacing existing approaches.

Externalities

A well-known standard textbook on economics defines externalities as: "effects, whether good or bad, on parties not directly involved in the production or use of a commodity."¹⁶ The commonly cited example of a negative externality is pollution.

Suppose two firms are located by a river. The first produces steel, while the second, somewhat downstream, operates a resort hotel. Both use the river, though in different ways. The steel firm uses it as a receptacle for its waste, while the second uses it to attract customers seeking water recreation--swimming, sailing, and water skiing. If these two facilities are owned by different owners, an efficient use of the water is not likely to result. Because the steel plant does not bear the cost of reduced business at the resort resulting from waste being dumped into the river, it is not sensitive to that cost in its decision making. As a result, it dumps too much waste into the river and an efficient allocation of the river is not attained.¹⁷

Externalities can be further classified as localized or pervasive. Localized externalities are those that affect a specific area or community. Pervasive externalities often have effects that are widespread, and the cause can be difficult to pinpoint, as with acid rain.

Herman Daly and John Cobb believe that there is a basic flaw in economic theory if important and common occurrences such as pollution and environmental degradation are treated as outside the system and as market inefficiencies:

When vital issues (e.g., the capacity of the earth to support life) have to be classified as externalities, it is time to restructure basic concepts and start with a different set of abstractions that can embrace what was previously external.... The frequency of appeal to externalities is a good index of the overall problem of misplaced concreteness in economic theory.¹⁸

Issues in Environmental and Natural Resource Economics

From the point of view of World Wildlife Fund's tropical forestry program, environmental and natural resource economics can be a powerful way to promote sustainable management of forest resources. By giving a truer valuation of the benefits from healthy forests and the costs of forest loss than traditional economics, environmental and natural resource economics can make

policy makers and citizens more aware of the need for long-term stewardship of forest resources. In that regard, several specific issues are particularly relevant and are discussed below.

1. Forestry

Forestry economics has traditionally focused on temperate forests in Western countries and has examined such issues as the economics of forest harvesting.¹⁹ Recently, with the increased international attention on tropical deforestation, some studies have been done on the economics of tropical forests and on government policies that have encouraged deforestation.

In 1988, the Harvard Institute for International Development (HIID) prepared a report for the International Tropical Timber Organization (ITTO) on multiple-use management of tropical hardwood forests.²⁰ The report examined "sustainable production of hardwood timber with other nontimber goods and forest services through the multiple-use management of natural moist forests in the humid tropics.... Forest services include environmental benefits and ecological services based on the presence of the natural forests."²¹

The most serious problem for the tropical timber trade, according to the report, is that governments of tropical countries undervalue timber resources. This situation, in combination with overvaluing of the net benefits from forest conversion, has "led to excessive deforestation, failure to implement natural forest management, and underinvestment in forest plantations."²² The second major economic problem is that forest management and investment decisions often fail to account for nontimber forest products and various services provided by the forests such as environmental services.

The report explains that although multiple-use management identifies and tries to evaluate the possible uses of tropical forests, it does not suggest that every hectare of tropical forest should be used for these various purposes. Five basic uses are identified for forest lands: (1) timber production, (2) production of nontimber goods, (3) provision of environmental/biological services, including conserving biodiversity, (4) recreational and aesthetic benefits, including tourism, and (5) conversion to agriculture or livestock production.

The economics of multiple-use management is described in the report. The authors explain that, generally, forests are "managed" for timber without much consideration for other values and without justification for only concentrating on this one forest use. "The concept of multiple-use as applied to forests

is based on the recognition that a variety of goods and services can be produced from the same land, either simultaneously or serially, and that such management can greatly increase the net value of the forest."²³

Multiple-use economics is used to ascertain whether multiple-use management should be employed and to what degree it is suitable. A simple method of multiple-use management is dominant-use management. One first decides what is the primary use for the land and then to what extent other uses are allowed. For example, if one chooses genetic-resource conservation as the primary output, it would be generally incompatible to have timber production as a secondary output.

Benefit-cost analysis is used in multiple-use economics to calculate the "true" social value of management alternatives. "Values are given to all relevant variables regardless of whether a market price can be placed on them. The variables include timber and nontimber goods, environmental services, labor costs, social benefits, etc."²⁴

There are a number of methods for assigning values to nonmarket goods.²⁵ The methods are grouped into three categories: value methods based on observed economic behavior, valuation based on surrogate values, and valuation based on elicited responses. Group one, valuation methods based on observed economic behavior, assigns values to environmental services by calculating how changes in environmental services are connected to the supply or productivity of goods and services that are traded in the market. The methods commonly used are: changes-in-productivity approach; loss-of-earning expenditure approach; cost-effectiveness approach; replacement-cost approach; compensation approach; and wage-differential approach. Group two, valuation based on surrogate values, looks at prices for other marketed goods to gauge the implicit values. The most well-known of the approaches is the shadow-pricing approach, which examines substitutes in the market place for the environmental service. Other approaches include property value approach and travel-cost approach. Group three, valuation based on elicited response, relies on surveying individuals on their willingness to pay for higher-quality water, air, etc. Dixon and Sherman feel the last group of methods is not very useful in dealing with developing countries.

There are limitations to economic appraisal, the report acknowledges, since private firms and society value costs and benefits differently. Benefits accrued to private owners or concessionaires are referred to as financial benefits. Benefits that go to a society as a whole are economic benefits. The difficulty arises because financial benefits are the only incentives for private investment; moreover, public benefits (e.g., watershed protection) are generally not part of the private decision-making process.²⁶ Therefore, how society and

private firms perceive costs and benefits may be directly opposite.

A fundamental question in forest management then becomes: Whose interest is being considered? A private firm? A local community? The government? The international community? Incentives may be needed to practice multiple-use forest management and to alleviate the contrast between private and public benefits on privately held lands.

Taxes and subsidies can promote multiple-use management on privately held lands by providing incentives for the preservation of nonmarket goods and services. Taxes could be imposed to discourage practices such as clear-cutting, which contribute to the destruction of a watershed or soil erosion. Subsidies could be used to promote more beneficial practices, such as the use of selective cutting techniques, to maintain biological diversity.²⁷

Another recent study of tropical forest economics was done on forest valuation by Randall Kramer, Robert Healy, and Robert Mendelsohn for the World Bank Forest Policy Study.²⁸ The main thesis of the paper is that:

...accurate valuation of forest resources is essential to both appraisal of projects affecting forests and to the development of forest and nonforest policies. Undervaluation of forests and their outputs and services can create a policy bias in favor of competing land use activities.²⁹

The paper describes forest products, why valuation is important, and how to measure forest values. It categorizes forest products into four groups: market goods, potential market goods, public goods, and goods with non-use value.

Values for market goods can be obtained by using market prices and consumer surplus. For potential market goods, valuation can be calculated from observed prices in competitive markets or on the basis of the value of a close substitute. To value public goods the authors recommend the following methods: hedonic methods, travel cost, replacement cost, and contingent valuation. For non-use values, which refer to existence values and could apply to ecosystems, species, or habitats, they identify option value, non-user preservation value, and pure existence value.³⁰ The authors are not convinced that non-use values, especially the option value, should be included in the value of a resource.

Six reasons why forests may be misvalued are identified: (1) many of the services from forests are public goods (i.e., nonmarket services); (2) forests can provide multiple joint products; (3)

the long growing periods trees require and the loss of ecosystems can be irreversible; (4) various forest products are often available under open access conditions; (5) scientific data on forest products and the information on markets for nontimber forest products are limited; and 6) "many forest products and services are important to the livelihood of the rural poor, a group whose welfare is a major object of public policy, but whose demands have little weight in organized commodity markets."³¹

Theodore Panayotou, one of the leading authors for the HIID's report to ITTO, described the valuation of the Mishana Forest in Peru.³² In a one-hectare stand of the Mishana, the net present value (NPV) was calculated. It was determined that managing the forest for a combination of fruits, latex, and timber would produce three times as great a NPV as would be generated from converting to an intensively managed single-species plantation.³³

The study was done using two harvest scenarios. The first selectively removed all timber greater than 30 centimeters in diameter in the present year, the twentieth year, and the fortieth year, and made a final cut in the sixty-fifth year of all remaining trees. Throughout this 65-year cutting cycle, fruit and latex were collected. The second scenario focused on sustainable yields of "minor forest products" with 20-year cutting cycles of selective timber removal (30 cubic meters per hectare per harvest). The NPV for the first scenario was calculated at \$9,192 (fruit \$7,680, latex \$428, timber \$1,084) and \$8,610 for the second (fruit \$8,003, latex \$446, timber \$161). Panayotou contrasts these NPVs with the NPV from an intensively managed plantation of Gmelina arborea in Brazilian Amazonia, \$3,184, and the gross revenue from fully-stocked cattle pastures in Brazil, \$148 per hectare per year, with an NPV of \$2,960. Panayotou concluded that "even though multiple-use management of this tropical forest could generate three times the net present value of a single-species, single-use plantation, large tracts of forest in Peruvian and Brazilian Amazonia are converted to such plantations and ranches."³⁴

The concern for correct valuation of tropical forests is reiterated by Edward B. Barbier, Joanne C. Burgess, and Anil Markandya. "Sustainable management of tropical forests is dependent on accounting correctly for all the economic uses of the forests."³⁵

Richard Norgaard, in a forthcoming discussion paper,³⁶ detects two fundamental conceptual contradictions with the various attempts to measure forest goods and services, including nontimber products, environmental services, and biodiversity preservation. One, nonmarket goods and services are valued according to the current generation's preferences. Two, the NPV calculation discounts the benefits that would be collected by the future generations. Norgaard proposes intergenerational

equity, weighing current and future generations equally, thereby ensuring sustainability and efficiency. "Expanded benefit-cost analyses may be able to 'make the case' for sustainable forest management, but to the extent they do, it is based on the interests of current generations. Sustainability reasoning, on the other hand, weighs current and future generation more or less equally."³⁷

On the policy side, economic incentives or disincentives can steer a course toward or away from tropical deforestation. Robert Repetto demonstrated how perverse incentives have led to the clearing of tropical forests for ranches and how inappropriate or ineffective government policies have encouraged destructive logging practices.³⁸

In a similar vein, Repetto, as well as Barbier, Burgess, and Markandya,³⁹ suggest two primary economic factors are encouraging deforestation, whether through forest conversion or unsustainable harvesting of timber. One, timber products or products from converted forestland do not internalize the environmental cost, or the option or existence value. Two, governments often subsidize the cost of harvesting or converting tropical forests.⁴⁰

The authors point out that forest resources and the long growing period for tropical hardwood species are not conducive to short-term investment schemes. "If those responsible for exploiting them have a high discount rate for the future relative to what society considers to be an acceptable discount rate, then there will be a tendency to overuse and run down these resources."⁴¹ These tendencies are aggravated and augmented by governments' "misconceived fiscal policies and inadequate or inappropriate ownership and usufructuary rights to forest resources."⁴² The conclusion of the authors is that, due to the aforementioned reasons, the worth of sustainable use of forest resources is underappreciated in the market.⁴³

2. Land Use

Economics can be used to articulate the benefits of conservation and aid in the decision-making process. Costs of conservation are usually obvious, but the benefits can be unnoticed since they either do not directly go through a market (e.g., forest products collected by local inhabitants) or are somewhat abstract (e.g., biodiversity). John Dixon and Paul Sherman provide a methodology for assigning values to protected areas. Their main objective "is to demonstrate how economics can be used to improve the decision-making process."⁴⁴

In an interview,⁴⁵ Dixon explained that his book's starting point is the decision by governments or societies to protect an area

for whatever reason. The issue then becomes

...what are the economic questions associated with protecting it. We know a lot about the costs involved, financial expenditures by governments for protection, for guards, for facilities, but what about the benefits? This book tries to look at both the benefits and cost sides of protection.

When the protected area is forest, then there is also the question of: Can you have conjunctive use of the forest? Can you allow resource exploitation at the same time? I think many times the answer is yes, depending on for what use and what you are protecting it for. One of the important lessons to come out of this work is that the people who frequently pay the greatest cost for protecting an area are nearby residents, who are frequently poor, sometimes politically disenfranchised. In a sense you are asking these people, who usually receive very little benefit, to pay a disproportionate share of the cost of providing this social service to the community, the world. Therefore, if you want to be successful in managing an area, it is essential to take local residents into account, either by deriving benefits from the park or providing continued access to this facility, perhaps some limited resource extraction. It is very important to try and work with the groups because if you take a policing attitude-- fences, guards--you polarize both sides, and frequently it is not very effective and is hard to monitor.

The reason a government has to protect an area is because the benefits are diffused. It does not pay for any individual to create a national park and sell admissions. The economics do not work out on a personal basis.

I feel it is very important for countries to make a decision about protection based on a broad overview of the resources and within the framework of a system of protected areas. Rather than looking at each individual site of protected area or wildlife reserve and deciding whether or not it passes a benefit-cost test, you have to develop a package that balances the various assets and resources that you are trying to preserve. If you do simple financial analyses some areas will win and some will lose. Some areas will lose because they are strict natural reserves where there is no tourism allowed, just scientific research or not even that. As a system one can sell the package to the policy makers. One can balance revenues from the more attractive sites to help support the other ones.

Dixon cited a parallel example from Washington--the Smithsonian Institution museums sponsored by the government. Some museums, such as the National Air and Space, are extremely popular, whereas others, such as the Folger Library, are less frequented by visitors. By using a system approach, a country can be assured of protecting an array of natural resources. If a country has limited resources, the economics can be used to decide several alternative sites that provide the same generic benefits.

Dixon pointed out that when dealing with issues concerning protected areas a strict benefit-cost analysis is not enough, since so many of the benefits are difficult to quantify. However, to ignore economic constraints is also foolish. "Sometimes it is worse to protect a site and not manage it properly than to use those scarce resources for fewer sites," Dixon said. From Dixon's perspective, economics does not determine the value of a site, because resources have intrinsic, nonmeasurable values. However, economics can be used to justify allocating scarce public funds for management of these resources.

Daniel Bromley's work on land use issues concentrates on common property issues and natural resource problems, focusing on forests, grazing areas, and water. In an interview he described his work:⁴⁶ "I'm interested in the way property rights and institutional arrangements influence natural resource use and how we might design institutional arrangements to conserve what is referred to as common resources and common property problems."

Bromley researches and gives policy advice on how governments manage natural resources. "My graduate students and I work on natural resource problems in Asia and Africa where institutional arrangements have broken down. We are trying to find out why resources are overused and what governments ought to do to prevent overuse."

Economists often use the terms common, public, or private property without understanding there are many different forms of land tenure and that these labels are gross simplifications that can distort the situation. An example⁴⁷ of the difference between European and Asian property concepts is that, during the Raj period, the English were confronted with the fact that British property concepts did not translate well into Indian societies. In India, when discussing land tenure one needs to ask not only who owns it but who has rights to use it, even when discussing private land tenure situations.

3. Biodiversity

Alan Randall wrote that as the goal of biodiversity increasingly conflicts with other human goals, "a rationale for choosing" needs to be developed.⁴⁸ Randall and other economists argue that

economics can provide the rationale for choosing through the welfare change approach, particularly a modified benefit-cost analysis approach (BCA).

The modified BCA approach attempts to implement the conceptual framework of welfare change measurement by identifying and measuring (insofar as possible) the benefits and costs of the alternative courses of action. This approach requires major efforts to measure the noncommercial components of economic value, including amenity, option, and existence values. The benefit-cost decision criterion itself is modified, however, by assigning the benefits of any doubt to the preservation side of the ledger.⁴⁹

An alternative criterion proposed by economists for deciding on preservation issues is the safe minimum standard (SMS) for conservation. The basic rule of SMS is: "avoid extinction unless the social costs of doing so are unacceptably large."⁵⁰ Richard Bishop, who has worked on SMS and economics of endangered species for a number of years, described this approach:

The SMS is designed to avoid a species' 'critical zone': the point at which it becomes economically infeasible to prevent the extinction of a species. In order to maintain a SMS, two types of costs are incurred: out-of-pocket costs and opportunity costs.... From an economic viewpoint, out-of-pocket and opportunity costs (minus any known preservation benefits) may be thought of as insurance premiums.⁵¹

With a modified BCA, each investigation of a site or situation begins by weighing the benefits versus the cost of preservation; the SMS approach starts with the premise that maintaining a SMS is a good idea for any species. With SMS the economic question becomes "Can we afford to maintain the SMS?" Unless the opportunity cost is extremely unaffordable for a society, the SMS approach advocates preserving the species. Therefore, with the SMS approach, the burden of proof is given to the side against preservation.

Despite the difference between the two approaches, their applications are not mutually exclusive. Randall suggests using a BCA in conjunction with SMS policy.

The idea that benefits and cost count in a more complete theory of biodiversity does not exclude other moral or consequential considerations. One admissible theory would be that policy should implement the strategy with the greatest net benefits, subject to the safe minimum standard constraint.⁵²

Bishop is presently investigating the social cost of conserving biodiversity in Costa Rica's Talamanca region. He defines net social costs of conserving biodiversity as consisting of three elements:

1. Out-of-pocket project costs,
2. Opportunity costs of alternatives, and
3. Off-setting conservation benefits from consumption, production, and non-consumptive uses.⁵³

Subtracting the third element from the first two yields the net cost.

Ehrenfeld, Norton, and other conservationists and philosophers argue against these conventional economic approaches to biodiversity. Norton, a philosopher, questions economists' attempts to value biodiversity.

It is one thing to treat the valuation of biodiversity as a guessing game or as a set of very interesting theoretical problems in welfare economics. It is quite another thing to suggest that the guesses we make are to be the basis of decision making that will affect the functioning of the ecosystems on which we and our children will depend for life.⁵⁴

Ehrenfeld, a biologist, argues that by placing values on biodiversity, attention is being diverted from the causes of extinction.

There are probably many explanations of why we feel compelled to place a value on diversity...a straightforward explanation is that the dominant economic realities of our time--technological development, consumerism, the increasing size of governmental, industrial, and agricultural enterprises, and the growth of human populations--are responsible for most of the loss of biological diversity. Our lives and futures are dominated by the economic manifestations of these often-hidden processes, and survival itself is viewed as a matter of economics (we speak of tax shelters and safety nets), so it is hardly surprising that even we conservationists have begun to justify our efforts on behalf of diversity in economic terms.⁵⁵

Ehrenfeld does not support the theory of preserving biodiversity because the species may have possible commercial use. Ehrenfeld asks what happens to species when technology has found or created substitutes? Ehrenfeld uses an example from the pharmaceutical field.

Pharmaceutical researchers now believe, rightly or wrongly, that they can get new drugs faster and cheaper

by computer modeling of the molecular structures they find promising on theoretical grounds, followed by organic synthesis in the laboratory using a host of new technologies, including genetic engineering. There is no need, they claim, to waste time and money slogging around in the jungle. In a few short years, this so-called value of the tropical rain forest has fallen to the level of used computer printout.⁵⁶

Ehrenfeld does not have faith in economists to assess the true economic value of particular species, let alone the value of diversity in its entirety. "We do not know enough about any gene, species, or ecosystem to be able to calculate its ecological and economic worth in the larger scheme of things."⁵⁷

Jeffrey McNeely approaches the issues of economics and biodiversity from a policy perspective. McNeely suggests that on the policy level, economic incentives should be used to promote conservation of biodiversity, and that existing incentives that have promoted depletion of species should be removed. Through a system of incentives and disincentives (rewards and punishments), McNeely hopes to motivate behavior along a course of conservation.⁵⁸ Disincentives include direct recourses such as penalties, taxes and fines, and subtle pressures such as public opinion or peer pressure.⁵⁹ Incentives could be direct or indirect. Direct incentives are cash or kind given for a specific purpose and usually connected to definite rewards (for example, giving subsidies to a community to reforest). Indirect incentives do not use cash or kind, or any appropriated funds but rather involve "applying fiscal, service, social, and natural resources policies to specific conservation problems and may involve providing preferential treatment in trade agreements, price supports, or land tenure."⁶⁰

McNeely also notes the importance of removing perverse incentives, for instance, agricultural and pesticide subsidies. Changes need to be made, McNeely proposes, in both economic analyses and accounting so that the economic system does not encourage the over-exploitation of biological resources. He identifies six major issues: national income accounting; ownership of resources; benefits of conserving resources not being fully shown in markets; the benefits of protecting natural areas being underestimated by benefit-cost analysis; biological resources usually being underpriced in the marketplace; and discount rates tending to emphasize current generations and encourage depletion of biological resources.⁶¹

4. National Income Accounting

Since their creation, national income accounting methods such as gross national product (GNP) and net national product (NNP) have

been criticized for not truly reflecting the income or wealth of a country. In terms of developing countries, this complaint has been particularly acute since a substantial part of their economic activities occur within households, or communities' markets, without market exchange.⁶²

GNP increases when subsistence farmers join the labor force and stop producing their own food, when women join the labor force and hire domestic help and childcare, when the stock of housing and factories is destroyed by war and then replaced, and when the environment deteriorates and the government initiates corrective actions.⁶³

Figures from national income accounting (NIA) are important because they are used as tools for economic analysis and policy prescription. The United Nations System of National Accounts (SNA) supposedly measures national income, and countries are judged whether there has been economic growth by an increase in national income. In the last decade, a new set of criticisms has been leveled against NIA concerning treatment of natural resource depletion and environmental costs. SNA ignores the fact that a country could reputedly be encountering economic growth while it is depleting its natural resources and damaging the environment. SNA ignores the basic question of sustainability of economic growth. It does measure the depreciation of man-made capital, but it does not take into account depreciation of natural capital whether it is renewable or nonrenewable resources. SNA is also being criticized by some economists for including defensive expenditures. Defensive expenditures are money spent to protect or restore the environment. For example, if there is an oil spill and afterwards a clean-up, this effort is reported as an income generating activity by SNA. However, there is no negative accounting for the environmental losses.

Herman Daly suggests a new income concept of sustainable social net national product (SSNNP). He defines SSNNP as net national product minus both defensive expenditure and depreciation of natural capital.⁶⁴

Some economists argue for a conceptually different approach to defensive expenditures. Anne Harrison proposes that water, air, soil, etc., should be considered natural capital. In Harrison's proposal, when such natural capital is degraded or drawn down this would be noted as consumption in the measurements of national income regardless of whether defensive expenditures had been incurred to correct the negative situation. The depreciation of environmental capital would be indicated at the level of net domestic product (NDP).

Henry Peskin suggests a similar approach to Harrison's. In addition to standard accounts for households, industry, and

governments, Peskin proposes introducing a nature account as a separate sector. "Nature is shown as the primary source of all environmental asset services and as the final consumer of environmental damage."⁶⁵

SNA measures and notes the deterioration and depreciation of man-made assets as a loss in production. For the most part, the loss of natural resource assets is not adequately noticed or measured. "If a country is exhausting its renewable or nonrenewable resources, its current income will thus be inflated by the sale of natural assets that will eventually disappear."⁶⁶

Whether a depletion in natural resource stock is being recorded may depend on whether it is publicly or privately owned. Many private companies "make provisions for the decrease in the capital stock of natural resources, and in certain countries tax legislation permits such provisions to be excluded from taxable income."⁶⁷ In developing countries, where resources are generally owned or exploited by the governments, no such provisions are made.

The underlying problematic assumption is that natural resources are viewed either as greatly abundant or as "free gifts of nature." By selling off natural resources a country can temporarily increase its income, and this can lead to an increase in consumption. This situation presents a false image of a country's real wealth. The so called "prosperity" is not sustainable, especially if the gains in income are not being plowed back into new productive investment. Thus, incorrect income accounting can translate into inappropriate policy making.

Industrial and agroindustrial production relies on stocks of geological and biological resources, as well as "flow" resources such as water, air, etc. Recycling, conservation, and new geological discoveries do not negate the process of depleting known stocks but merely expand the time period of depletion.⁶⁸ Optimists would argue that human intelligence will discover or invent substitutes for the depleted resources. It would be foolish for policy makers to base decisions on hopeful possibilities. Also, new discoveries and innovations may rely on the input from other natural resources.

The current SNA was originally published by the United Nations in 1968. Since the 1980s, a number of expert groups have met at workshops to examine various issues relating to SNA and how to represent sustainable income. A consensus has not been reached by the experts on how to improve SNA, and the debate has ranged from important conceptual issues to technical aspects of implementation.

Ernst Lutz, Salah El Serafy, Peter Bartelmus, and others state that since consensus has not been reached, a satellite system of

environmental accounts should appear along side the existing SNA, rather than integrated into the SNA, as others have suggested.

By having satellite accounts, the user could compute sustainable GDP and NDP (SGDP and SNDP) in them. This half-way solution would not represent a threat to the historical continuity of GDP but has a fair chance of being adopted."⁶⁹

As for now, the United Nations has agreed to use a set of environmental satellite accounts, and is working on revising the "blue book" (the volume describing the core accounts of SNA) to have a section outlining environmental satellite accounts.

Concerning even basic concepts, there is considerable disagreement among economists, environmentalists, and national accountants. Some argue that environmental accounting should be expressed in physical terms, without any linkage to SNA, as a means to influence public opinion and environmental policies.

Richard Norgaard notes that SNA is not based on procedures deduced from economic theory but on conventions established through a process of acquiring consensus. He argues for multiple methodologies.

Logic, however, indicates that multiple methodologies--conceptual pluralism--provide the key to a safer and more pragmatic strategy for linking environmental and economic accounting. Sustainability is too important, too multidimensional, and too poorly understood for societies to rely on one methodology.⁷⁰

A number of industrial countries, including France, Norway, Canada, Germany, Japan, France, Netherlands, and the United States have created, or are creating, resource accounting systems.⁷¹

Henry Peskin explains why natural resource deterioration was ignored.

Historically, overlooking declines in the stock of natural resources in the conventional accounts was thought to be of little significance. This view was based on the fact that discoveries of new natural resources were also neglected, as were other resource-increasing factors such as recharge and the natural growth of renewable resources.... The current perception, however, is that discoveries, recharge, and natural growth are not keeping up with depletion.⁷²

Two basic conceptual approaches deal with depletion of natural resources: the depreciation approach and the "user-cost"

approach. The depreciation approach follows the principles of man-made capital, except the depletion of renewable and nonrenewable resources has to be translated from physical units to monetary units. The valuation can be done through a variety of methods based on the principle of replacement or willingness to pay. The user-cost approach was proposed by Salah El Serafy, specifically to account for the depletion of mineral resources. El Serafy argues for this approach since the depreciation method does not acknowledge the income advantage attributed to the owner of the natural resource.

Possession of a natural resource conveys on its owner an income advantage that is denied to those without a natural resource, and it is not satisfactory to arrive at a measurement of zero net income, as proposed by the depreciation method."⁷³

In developing countries, a number of economists and national accountants are concerned about constructing environmental and natural resource accounts. Not only what approach to use but also what to measure for the accounts is of great theoretical debate. Willy Cruz explained the approach of the World Resources Institute (WRI):

The usual distinction that people try to make is whether you examine productive natural resources (productive sectors), i.e., forestry, coastal fishing, and watersheds resources, or whether you look at amenities, environmental concerns such as water quality, air quality, noise, or pollution. WRI focuses on the production sectors while others focus on the second.⁷⁴

Henry Peskin called the work of Repetto and others a "partial effort." He advocates a wider approach, including both environmental and other nonmarket factors.

Should the expanded accounts be confined to environmental assets or should the effort attempt to cover a full spectrum of nonmarket assets? In principle, the latter approach is preferable, basically because a fully expanded accounting system will be able to show important relations between environmental asset use and other nonmarket activity.⁷⁵

Although this is a new field with a cacophony of opinions on methodology and approaches, all the experts agree on the importance in amending SNA to reflect truer images of economic development and sustainable income.

II. DIRECTORY OF RESEARCHERS

The following section provides information on some of the leading researchers and practitioners of environmental and natural resource economics in the United States. For each individual, contact information is provided, along with a description of specific research interests and a selected list of publications.⁷⁶ The listing is presented in three parts: individuals at governmental and nonprofit institutions, then individuals at universities with several researchers, and finally, individuals working in institutions that do not have more than one individual in the field.

Governmental and Nonprofit Institutions

East-West Center

The East-West Environment and Policy Institute
1777 East-West Road,
Honolulu, HI 96848
(808) 944-7555

Lawrence S. Hamilton: Research Associate.

Involved in research on protected areas and biodiversity, forestlands in development, watershed management, and mountain development.

Maynard M. Hufschmidt: Senior Fellow.

Has been active in field of environmental and natural resource for many years. Researched water resources and environmental/natural resources management and policy and benefit-cost analysis.

James E. Nickum: Research Associate.

Conducts research on economic, institutional, and organization aspects of water resources policy and management.

Resources for the Future

1616 P Street, N.W.
Washington, DC 20036
(202) 328-5000

Michael Bowes: Fellow--Energy and Natural Resources Division. Specializes in issues concerning: forests--economics, Forest Service planning, and multiple-use management; land use--public/private management; natural resources--economics; outdoor recreation; and public lands. Studying issues in multiple-use management and the demands for nonmarket

services of national forests.

Publications include:

"Multiple-use Management of Public Forestland." In A. V. Kneese and J. L. Sweeney, eds. Handbook of Natural Resource and Energy Economics V2. (North-Holland Press, 1985).

Multiple-Use Management: The Economics of Public Forestlands. (with Krutilla) (Washington, DC: Resources for the Future, 1989).

Marion Clawson: Senior Fellow--Energy and Natural Resources Division.

Specializes in issues concerning: forests--general; land use--agriculture; outdoor recreation; and public lands.

Publications include:

New Deal Planning: The National Resources Planning Board. (for Resources for the Future) (Baltimore: Johns Hopkins University Press), 1981.

The Federal Lands Revisited. (Washington, DC: Resources for the Future, 1983).

Statistics on Outdoor Recreation. (Washington, DC: Resources for the Future, 1984).

Jeffrey Hyman: Fellow--Quality of the Environment Division.

Specializes in following issues: biodiversity; ecology/ecosystems--general, modelling; fisheries--management; forests--general, deforestation, species preservation.

Publications include:

"Ecological Stability in the Context of Multispecies Fisheries." Canadian Journal of Fisheries and Aquatic Science. (With S. L. Pimm).

"An Individual-based Simulation Model of Herbivory in a Heterogeneous Landscape." In M. G. Turner and R. H. Gardner, eds. Quantitative Methods in Landscape Ecology. In press.

Allen V. Kneese: Senior Fellow--Quality of the Environment Division.

A pioneer in the field of environmental and natural resource economics. Received the 1990 Volvo Environment Prize along with John Krutilla. The committee said: "Krutilla and Kneese established Resource and Environmental Economics as a respectable and comprehensive research discipline.... They were the first to combine economics with ecology, systematically analyzing the various aspects of environmental impact in relation to the prevailing economic system.... The advances to date in environmental economics are based exclusively on the pioneering work by Krutilla and

Kneese." (Association of Environmental and Resource Economists Newsletter, November 1990, p. 3.)

Publications include:

Pollution, Prices, and Public Policy. (With C. E. Schultze) (Washington, DC: Brookings Institution and Resources for the Future, 1975).

Economics and the Environment. (Penguin Books, 1977).

The Southwest Under Stress: National Resource Development Issues in a Regional Setting. (With F.L. Brown) (Baltimore: Johns Hopkins University with Resources for the Future, 1981).

Measuring the Benefits of Clean Air and Water. (Washington, DC: Resources for the Future, 1984).

John V. Krutilla: Former Senior Fellow. Presently private consultant in Virginia.

A pioneer in the field of environmental and natural resource economics. Earned the 1990 Volvo Environment Prize. Contributions include some of the original work on establishing natural resource management in an economic framework, application of relevant concepts from welfare economics for the valuation of non-priced resource services.

Publications include:

The Economics of Natural Environments. (With A. Fisher) (Baltimore: Johns Hopkins University Press, 1975).

Explorations in Natural Resource Economics. (With V. K. Smith) (Baltimore: Johns Hopkins University Press, 1982).

Norman Rosenberg: Senior Fellow--Energy and Natural Resources Division.

Specializes in agriculture--environmental impacts, irrigation; climate change/variability--general, agricultural aspects, forestry effects, policy, response, water supplies; ecology/ecosystems--general; forests--deforestation; international environmental issues--general, climate change, environment and development; land use--agricultural; ozone--stratospheric; water supply--agricultural use.

Publications include:

Greenhouse Warming: Abatement and Adaptation. (Washington, DC: Resources for the Future, 1989).

"From Climate and CO₂ Enrichment to Evapotranspiration." In Waggoner, P. E., ed. Climate Change and U.S. Water Resources. John Wiley, 1990.

Robert Sedjo: Senior Fellow--Energy and Natural Resources. Specializes in the following issues: acid rain--forestry effects; biodiversity; climate change--forestry effects; forests--general, deforestation, economics, international forestry, property rights, species preservation, timber supply, tropical forests; land use--public/private management; natural resources--economics; trade--general, forest products.

Publications include:

The Comparative Economics of Plantation Forestry: A Global Assessment. (Washington, DC: Resources for the Future, 1983).

Investments in Forestry, Land Use, and Public Policy. (Boulder: Westview Press, 1985).

"Tropical Forests, Land Use and Environmental Values: Economic Concepts and Real World Complexities." In The Long-Term Adequacy of World Timber Supply. (With Kenneth Lyon) (Washington, DC: Resources for the Future, 1990).

Robert Stavins: University Fellow. Assistant Professor of Public Policy at the John F. Kennedy School of Government, Harvard University.

Specializes in the following issues: acid rain--policy; air pollution--economic incentives, policy, regulation; benefit cost analysis; environmental regulation; forests--deforestation, economics; land use--agriculture, public/private management; natural resources--economics, policy; regulatory policy--state/federal; technological changes; water supply--general, agricultural use, institutional/economic issues.

Publications include:

"Harnessing Market Forces to Protect the Environment." Environment (January/February 1989).

"Clean Profits: Using Economic Incentives to Protect the Environment." Policy Review (Spring 1989).

United Nations Statistical Office
2 United Nations Plaza
New York, NY 10017
(212) 697-3232

Peter Bartelmas: Chief, Environmental Statistics Section. Currently working on national income accounting.

Publications include:

Accounting for Sustainable Development. Working Paper 8. New

York: United Nations Department of International Economic and Social Affairs, 1987.

"Beyond GNP: New Approaches to Applied Statistics." The Review of Income and Wealth 33 (December 1987).

"Environmental Accounting and the System of National Accounts." Environmental Accounting for Sustainable Development. (Washington, DC: World Bank, 1989).

Jan Von Tongeren: Chief--National Accounts Section. Currently working on national income accounting.

Publications include:

SNA Framework for Environmental Satellite Accounting. (With P. Bartelmus) (New York: United Nations Statistical Office, 1988).

The World Bank
1818 H Street, N.W.
Washington, DC 20433
(202) 477-1234

Hans Binswanger: Division Chief--Agriculture Operations, Latin America and Caribbean Region.

Publications include:

Agricultural Mechanization: A Comparative Historical Perspective. (Washington, DC: World Bank 1984).

Contractual Arrangements, Employment, and Wages in Rural Labor Markets in Asia. (With Mark Rosenzweig) (New Haven, CT: Yale University Press, 1984).

Brazilian Policies that Encourage Deforestation in the Amazon. (Washington, DC: World Bank, 1989).

"The Dilemma of Modern Man and Nature: An Exploration of the Faustian Imperative." Ecological Economics (October 1990). (With M. Faber, and R. Manstetten).

Herman E. Daly: Senior Economist--Environmental Department. Professor of Economics at Louisiana State University. Associate editor of Ecological Economics.

Research interests are economic development, population, resources, and environment. Has written over 75 articles and 4 books.

Publications Include:

"The Population Question in Northeast Brazil: Its Economic and Ideological Dimensions." Economic Development and

Cultural Change (July 1970).

Economics, Ecology, Ethics. (With John Cobb, Jr.) (San Francisco: W. H. Freeman and Co., 1980).

For the Common Good: Redirecting the Economy Toward Community, the Environment, and a Sustainable Future. (With John Cobb, Jr.) (Boston: Beacon Press, 1989).

"Carrying Capacity as a Tool of Development Policy: The Ecuadorian Amazon and the Paraguayan Chaco." Ecological Economics (October 1990).

Steady-State Economics: Second Edition with New Essays, (Washington, DC: Island Press, 1991).

John Dixon: Environmental Economist--Latin America and Caribbean Region. Research associate at the East-West Center Environment and Policy Institute from 1981-1990.

Has studied the process of economic valuation and been involved in applied work on various resources including protected areas, mangroves, watersheds, drylands, and ground and surface water. Co-author or co-editor of eight books on these topics.

Publications include:

Environment, Natural Systems, and Development. (Baltimore: Johns Hopkins University Press, 1983).

Watershed Resources Management. (Boulder: Westview Press, 1986).

Economic Analysis of the Environmental Impacts of Development Projects. (London: Earthscan Press, 1988).

Economics of Protected Areas: A New Look at Benefits and Costs. (With Paul Sherman) (Washington, DC: Island Press, 1990).

Robert Goodland: Advisor--Environmental Assessment, Environment Department.

A tropical ecologist, Goodland has written numerous books on topics including the cerrado ecosystem of Brazil, tropical hydroprojects, and tropical agriculture, tribal peoples, wildland management, and cultural property.

Publications include:

"Neoclassical Economics and Principles of Sustainable Development." Ecological Modelling 38 (1987).

Race to Save the Tropics: Ecology and Economics for a Sustainable Future. (Washington, DC: Island Press, 1990).

Tropical Deforestation: Solutions, Ethics and Religions.
(Washington, DC: World Bank Environment Department, January 1991).

"Tropical Moist Forest Management: The Urgency of Transition to Sustainability." In Ecological Economics. To be published in 1991 by Columbia Press.

Ernst Lutz: Senior Economist--Environmental Department.

Publications include:

"Agricultural Protectionism in Industrialized Countries and its Global Effects: A Survey of Issues." Aussenwirtschaft (December 1980). (With Malcolm Bale).

"Penetration of Industrial Country Markets by Agricultural Products from Developing Countries. World Development (September 1983).

Environmental Accounting for Sustainable Development. (ed. with S. El Serafy and Y. J. Ahmad) (Washington, DC: The World Bank, 1989).

William Magrath: Natural Resource Economist--Environmental Department.

Formerly an associate with World Resources Institute and on the staff at Cornell University. Has graduate degrees in natural resources and economics from the University of Michigan.

Publications include:

The Costs of Soil Erosion on Java: A Natural Resource Accounting for Indonesia. (With Peter Arens) (Washington, DC: World Resources Institute, 1987).

Salah El Serafy: Economic Adviser--Economic Advisory Staff in the Office of the Senior Vice President-Operations.

El Serafy works on structural adjustment and on the Bank's development strategy in a country context. Active in, and very concerned about, integrating environmental issues into the Bank's country economic work. Was a member of the U.N. Environmental Programme's Montreal Protocol International Economics Panel and the follow-up International Economic Panel. Works on issues concerning national resource accounting.

Publications include:

Costa Rica: Country Economic Memorandum. Latin America and the Caribbean Country Operations Department. (Washington, DC: World Bank, 1988).

Environmental Accounting for Sustainable Development. (ed. with E. Lutz and Y. J. Ahmad) (Washington, DC: The World

Bank, 1989).

Natural Resource Accounting: An Overview. Paper presented to Overseas Development Institute. London, March 27, 1990.

The Environment as Capital. Paper presented at Conference on the Ecological Economics of Sustainability. Washington, DC, May 21-23, 1990.

United States Department of Agriculture
(Address and phone listed for each researcher)

Patrick B. Durst: Coordinator--Asia/Near East Programs.
USDA Forest Service
Forestry Support Program
201 14th St. S.W.
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Washington, DC 20090-6090
(202) 453-9589

Project design, evaluation, and technical support for forestry development projects. Economic analysis of energy and biomass projects, alternative economic opportunities for forest dwellers. Coordinator, Forestry Support Program, providing technical support to U.S. Agency for International Development's forestry and natural resources projects in Asia.

Publications include:

"Inaccuracies in Forest Products Trade Statistics." Forest Products Journal 36, no.9 (1986).

"Wood-fired Power Plants in the Philippines: Financial and Economic Assessment of Wood Supply Strategies." Biomass 11, no. 2 (1986).

"Nature Travel and Tropical Forests." Journal of Forestry 85, no. 5 (1987). (With J. Laarman).

Dr. William F. Hyde: Branch Chief--Economic Research Service.
1713 37th St. N.W.
Washington, DC 20007
(202) 219-0410

Current research on forestry and rural development; distributive impacts of forest policies; tropical forestry. Also Adjunct Professor, Duke University, and Associate Fellow, London Environmental Economics Centre. Previously Senior Research Associate, Resources for the Future; and Associate, Winrock International. Supervising 25 resource economists and policy analysts in focusing on supply and technology in irrigated agriculture, agricultural impacts on water quality, and global change.

Publications include:

Timber Supply, Land Allocation, and Economic Efficiency. (Baltimore: Johns Hopkins University Press, 1980).

Forestry Sector: The Impacts of Public Regulation on Social Welfare. (With R. Boyd) (Ames: Iowa State University Press, 1989).

The Economic Benefits of Forestry Research. (With D. Newman and B. Seldon) (Ames: Iowa State University Press, 1991).

Forestry and Rural Community Development: An Empirical Introduction from South and Southeast Asia. (London and New Delhi: Oxford University Press, forthcoming).

"The Financial and Economic Feasibility of Tropical Forestry Systems. In R. Sedjo and J. Douglas, eds. Management of Tropical Forests. Forthcoming--1992.

World Resources Institute
1709 New York Ave. N.W.
Washington, DC 20006
(202) 638-6300

Wilfredo Cruz: Associate--Economics and Institutions.

Involved in the following issues: development (economics); environmental and resource economics; international economics; soil conservation. Background: Associate Professor of Economics and Executive Director, Center for Policy and Development Studies, University of the Philippines at Los Banos; Consultant, Forestry, Fishery and Agricultural Resource Management Project (FFARM), World Bank.

Work for World Resources Institute includes: studies of the effects of structural adjustment on the environment; and national income accounting, including Costa Rica.

Robert Repetto: Director--Program in Economics and Institutions.

Involved in the following issues: conservation/development financing; debt-for-nature swaps; development (economics); environmental and resource economics; forestry; international economics; tropical forest, international institutions. Formerly an associate professor of economics in the School of Public Health at Harvard University and economics faculty member at Harvard's Center for Population Studies.

Publications include:

Wasting Assets: Natural Resources in the National Income Accounts. (Washington, DC: World Resources Institute, 1989).

The Forests for the Trees? Government Policies and the Misuse of Forest Resources. (Washington, DC: World Resources Institute, 1988).

Daniel B. Tunstall: Senior Associate--Program in Resource and Environmental Management.

Involved in the following issues: environmental data and statistics; environmental indicators; environment--country profiles and assessments. Experience includes: manager, information sources and planning, IBEX International/Mead Data Central; Director of Research, World Resource Report, World Resources Institute; consultant on environmental reporting, Council on Environmental Quality.

Universities

Duke University

School of Forestry and Environmental Studies
Durham, NC 27706
(919) 684-2135

Malcolm Gillis: Dean of Faculty of Arts and Science.

Publications include:

Economics of Development. (New York: W.W. Norton, 1987).

Deforestation and Government Policy. (With Repetto) (San Francisco: ICS Press, 1988).

Tax Reform in Developing Countries. (ed). (Durham, N.C.: Duke University Press, 1989).

Robert Healy: Professor--School of Forestry and Environmental Economics.

Involved with issues of land-use and environmental policy in the United States and developing countries. Was a senior associate at World Wildlife Fund. Currently researching environmental problems of Mexico and Central America and economic and environmental impacts of tourism in developed and developing countries. Teaches a course in land-use and environmental policy and is a collaborator in the Duke Program in International Development Policy and in the joint Duke-North Carolina State University program in conservation and sustained development.

Publications include:

Incorporating Environmental Information in Natural Resources Policy Making: A Policy Process Approach. Paper prepared for the Association of Public Policy Analysis and Management, San Francisco, October 1990. (With W. Ascher).

"Forest Valuation." World Bank Forest Policy Study (October 1990). (With R. Kramer and R. Mendelsohn).

Randall Kramer: Associate Professor--School of Forestry and Environmental Studies.

Research on quantitative economic analysis of the environment. Currently researching economic valuation of environmental amenities. Kramer believes that valuation techniques need to be refined in order to provide citizens and policy makers with better information on the economic impacts of environmental policies. Involved in a valuation study to estimate environmental costs and benefits of large scale development projects in developing countries.

Publications include:

"The Integration of Farm Programs for Achieving Soil Conservation and Nonpoint Pollution Control Objectives." Land Economics 62 (1986).

"An International Overview of Soil Conservation Policy." Agriculture and the Environment. (Washington, DC: Resources for the Future, 1986).

"Forest Valuation." World Bank Forest Policy Study (October 1990). (With R. Healy and R. Mendelsohn).

Evan D. Mercer: Resource Economist--School of Forestry and Environmental Studies.

Recently awarded Ph.D. Dissertation was entitled "Application of household production theory to selected natural resource problems in less developed countries." Currently estimating value of tropical forest in Madagascar for World Bank, Environment Department; Research, East-West Center Environment and Policy Institute, Honolulu; social forestry, agroforestry, watershed management; Consulting Resource Economist, World Bank, Household Energy Department, developed methodology for fuelwood valuation; Consultant, Winrock.

Publications include:

"Mangrove Ecosystem: Some Economic and Natural Benefits." Nature and Resources 20 (1984).

"Putting Social and Community Forestry in Perspective in the Asia Pacific Region." In Man, Agriculture, and Tropical Forests: Change and Development in the Philippine Upland. (Bangkok, Thailand: Winrock International, 1986).

"Fuelwood: An Analysis of Problems and Solutions for Less Developed Countries." World Bank Forestry Policy Review (December 5, 1990).

"Economics of Agroforestry." Agroforestry and the Social Sciences. (Delhi, India: Oxford University Press, 1990).

Harvard Institute for International Development
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Cambridge, MA 02138
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Theodore Panayotou: Research Associate and lecturer on economics.

Publications from HIID include:

An Econometric Study of the Causes of Tropical Deforestation: The Case of Northeast Thailand. March 1989.

Economics, Environment and Development. December 1987.

The Economics of Man-made Natural Disasters: The Case of the 1983 Landslides in South Thailand. United States Agency for International Development, August 1989.

Natural Resources and the Environment in the Economies of Asia and the Near East: Growth, Structural Change, and Policy Reform. July 1989.

Natural Resource Management Strategies for Sustainable Asian Agriculture in the 1990s. September 1988.

Thailand's Management of Natural Resources for Sustainable Development: Market Failures, Policy Distortions, and Policy Options. May 1988.

Jeffrey Vincent: Institute Associate.

Publications include:

"Growth of the Forest Products Industry in Malaysia: 1961-1985." Malaysian Forester 49, no. 3 (1986).

"Malaysia: Key Player in International Trade." (ed.). Journal of Forestry 86, no. 12 (1988).

Utilization Without Conversion: Natural Management of Tropical Moist Forests. (With F. Mergen) (New Haven, CT: Yale University School of Forestry and Environmental Studies, 1987).

"Don't Boycott Tropical Timber." Journal of Forestry 88, no. 4 (1990).

"Rent Capture and the Feasibility of Tropical Forest Management." Land Economics 66, no. 2 (1990).

Forest-based Industrialization: A Dynamic Perspective. A

World Bank Forest Policy Issues Paper, November 26, 1990.
(With Clark Binkely).

Demand for Sawntimber of Less-known Species in Peninsular Malaysia. In preparation (with I. H. Ahmad).

North Carolina State University
Graduate School
Box 7102
Raleigh, NC 27695
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Jan G. Laarman: Associate Professor--Department of Forestry.
Research interests are: forestry economics, emphasizing forestry in regional economic developments; economics of small-scale enterprise in forestry and forest industries; institution building, training and education, government policies; forest products trade, economic incentives, and forest-based enterprises.

Publications include:

"Nature Travel and Tropical Forests." Journal of Forestry 85, no. 5 (1987). (With P. Durst).

The Economic Outlook for Forestry in Tropical America: A Hazardous Period for Projections. FPEI Working Papers Series, June 1987.

Kerry Smith: University Distinguished Professor--Department of Economics.

Evaluation of natural resources, including the measurement of natural resource scarcity and the treatment of natural resources in economic models. Conducted an evaluation of the authenticity of neoclassical models' descriptions of factor input substitution and nonneutral technical change. Working on the modelling and estimation of individuals' willingness to pay for risk reductions and the evaluation of the performance of partial equilibrium measures of welfare changes.

Publications include:

"Can Public Information Programs Affect Risk Perceptions?" Journal of Policy Analysis and Management (Winter 1990). (With William Desvousges et al.).

"Can We Measure the Economic Value of Environmental Amenities?" Southern Economic Journal (April 1990).

"Signals or Noise? Explaining the Variation in Recreation Benefit Estimates." American Journal of Agricultural Economics (May 1990). (With Yoshiaki Kaoru).

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Berkeley, CA 94720
(415) 642-6000

M. G. Chandrakanh: Research Associate--Department of Forestry
and Resource Management.
Room 201, Mulford Hill
Berkeley, CA 94720
(415) 642-3765
Teaching Agricultural and Resource Economics.

Anthony Fisher: Professor--Department of Agricultural and
Resource Economics.
Research in valuing tropical forests; combining ecological
and economic models in policy analysis; alternative ways of
coping with periodic water shortages; behavior of world oil
prices.

Publications include:

"Energy Taxes and Economic Performance: A Regional General
Equilibrium Analysis." Energy Economics 11, no. 2 (April
1989).

"Option Value: Theory and Measurement." European Review of
Agricultural Economics 17, no. 2 (1990). (With W. H.
Hanemann).

"Endangered Species: The Economics of Irreversible Damage."
In Hall, D. O., N. Myers, and M. S. Margaris, eds., Economics
of Ecosystem Management. (With W. H. Hanemann).

Michael W. Hanemann: Associate Professor--Department of
Agricultural and Resource Economics.

Publications include:

"Welfare Evaluations in Contingent Valuation Experiments
with Discrete Response Data: Reply." American Journal of
Agricultural Economics 71, no. 4 (November 1989).

Option Value: Theory and Measurement. European Review of
Agricultural Economics 17, no. 2 (1990). (With A. Fisher).

"Endangered Species: The Economics of Irreversible Damage."
In Hall, D. O., N. Myers, and M.S. Margaris, eds., Economics
of Ecosystem Management. (With A. Fisher).

Richard B. Norgaard: Associate Professor of Energy and Resources.

**Energy and Resource Group
Room 100, Building T4
Berkeley, California 94720
(415) 642-3465**

Publications include:

Environmental Economics: An Evolutionary Critique and a Plea for Pluralism. Division of Agricultural Sciences, University of California, Berkeley, 1984.

"Coevolutionary Development Potential." Land Economics 60, no. 2 (1984).

The Economics of Cattle Ranching in Eastern Amazonia. University of California, Agricultural Experiment Station Working Paper 332, 1984.

"The Economics of Biological Diversity: Apologetics or Theory?" In Sustainable Resource Development in the Third World. (Boulder: Westview Press, 1987).

"The Rise of the Global Exchange Economy and the Loss of Biological Diversity." In Biodiversity. (Washington, DC: National Academy Press, 1988).

**University of Maryland
College Park, MD 20742
(301) 454-1000**

Robert Costanza: Professor--Coastal and Environmental Policy Program.

**Center for Environmental and Estuarine Studies
Chesapeake Biological Laboratory
University of Maryland
Solomons, MD 20688-0038
(301) 326-4281**

Founded the International Society for Ecological Economics.
Editor-in-Chief of the journal Ecological Economics.

Publications include:

"Valuation and Management of Wetland Ecosystems." Ecological Economics 1 (1989). (With Stephen Farber and Judith Maxwell).

"A Flexible Assurance Bonding System for Improved Environmental Management." Ecological Economics (April 1990). (With C. Perrings).

Ecological Economics: The Science and Management of Sustainability. (ed.) (New York: Columbia University Press,

1991).

Mark Sagoff: Research Scholar--Center for Philosophy and Public Policy.

Publications include:

"Some Problems with Environmental Economics." Environmental Ethics (Spring 1988).

The Economy of the Earth: Philosophy, Law, and the Environment. (Cambridge: Cambridge University Press, 1988).

University of Minnesota
110 Green Hall
1530 Cleveland Avenue
St. Paul, MN 55108
(612) 625-5212

Paul Ellefson: Professor of Forest Economics and Policy--
Department of Forest Resources.

Publications include:

Forest Resource Economics and Policy Research: Strategic Directions for the Future. (ed). (Boulder: Westview Press, 1989).

Hans Gregersen: Professor--College of Natural Resources.
FAO Forestry Officer, consultant to international technical assistance and donor organizations. Teaching and research in economics of forestry and watershed management.

Publications include:

Valuing Goods and Services from Tropical Forests and Woodlands. Report prepared for the United States Congress, Office of Technology Assessment. Washington, DC, June 1985.

Guidelines for Economic Appraisal of Watershed Management Projects. UNIPUB, 1987.

People and Trees: The Role of Social Forestry in Sustainable Development. World Bank, 1989.

Allen L. Lundgren: Adjunct Professor--Department of Forest Resources.

Research Fellow, Environment and Policy Institute; organizes and conducts workshops on Forestry Research for Sustainable Development, Asia-Pacific region. Consultant for U.S. Agency for International Development, Forestry/Fuelwood Research and Development project in Asia. Director, Forestry for Sustainable Development Program, University of Minnesota.

University of Washington
Seattle, WA 98195
(206) 543-7081

Gardner Brown: Chairman, Department of Economics

Has written on fisheries, valuing recreation, wildlife including endangered species and water fowl, genetic diversity; involved in WWF project valuing elephants in Kenya. Initially interested in water quantity development; later, analyzed managing water quality in the Western United States. Teaches graduate level course on natural and environmental economics dealing with fisheries, forestry, benefit-cost analysis. Has worked as a consultant for numerous organizations including: National Oceanographic and Atmospheric Administration, State of Alaska, U. S. Forest Service, Environmental Protection Agency, U.N. Food and Agriculture Organization, and Audubon Society.

Publications include:

"The Hedonic Travel Cost Method." Review of Economics and Statistics 66, no. 3 (August 1984). (With R. Mendelsohn).

"Preserving Endangered Species and Other Biological Resources." In Recherche Economique 39, no. 4 (October-December 1985).

Economics of Natural Resource Damage Assessment: A Critique. Paper presented at conference at Resources for the Future, June 16-17, 1988.

The Preservation and Valuation of Biological Resources. (ed. with Gordon H. Orians, et al.) (Seattle: University of Washington Press, 1989).

The Economic Value of Elephants. International Institute for Environment and Development, LEEC Paper 89-12. London Environmental Economics Centre, 1989.

Greg Ellis: Assistant Professor.

Research includes: environmental contingent evaluation methods, evaluation method for oil drilling off Oregon and Washington--model building and diagnosis and recreation, environmental amenity diagnosis.

Robert Lee: Professor of Forest Resources--College of Forest Resources.

Studies sociology of natural resources; community studies, forestry institutions that mediate sustainable relations to forests, property rights, human use of environment; problems of community structure.

University of Wisconsin at Madison
Madison, WI 53706
(608) 262-8966

Richard Bishop: Professor of Agricultural Economics--Center for Resource Policy Studies and the Institute for Environmental Studies.

Does research and teaches graduate courses in natural resource and environmental economics, with emphasis on renewable resource management, welfare theory and benefit-cost analysis, and valuation of nonmarket commodities. His applied research has focused on a variety of topics including endangered species policy. Present research is "Net Social Cost Assessment for Conserving Biological Diversity in Costa Rica's Talamanca Region."

Publications include:

"Contingent Valuation Methods." (With Thomas A. Heberlein) In R. L. Johnson and G.V. Johnson, eds. Economic Valuation of Natural Resources, (Boulder: Westview, 1990).

"Endangered Species and Uncertainty: The Economics of a Safe Minimum Standard." Journal of Agricultural Economics 60 (1978).

"Endangered Species: An Economic Perspective." Transcripts of the North American Wildlife and Natural Resources Conference 45 (1980).

"Economic Values Defined." In D. J. Decker and G. R. Goff, eds. Valuing Wildlife: Economic and Social Perspectives. (Boulder: Westview Press, 1987).

Natural Resource Economics: Selected Papers. (ed. with Stephen O. Anderson) (Boulder: Westview Press, 1985).

Daniel W. Bromley: Anderson-Bascom Professor of Agricultural Economics. Director of Institute for Environmental Studies. Professional interests are: economic aspects of natural resource use; role of natural resources in economic development; property rights in natural resources. Teaches graduate-level courses in Institutional Economics; Natural Resources and Markets; Advanced Benefit-Cost Analysis; Workshops in Resource Economics; Advanced Natural Resource Economics; Economics of Public Decision Making; Water Resource Economics.

Publications include:

"Institutional Change and Economic Efficiency." Journal of Economic Issues 23, no. 3 (September 1989).

Contemporary Analysis. (ed). (Boston: Kluwer-Nijhoff, 1986).

Economic Interests and Institutions: The Conceptual Foundations of Public Policy. (Oxford: Basilwell, 1989).

"Property Relations and Economic Development: The Other Land Reform." World Development 17, no. 6 (June 1989).

"The Ideology of Efficiency: Searching for a Theory of Policy Analysis." Journal of Environmental Economics and Management 19, no. 1 (July 1990).

"Private Property Rights and Presumptive Policy Entitlement: Reconsidering the Premises of Rural Policy." (with Ian Hodge). European Review of Agricultural Economics 17 (Spring 1990).

"Property Rights as Authority Systems: The Role of Rules in Resource Management." Journal of Business Administration 19, no. 2 (1990/91).

Environmental and Economy: Property Rights and Public Policy. (Oxford: Basil Blackwell, 1991).

Yale University
School of Forestry and Environmental Studies
205 Prospect Street
New Haven, CT 06511
(203) 432-3626

Robert Evenson: Professor of Economics and Professor of Agricultural Economics--School of Forestry and Environmental Studies.

Focuses on the problems and policies of agricultural development in terms of the agricultural household and the development and adaption of improved technology. Has done empirical studies of farm households in India, Brazil, Philippines, and Thailand. Technology studies have examined the public sector research institutions, research and development, and invention in both public and private enterprises.

Publications include:

"Tropical Forests in Economic Development." In Tropical Forests Utilization and Conservation. An international symposium held at Yale University, April 15-16, 1981.

"Institutional Change in Intellectual Property Rights." American Journal of Agricultural Economics 69, no. 2 (1987).

"Technology Production and Technology Purchase in Indian Industry: An Econometric Analysis." Review of Economics and Statistics 17, no. 4 (November 1989).

Robert Mendelsohn: Associate Professor of Forest Policy and Associate Professor of Economics--School of Forestry and Environmental Studies.

Professor Mendelsohn has written on issues concerning nonmarket commodities such as wildlife, air pollution, and recreation sites. Has also examined theoretical issues in natural resources including dynamic models of forestry, forest taxation, and common property fisheries.

Publications include:

"A Review of Identification of Hedonic Supply and Demand Functions." Growth and Change 18, no. 1 (Winter 1987).

"Information and Exhaustible Resources: A Bayesian Analysis." Journal of Environmental Economics and Management 16, no. 3 (May 1989).

Individual Researchers

Juan Carlos Belausteguigoitia Ruis: Lecturer in Economics.
Instituto Tecnológico Autónomo de México (ITAM)
Departamento Académico de Economía
Río Hondo #1, Colonia Tizapan San Ángel
Delagación Alvaro Obregón
México DF 01000
(525) 548-3212

Research interests: environmental economics and regulation. Juan Carlos will be in the United States on a Fulbright scholarship from September 1991 until August 1992. Courses taught at ITAM: mathematical methods, introductory microeconomics, economics of pollution, economics of exhaustible resources. Presently working on an applied forestry project for WWF.

Publications include:

Contaminación e Intervención Gubernamental. Paper presented to Congress "Metropolis 87."

The Economics of Environmental Deterioration in Mexico. Paper presented to the Seminar on Latin America. St. Anthony College, Oxford.

Environmental Protection and Green Lobbying. ITAM, March 1989.

Environmental Economics in Mexico. Paper presented at the "Centro de Investigación en Matemáticas." Guanajuato, Mexico.

Kenneth Boulding: Professor Emeritus.
University of Colorado
Boulder, CO 80309
(303) 492-1411

Pioneer in the field of environmental economics.

Publications include:

The Meaning of the Twentieth Century. (New York: Harper and Row, 1964).

Beyond Economics. (Ann Arbor: University of Michigan Press, 1968).

Ecodynamics: A New Theory of Societal Evolution. (Newbury Park, CA: Sage, 1978).

Evolutionary Economics. (Newbury Park, CA: Sage, 1981).

The Meaning of the Twentieth Century: The Great Transition. (Lanham, MD: University Press of America, 1988).

Norman R. Collins: Program Officer--Rural Poverty and Resources Program.

Ford Foundation
320 E. 43rd St.
New York, NY 10017
(212) 573-4778

Responsible for the coordination of the Ford Foundation's worldwide Rural Poverty and Resources Program.

Ralph D'Arge: Professor of Economics.
University of Wyoming
Laramie, WY 82071
(307) 766-1121

Has been involved in natural resource and environmental economics for over 20 years. Founded the Journal of Environmental Economics and Management.

Partha Dasgupta: Professor--Department of Economics
Stanford University
Stanford, CA, 94305
(415) 723-3987

Works at Stanford University and Cambridge University. Works on issues concerning the relation of development and resource, and ethical issues.

Publications include:

The Control of Resources. (Cambridge: Harvard University Press, 1983).

Economic Policy and Technological Performance. (Cambridge: Cambridge University Press, 1987).

Steven E. Dennison: Natural Resource Economist.
Associates in Rural Development Inc.
P.O. Box 1397
Burlington, VT 05402
(802) 658-3890

Charles Howe: Professor of Economics. Director--Environment and Behavior Program.
Campus Box 468
University of Colorado
Boulder, CO 80309
(303) 492-7245

President of the Association of Environmental and Resource Economists. On leave 1991-1992 in the Netherlands. Research on combining traditional and modern technologies in the Third World; Water transfers and their impacts; perceptions of risk by utility customers and managers; measurement of natural hazard damages.

Publications include:

"Project Benefits and Costs from Natural and Regional Viewpoints." Natural Resources Journal (Winter 1987).

"Water Resources of the Upper Colorado River Basin." In Water and Arid Lands of the Western U.S. (Cambridge: Cambridge University Press, 1988).

"Public Intervention Revisited: Is Vulnerability Vulnerable?" In Environmental Resources and Applied Welfare Economics. (Washington, DC: Resources for the Future, 1988).

Eric L. Hyman: Program Economist.
Appropriate Technology International
Suite 1200
1331 H Street N.W.
Washington, DC 20005
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Affiliations: United States Congress Office of Technology Assessment; East-West Center Environment and Policy Institute; Winrock International; Social Impact Assessment Center. Feasibility study of high-value coconut products, South Pacific. Evaluation of labor-saving technologies for processing palm oil and peanut butter.

Publications include:

"The Strategy of Production and Distribution of Improved Charcoal Stores in Kenya." World Development 15 (1987).

Combining Facts and Values in Environmental Impact Assessment: Theories and Techniques. (Boulder: Westview Press, 1988).

Charles Perrings: Professor.
Department of Economics
University of California, Riverside
Riverside, CA 92521-0427
(714) 787-3394

Research includes: in Botswana, the link between and the structure of rural communities and use of natural resources; international labor organizations connection to resource and income, focusing on technology and employment. Program Director on biodiversity issues at the Beijer Institute in Sweden, which is being established. The Institute will be involved in ecological and economic questions covering a full range of questions: theoretical case studies drawn from different terrains--tropical forests, marine ecosystems, dryland ecosystems, northern wetlands. Presently teaching environmental development courses and history of economic thought. Formerly worked for the London Environmental Economics Centre (LEEC), the University of Auckland, and the University of London.

Publications include:

Natural Resource Accounts for Botswana: Environmental Accounting for a Resource-Based Economy. LEEC Paper 89-11, November 1989. (With A. Gilbert, D. Pearce, and A. Harrison).

Industrial Growth, Rural Income, and the Sustainability of Agriculture in the Dual Economy. LEEC Paper 89-13, December 1989.

"A Flexible Assurance Bonding System for Improved Environmental Management." Ecological Economics (April 1990). (With R. Costanza).

The Preservation of Natural Capital and Environmental Control. Centre for Resource and Environmental Economics, Australian National University, 1991.

Towards an Ecological Economics of Sustainability. Center for Resource and Environmental Economics, Australian National University, 1991. (With M. Common).

Henry Peskin: President of Edgevale Associates.
1210 Edgevale Road
Silver Spring, MD 20910
(301) 588-2533

With over 20 years experience as a research economist, Peskin specializes in: cost-benefit analysis, environmental policy analysis, environmental statistics, and resource accounting. In the area of national income accounting worked as consultant for Environmental Protection Agency, U.S. Agency for International Development, and World Bank. Was a

Senior Fellow at Resources for the Future. Presently consulting the Environmental Protection Agency on environment and natural resource accounting for Chesapeake Bay. For USAID he is doing national income accounting for the Philippines.

Publications include:

Two Papers on National income Accounting and the Environment. Discussion Paper D-71. (Washington, DC: Resources for the Future, 1980).

"One More Externality Article." Journal of Environmental Economics and Management (September 1988).

Cost-Benefit Analysis of Environmental Policy. Address presented at the World Bank Seminar of Environmental Issues in Urban Management, Washington, DC, May 30, 1989.

"Environmental and Nonmarket Accounting in Developing Countries." In Environmental Accounting for Sustainable Development. (Washington, D.C.: The World Bank, 1989).

"A Proposed Environmental Accounts Framework." In Environmental Accounting for Sustainable Development. (Washington, D.C.: The World Bank, 1989).

"Productivity and the Pendulum: Nonmarket Accounting and Productivity Measurement." In Roger Conway, ed. New Measurement Procedures for U.S. Agricultural Productivity. Forthcoming.

Raymond Prince: Assistant Deputy Director--Economics Institute; Adjunct Professor--Department of Economics at the University of Colorado.

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1030 13th Street
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Research in valuing nonmarket crops; technological change and environmental regulation.

Publications include:

"Some Implications of Delayed Environmental Costs for Benefits-cost Analysis." Growth and Change (1985).

"Firm Incentives to Promote Technological Change in Pollution Control." Journal of Environmental Economics and Management (December 1989).

"Individual Recreation Benefits Under Congestion and Uncertainty." Journal of Leisure Research (1989).

Alan Randall: Professor of Resource Economics and Environmental Policy--Department of Agricultural Economics and Rural Sociology.
The Ohio State University
2120 Fyffe Road
Columbus, OH 43210.
(614) 292-6423

Research involves welfare economics, benefit-cost analysis, and valuation of environmental policy.

Publications include:

"What Mainstream Economists Have to Say About the Value of Biodiversity." In E.O. Wilson, ed. Biodiversity. (Washington, DC: National Academy Press, 1988).

"Nonuse Benefits." In Braden, J.B. and Kolstad, C.D., Measuring the Demand for Environmental Improvement. (Urbana: University of Illinois, 1989).

"The Value of Biodiversity." AMBIO 20 (April 2, 1991).

Paul Sherman: Resource Economist.

Presently an economist for the Hawaiian state government. Previously with East-West Environment and Policy Institute. Has advanced degrees in economics and environmental management. Worked as a consultant to U.S. Agency for International Development projects on protected-area issues in Thailand and Indonesia. Co-authored with John Dixon Economics of Protected Areas: A New Look At Benefits and Costs (Washington, DC: Island Press, 1990).

David Southgate: Associate Professor--Department of Agricultural Economics and Rural Sociology.
Ohio State University
2120 Fyffe Road
Columbus, OH 43210-1099
(614) 292-6409

Research on tropical deforestation, soil erosion, and other environmental problems facing developing countries.

Publications include:

Agricultural Colonization and Environmental Degradation in Frontier Developing Economies. (With David Pearce) (Washington, DC: World Bank, October 1988).

"Downstream Benefits of Soil Conservation." Land Economics (1989).

"Land Degradation Along Third World Agricultural Frontiers." Land Economics (1990).

How to Promote Tropical Deforestation: The Case of Ecuador. Paper presented to International Society for Ecological

Economics, May 1990.

Tom Tietenberg: Professor--Department of Economics.
Colby College
Waterville, Maine 04901
(207) 872-3143

Publications include:

"Poverty Connection to Environmental Policy." Challenge Magazine Economic Affairs Issue 33, no. 5 (September/October 1990).

"Using Economic Incentives to Maintain Our Environment." Environmental and Natural Resource (March 1990).

"Managing the Transition: The Potential Role for Economic Policies." In J. T. Mathews, ed. Preserving the Global Environment. (New York: W. W. Norton and Co., 1991).

Stephen Viederman: President.
Jessie Smith Noyes Foundation
16 East 34th Street
New York, NY 10016
(212) 682-6577

The Foundation funds sustainable agriculture and tropical ecology programs in North and Latin America. Formerly U.N. Fund for Population Activities, involved in population and development planning.

III. ENVIRONMENTAL ECONOMICS TRAINING PROGRAMS AT U.S. UNIVERSITIES

The following section describes the environmental economics training programs at several leading United States universities. Most information was obtained from program brochures, registrars' offices, and interviews with program faculty. It is not a complete list.

**Duke University--School of Forestry and Environmental Studies
Duke University
Durham, NC 27706
(919) 684-2135**

The School of Forestry and Environmental Studies offers a Masters degree in Environmental Management with a possible focus in Resource Economics and Policy. The description of this program states that

...for the natural resource decision maker, the most important social sciences are economics, public policy, and law. Economics includes production economics, the economics of public goods and externalities, public finance, and the intertemporal allocation of natural resources. Public policy includes political science, public administration, and the social science that relate to societies, governments, and natural resource allocation. Quantitative methods, an essential component of this program, include regression analysis, methods of optimization, risk analysis, and decision theory.

Students have the opportunity to be involved in research projects at the Southeastern Center for Forest Economics Research.

Core courses are: resource and environmental economics, resource and environmental policy, and one of three environmental law classes.

Faculty members in this area are: Dutrow, Healy, Kramer, MacKinnon, Parks, Pilkey, Steen, and Wear.

Harvard Institute for International Development (HIID)
One Eliot Street
Room 218
Cambridge, MA 02138
(617) 495-2133

The Biennial Report for 1987-1989 declares that the mission of HIID is three-fold: development assistance, teaching, and research. HIID is an institute and not a school; therefore, HIID staff teach in various schools and faculties at Harvard including the Faculty of Arts and Science, the John F. Kennedy School of Government, Harvard Business School, etc.

Research at HIID is in four broad areas: policy analysis, human capital formation, resource mobilization policies, and agriculture, food policy, and natural resource management.

HIID offers, in conjunction with the Kennedy School of Government, the Edward S. Mason Program in Public Policy and Management, a one-year intensive mid-career Masters degree program in public administration designed for public officials from developing and newly industrialized countries. Its mission "is to train leaders with analytic skills, managerial competence, and ethical sensitivities needed for distinguished public service." The teaching staff is drawn from the Kennedy School and HIID.

HIID also offers special workshops in the summer that range from a week to a few months in duration. If outside funding is provided, HIID will arrange special workshops on specific topics. Workshops for summer 1991 were:

- Food and agricultural analysis;
- Program on investment appraisal and management;
- Fifth annual workshop on budgeting in the public sector;
- Macroeconomic adjustment and food/agricultural policy;
- Public enterprise policy and management in developing countries; and
- Computer-based techniques for education policy analysis and planning.

Faculty members at HIID or the Kennedy School working on environmental economics, forestry, or related topics are: Peter Ashton, Jeffrey Vincent, Theo Panayotou, Shantayanan Devarajan, and Robert Stavins.

**North Carolina State University
Department of Economics and Business
Box 8109
Raleigh, NC 27695-8109
(919) 737-7156**

The Department of Economics and Business offers three Masters degrees: Master of Economics, Master of Science in Agricultural Economics, and a multi-departmental degree, the Master of Science in Management.

Faculty members in agricultural economics are working on such issues as agricultural policy, international trade, pest management, natural resources, agricultural development, agricultural production and marketing, monetary theory, econometrics, labor economics, and decision theory. About 50 students are enrolled in agricultural economics at present.

Faculty members involved in natural resource economics include V. Kerry Smith and Leon Danielson.

**North Carolina State University
Department of Forestry
College of Forest Resources
North Carolina State University
Raleigh, NC 27695-8002
(919) 737-2891**

The Department of Forestry offers two Masters programs, Master of Forestry, and Master of Science. It also offers a Ph.D. program. Courses are offered in forestry economics, business, and taxation. The forest faculty "is involved in a significant number of interdisciplinary research projects with individuals from other departments." The Economics and Business Department is included in the list.

Faculty members involved in forestry economics or related topics include Jan Laarman.

**Southeastern Center for Forest Economics Research
Box 12254
Research Triangle Park, NC 27709
(919) 549-4030**

According to Tom Holmes, a natural resource economist, the U.S. Department of Agriculture Forest Service Southeastern Forest Experiment Station is presently proposing that funds be allocated for tropical forestry economics from its 1992 budget. Holmes mentioned that Duke and North Carolina State are active in putting together a framework for funding to work in tropical

forestry. Jan Laarman is the primary researcher for the Forestry Private Initiative project.

University of California, Berkeley
Energy and Resources Group
Building T4, Room 100
Berkeley, CA 94720
(415) 642-1640

The Energy and Resources Group is an interdisciplinary academic unit of the University of California at Berkeley (UCB), conducting programs of graduate teaching and research that treat issues of energy, resources, development, and international security as the intersection of technological, economic, environmental, and sociopolitical components. Established in 1973, ERG offers two-year M.A. and M.S. degrees in Energy and Resources, as well as a Ph.D.

The faculty comprises "core" professors and "affiliated" faculty members. The core professors are Mark Christensen, John Harte, John Holdren, Jack Hollander, Richard Norgaard, and Gene Rochlin. There are about 90 affiliate faculty from all 5 colleges and 4 of the schools at Berkeley, in addition to guest and visiting professors and researchers, and postdoctoral fellows. The current Chair of the group is forestry professor Jeff Romm.

The program started in the 1970s as a response to the energy crisis. To date, research has focused on

...technical, economic, environmental, and institutional aspects of energy conservation in residential and commercial buildings; comparative environmental assessment of conventional and unconventional energy sources; international comparison of patterns of energy use; roles of energy, resources, and environment in development problems and strategies; economic valuation of energy and environmental resources; scientific and policy dimensions of climate change; acid precipitation, and stratospheric-ozone depletion; problems of water supply and contamination; and linkages among resources, environment, and international security.

The program has about 50 students split evenly between Masters students and Ph.D. students--about 10 Masters and 3 or 4 doctoral students per year. In 1990-1991 enrollment was reduced to 8 positions for Masters students. The students come from diverse backgrounds, from physics to theology. Some of the students are interdisciplinary, integrating everything into their dissertations; some students are crossovers; for example, they start from physics and end up in political science.

The program offers the following economics courses: energy economics; economics of resources and the environment; land and water economics; advanced topics in environmental and resource economics; economics of renewable natural resources; economics of exhaustible natural resources.

Faculty members who are working on environmental and natural economics include Richard Norgaard (core), Michael Hanemann (affiliate), and Anthony Fischer (affiliate).

**University of Maryland
Coastal and Environmental Policy Program
Center for Environmental and Estuarine Studies
Chesapeake Biological Laboratory
University of Maryland
Solomons, MD 20688-0038**

The Graduate Program in Marine-Estuarine-Environmental Sciences offers a M.S. or Ph.D. program. Possible areas of study include marine and estuarine science, environmental biology, environmental chemistry, environmental microbiology, environmental toxicology, environmental and resource economics, environmental management, marine and environmental technology, and fisheries and wildlife management.

Robert Costanza and others are establishing an Institute of Ecological Economics, which will be offering classes in January of 1992. They plan to offer a certificate in ecological economics rather than a degree. The idea, said Costanza, is

...that it can either be a stand alone certificate for people who already have a degree in ecology or economics.... People who are already getting a degree in our ecology or economics departments...could add on the certificate.

The program would be about 18 credit hours required; 9 credit hours for those already getting a degree. Some of the required courses are: ecological economics; ecological economics modelling (both of these courses will be taught in a block mode, i.e., workshop). The courses would focus on particular problems rather than techniques and would go for two to four weeks in solid blocks. The courses would be taught by teams of people from different disciplines. The focus will be issues, and then the appropriate tools will be brought in. Courses will begin next January.

National Science Foundation will be funding, Costanza hopes, seven graduate students and one post-doctorate. Once certificate programming is fully operating, about 20 students per year are anticipated.

**University of Michigan
Office of Academic Programs
School of Natural Resources
University of Michigan
Dana Building
430 E. University
Ann Arbor, MI 48109-1115
(313) 764-6453**

The School of Natural Resources and the Economics Department offer a jointly sponsored Natural Resource and Environmental Economics program with two Masters and a Ph.D. The program covers the following research areas: forest or land economics, water resource economics, resource taxation and regulation, and environmental economics.

The Economics Department provides a Masters of Applied Economics "for students who want to apply the theory and methodology of economics to the analyses of policy problems."

The School of Natural Resources offers a Master of Science degree with two concentrations: Resource Ecology and Management and Resource Policy and Behavior. It also offers a Master of Landscape Architecture degree.

The following courses are taught: natural resource economics, macroeconomics with natural resource applications, forest and land economics, water resource economics, environmental economics, natural resource and environmental economics, and research seminar in environmental and natural resource economics.

Core Faculty include: Carol Jones, Richard Porter, Stephen Salant, and Joseph Swierzbinski.

**University of Washington
College of Forest Resources
116 Anderson Hall, AR-10
Seattle, WA 98195
(206) 543-5929**

The College of Forest Resources at the University of Washington offers a Masters degree and a Ph.D. Through the Forest Resource Management Division, one can study forest economics.

Dr. Lee, in a telephone interview, described the program the College offers as "very interdisciplinary." Lee himself works with a number of faculty members in other departments, including the economics department. It is a program larger than Yale's, according to Lee, and, with the exception of Yale, has had greater involvement in international issues than any other similar program in the country. The school, through the work of

its students, has dealt with tropical forests in Latin America, Asia, and Africa. Lee believes that there is a great deal of faculty expertise in tropical forestry although the program may not reflect such expertise.

In the Economics Department, Gardner Brown and Greg Ellis teach courses on environmental and natural resource economics.

**University of Wisconsin, Madison
Institute for Environmental Studies (IES)
1007 WARF Building
610 Walnut Street
Madison, WI 53705
(608) 262-0651**

The Institute of Environmental Studies was created in 1967 to study the relationships "between people and the environment." IES stresses integrating knowledge from "a variety of specified fields in the classroom as well as in the research laboratory." It has a teaching staff of 70 faculty members.

The Institute for Environmental Studies offers a Masters and a Ph.D. with concentrations in (1) Conservation Biology and Sustainable Development, (2) Land Resources, (3) Environmental Monitoring, (4) Water Resources Management, (5) Energy Analysis and Policy. The Institute is interdisciplinary. One can take courses in natural resource economics through the Institute or from the Department of Agricultural Economics.

Faculty members at the Institute who are working on natural resources and economics are Richard Bishop, Daniel Bromley, and Stephen Bunker. Bunker has worked often in Brazil. Professor Bishop noted that in the past the University has had substantial Brazilian connections and still has extensive associations with Latin America.

Graduate level courses taught by Professor Bromley include: Institutional Economics; Natural Resources and Markets; Advanced Benefit-Cost Analysis; Workshops in Resource Economics; Advanced Natural Resource Economics; Economics of Public Decision Making; Water Resource Economics.

**Yale University
School of Forestry and Environmental Studies
205 Prospect Street
New Haven, CT 06511
(203) 432-5146**

The School of Forestry and Environmental Studies offers three Masters degrees (Forestry, Forest Science, and Environmental Science) and a Ph.D. All the programs are aimed at those whose "objectives are to preserve the health, productivity, and renewability of forests and related resources while still using them to satisfy human needs." Joint-degree programs are available with other schools and departments at Yale: Economics, Law, Public Health, etc.

According to the registrar's office, for the Masters in Environmental Science one can create one's own focus. For example, half the courses for the Masters could be in the department and half the courses from other departments.

Two full-time faculty members in the school, Robert Evenson and Robert Mendelsohn, work on forestry economic issues.

IV. INFORMATION FOR FUTURE RESEARCH

Journals and Associations

Two journals and two associations are specifically devoted to environmental and ecological economics:

1. Ecological Economics: The Journal of the International Society for Ecological Economics. Editor-in-Chief, Robert Costanza. University of Maryland, Solomons, MD.

The international society of Ecological Economics held a conference on May 21-23, 1990, at The World Bank entitled "The Ecological Economics of Sustainability: Making Local and Short-Term Goals Consistent with Global and Long-Term Goals." The conference covered the following set of issues:

- An ecological economic world view: theories, assumptions, and case studies;
- Accounting, modelling, and analysis; and
- Institutional changes.

2. Journal of Environmental Economics and Management: The Official Journal of the Association of Environmental and Resource Economists. Managing Editor, Ronald G. Cumming. The University of New Mexico, Albuquerque, NM.

Useful Publications

Ahmad Y., Salah El Serafy, and Ernst Lutz, eds. Environmental Accounting for Sustainable Development. (Washington, D.C.: World Bank, 1989).

AMBIO 20, no. 2 (April 1991). Special issue on ecological economics.

Bingham, G., and Paul DeLong (facilitators). Valuing Ecosystem Functions and Processes: Issues Concerning How to Provide Information Useful in the Policy Context. Background Paper #1. The Ecosystem Valuation Forum, sponsored by U.S. Environmental Protection Agency.

Bishop, R. "Endangered Species and Uncertainty: The Economics of a Safe Minimum Standard." Journal of Agricultural Economics 60 (1978).

"Endangered Species: An Economic Perspective." Transcripts of the North American Wildlife and Natural Resources Conference 45 (1980).

Rishop, R., and Stephen Andersen, eds. Natural Resource Economics: Selected Papers. (Boulder: Westview Press, 1985).

Conrad, J., and Colin Clark. Natural Resource Economics: Notes and Problems. (Cambridge: Cambridge University Press, 1987).

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El Serafy, S., and Ernst Lutz. "Toward Improved Accounting for Natural Resources and the Environment." Revista de Analisis Economico 5, no. 2 (November 1990).

Folmer, H., and E. van Ierland, eds. Valuation Methods and Policy Making in Environmental Economics. (Amsterdam: Elsevier, 1989).

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Kramer, R., Robert Healy and Robert Mendelsohn. Forest Valuation. World Bank Forest Policy Study, preliminary draft, October 1990.

Krutilla, J. Reflections on Resource and Environmental Economics. Seminar presented at the University of Gothenburg, November 8, 1990.

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Peskin, H., and Ernst Lutz. Survey of Resource and Environmental Accounting in Industrialized Countries. (Washington, D.C.: World Bank), Environment Working Paper No. 37, August 1990.

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APPENDIX: EXCERPTS OF INTERVIEWS

Richard Bishop, University of Wisconsin: March 28, 1991

In a telephone interview, Richard Bishop discussed his work on the economics of biodiversity, specifically his work on safe minimum standard. Bishop explained that his work derives from that of Ciriacy-Wantrup, under whom he studied at University of Berkeley. According to Bishop, Ciriacy-Wantrup was one of the founding fathers of natural resource economics. In the early 1950s, Ciriacy-Wantrup published a series of articles that dealt with various issues in the economics of resource conservation management. Originally a geneticist in Germany, Ciriacy-Wantrup was concerned in the late 1940s with the possible extinction of species:

His idea was based on a notion similar to insurance: keep these plants and animals around because it will not cost too much, and even if it does cost a little (like an insurance policy) we will have the diversity available for the future. He also tried to relate it to game theory. Remember the two-person zero-sum game theory? Using this theory one assumes that nature is an active opponent. One arrives with a solution that, unless the cost of choosing a safe minimum is greater than the potential losses from losing the species under the worst case scenario, you chose the safe minimum standards, that is, you chose to avoid the extinction threshold. He was trying to link safe minimum standard to the body of economic theory. At that time there was a great deal of excitement about game theory. A number of people suggested that if you are faced with serious uncertainty, in the early neoclassical sense of not knowing the probability of alternative outcomes, you make the assumption that nature is an active opponent and will do her worst. Therefore, you choose the strategies that minimize maximum losses. In theory it is like the minax solution for the two-person zero-sum game against nature.

Ciriacy-Wantrup never explored the structure of the game. When I was a student at Berkeley during the late sixties, he got a grant to do some work on the California elk and applied this idea. He also applied it to preservation of prime land--renewable resources that are capable of being irreplaceably damaged. Then the National Audubon Society granted him money to look into the California condor and I was the post-doc. on this study. In the process I tried to work out this simple game and I never got it right. It turns out now, with the help of one of my students, Richard Ready, (an assistant professor at Kentucky), we figured out that there is a flaw in the basic logic, and the link Ciriacy-Wantrup made to game theory is not strong. You can

change the story slightly and get the opposite results (i.e., you accept the economic development bird-in-bush rather than not getting anything out of endangered species). Game theory did not capture the intuitive notion that we need to carefully deal with irreversible losses. We are about to publish an article in The American Journal of Agricultural Economics showing that problem.

That was not a satisfying result. I had tried to make the Ciriacy-Wantrup idea more applicable. The basic idea of safe minimum standard is not unique to economics and is very intuitively appealing: we shouldn't do away with these things just because they are not useful since we are terribly uncertain about what they might be useful for in the future. How do you link that more closely to mainstream economics? This is what I am working on presently.

There was a very interesting article published recently by Howarth and Norgaard in Land Economics which deals with the resource depletion issue in a different way. They start with a good old competitive economy, if you ignore externalities, which grinds out a nice intertemporal Pareto optimum based on the status quo distribution of wealth and income. Norgaard and Howarth extend this into a world where there is a fixed resource. This is a simple world where you know the utility function of people. The people have their own labor. There are two generations, each lives two periods and there is an overlap between the generations. They can trade resources for labor or labor for resources depending on initial endowment. The trick of this model is to show that you get a different Pareto optimum for each allocation of this resource between the first generation and the second, so it's a matter of choosing from amongst a whole set of Pareto optima. Norgaard and Howarth show that under a wide variety of social functions you would never allocate it to the first generation. It seems to say that if we presume an oversimplified situation, assume no technology process, fixed resources, and so on, then the basic characteristic of how we run economic life is we use up whatever we can. It is as if we say 'this is our endowment and we will use up whatever we can afford to use, leaving the rest for future generations. That would not be socially optimal except under strange accusations about the social welfare function, and particularly the utility function for the second generation. They use various intergenerational welfare criteria to explore these matters.

What I am trying to do is link safe minimum standard to what I just discussed. We can always hope technological and social progress are going to cover future generation for resources we, the present generation, have lost. We can

hope that but it is not a guaranteed result. Even in the so-called "real" world one begins to suspect that the modern capitalist way of doing things is biased in favor of present generation, in ways that can't be justified on any social welfare function unless we assume technological progress is going to continue forever and make us all well off in the future.

This type of discussion gets back into the growth debates of 1979 and the early 1980s, which died down but are periodically resurrected. If you are concerned about making provisions for the future, you might spend money on science and technology, keep national parks. But one argument that we might want to consider that is being put forth by non-economists is maintaining biodiversity as a future resource. I'm trying to link safe minimum standard to that type of idea.

Another idea on the frontier is being presented by Tony Randall at Ohio State. He has been working on ethical foundations of benefit-cost analysis. He and a philosopher have been playing around with alternative ethical systems and how benefit-cost analysis would relate to them. He has a paper that shows that under three different ethical systems the players of the game would choose to maintain a safe minimum standard. If you were a pure utilitarian, for example, you would probably be happy to do strict benefit-cost analysis but you would not want to make it your sole decision-making criterion.

Bishop clarified that safe minimum standard conflicts with the idea of benefit-cost, since benefit-cost analysis uses data from the market or imitates market data for public goods. Therefore, it gives weight to the current system of endowment, which stresses the endowment of the present generation. Bishop explained that he also utilizes valuation systems in his work but noted:

Values are slanted towards the interest of the current generations. If you do benefit-cost analysis and it states that saving this or that will produce positive benefits, then there is a strong case for doing it. Even if the benefits do not exceed the cost, there might still be a good case for saving the resource. The safe minimum standard argument contends that society may be willing to absorb a social cost (i.e., have the cost exceed the benefits) in order to maintain future opportunities. We should maintain a safe minimum standard unless social costs to maintain it are judged excessive.

The Howarth and Norgaard article points out that there are many things which are efficient but unfair. Letting things

go extinct may be unfair. Maintaining biodiversity will enhance intergenerational equity unless the burden on the current generation is too heavy.

Bishop is currently involved in a Man and the Biosphere project* in the Talamanca region of Costa Rica, which deals with preservation of primary forests. He and a post-doctoral student are working on the issue of endangered species in Costa Rica.

We are trying understand the cost and benefits from maintaining forested areas. We are trying to build into the project the needs of the local people. We are studying what types of cost does a society, such as Costa Rica, face trying to maintain protected area. In particular, we are asking how feasible is it, what type of benefits are possible, while examining ways for local people to meet basic needs without infringing on the resources which are trying to be conserved. We have some case studies going since December which include the opportunity cost of resources that have not developed.

At the University of Wisconsin, a land tenure center has been concerned with land reform since the 1950s. An established graduate level program in natural resource economics teaches benefit-cost analysis and environmental and natural resource economics.

Bishop recommended the following people: Anthony Fisher and Michael Hanemann, who work on option value, Alan Randall, who uses a broader approach, and Gardner Brown.

Daniel Bromley: Director of Institute for Environmental Studies, University of Wisconsin: March 21, 1991.

In a telephone interview, Dr. Daniel Bromley discussed his work and the Institute for Environmental Studies at the University of Wisconsin. Bromley's research focuses on common property issues and natural resource problems. Concerning natural resource problems, Bromley examines the use and management of natural resources: forestry, grazing, water. "I'm interested in the way property rights and institutional arrangements influence natural resource use and how we might design institutional arrangements to conserve what are referred to as common resources and common property problems."

He researches and advises on the policy level how governments

*Sponsored by the U.S. Department of State. The project is called "Net Social Cost Assessment for Conserving Biological Diversity in Costa Rica's Talamanca Region."

manage natural resources. "My graduate students and I work on natural resource problems in Asia and Africa where institutional arrangements have broken down. We are trying to find out why resources are overused and what governments ought to do to prevent overuse."

Bromley has worked as a consultant to the World Bank and the U.S. Agency for International Development. He described his goal in terms of his research and his consultations as "the wise use of natural resources consistent with economic improvement in these countries." He is not sure if this is conservation since "some people think conservation means taking preserved areas and locking them up. With the exception of a few small preserves, it is impossible to lock up these areas. It's impractical because you have millions of people living among these resources who need to make a living."

His major criticism of the field of resource management in the tropics is that concepts and terms are tossed around but not clearly defined or well thought through. For example, "people talk about common property resources without the slightest idea what that means; they have never stopped to define these terms." In his work he stresses the need to define terms better and for economists to have a better grasp of legal and historical concepts, especially concerning the ideas of property and common property resources.

His underlying concern is

...the economic and political struggle between the poor South and the rich North and the way in which we deal with each other in how we are going about conflicting interests. I'm also interested in the local level where people have to scratch out a living in the face of corrupt governments, inept bureaucrats, nonfunctioning markets, and poverty. I'm particularly interested in the way the state has tended to delegitimize local-level resource management regimes, created a free-for-all out of them, set up concessionary deals with timber exporters, and then rake in all the profits. But they blame the peasants for the problems.

The Institute for Environmental Studies offers a Masters and a Ph.D. with concentrations in

- 1) Conservation Biology and Sustainable Development,
- 2) Land Resources,
- 3) Environmental Monitoring,
- 4) Water Resources Management, and
- 5) Energy Analysis and Policy.

The Institute is interdisciplinary. One can take courses in natural resource economics through the Institute or from the Department of Agricultural Economics, of which Bromley is also a faculty member. Other faculty members at the Institute who are

working on natural resources and economics are Richard Bishop and Stephen Bunker. Steven Bunker has worked often in Brazil.

Bromley stated his respect for the work of Richard Norgaard and John Dixon.

Robert Costanza, University of Maryland: Coastal and Environmental Policy Program and Editor of Ecological Economics. March 29, 1991.

In 1988, Robert Costanza of the University of Maryland, along with David Pearce, Ann Marie Jensen, and Herman Daly, founded a new journal and society, and what they hoped to be a new field of study--ecological economics. In a telephone interview, Costanza clarified that, before the term "ecological economics" was used, there were already people working on these issues. His interpretation of the term "ecological economics" includes work being done by natural resource and environmental economists.

One of the major distinctions between ecological economics and conventional environmental economics is that ecological economics places a greater emphasis on having a pluralistic approach. We in the field of ecological economics don't believe that there is a correct theory that should guide everything we do. In the field of environmental economics, they have reached a consensus on the approach.

Costanza went on to explain the differences between ecological economics and environmental economics.

There is a difference in the domain of what we are trying to cover. Conventional economics looks at exchanges between conventional economic sectors. Environmental economics looks at output, still within the standard economy, but looking outward to what the economy is exporting into nature, such as pollution. Resource economists are looking at the inputs from nature into the economy. Ecological economics has a broader perspective by looking at the ecosystem itself. In other words, conventional, environmental, and resource economics treat the environment as a passive thing; a place where you get resources from and a place into which you dump pollution. Whereas, ecological economics views nature as an active partner. Nature is just as much an economic activity as the steel industry. It is an active partner doing things on its own, and even if we were not around, it would still be functioning. From the point of view of the ecological economist it is not enough to take the standard neoclassical perspective and look outward. They support activities that are a more radical departure than that, although as of now there is no general consensus.

Costanza discussed projects on which he is working. For the U.S. Agency for International Development, he is involved with their environmental training project. The project will have USAID personnel come to Washington, D.C., to learn about environmental impact, environmental economics, and ecological economics. Costanza will be teaching a couple of short courses. USAID plans to publish shortly a request for proposal on the environmental policy and training project.

Costanza described his research in land use, energy analysis, and other related topics.

We are trying to obtain funding for a broad-based evaluation of the protected areas in Costa Rica. The land-use analysis part will include landscape, watershed, ecological economic modelling. This will tie into the national accounting. Our approach to national accounting is to expand the input-output tables to include natural sectors and to manipulate the input-output tables to get at the underlying values of this contribution. We are interested in how resources are connected in the system.

This approach is an extension of what Costanza calls the "energy analysis" or "material balance", a biophysical basis for valuation. This idea is based partially on the work of Gene and Howard Odum at the University of Florida and at the University of Georgia, Herman Daly, and Robert Ayres, who does material balance modelling.

We are trying to extend all these threads and pull them together. We also are attempting use models to get at the valuation issue as well as the physical connections. People have done a great job with the physical connection, for example, Bruce Hanin, University of Illinois. [There are] two major ways to approach these issues: one is to ask people what they think resources are worth. There are services which are directly utilized by people, such as recreation. Other services that indirectly affect people, such as global climate, watershed control, erosion. The more indirect services need more modelling to back up whatever you are doing. One needs to look closer at an ecosystem and how it's connected to economy. To simplify, it's the ecosystem modelling approach versus the direct survey approach--there are points where they come together. Through the ecosystem modelling one can examine the direct connections and figure out ultimately how the system connects into the economy.

After valuation there are a number of things one can do with the information. "Once you have a model on the computer, it can be manipulated in various ways. The implementation of this model can be stated in physical terms, or use of model results helps to

summarize impact in value units," explained Costanza. Costanza does perceive the model as a policy tool.

Costanza recommended the following people's work in forestry, land use and biodiversity, and national income accounting. For forestry: Robert Goodland; Ariel Lugo at the Institute of Tropical Forestry in Puerto Rico. For land use: Costanza and others at the University of Maryland are doing work on landscape modelling and the impact of land use at the watershed level; at Oak Ridge National Laboratory: Virginia Dale, Robert Gardner, or Monica Turner. For biodiversity: there is a new institute of ecological economics starting in Sweden called the Beijer Institute for Ecological Economics. The first program they are planning will be on the economics of biodiversity. Charles Perrings at the University of California-Riverside is involved with the institute.

The University of Maryland is starting an institute in ecological economics within the next six months. They plan to offer a certificate in ecological economics rather than a degree.

The idea is that it can either be a stand-alone certificate for people who already have degrees in ecology or economics, or, for people who are already getting a degree in our ecology or economics departments, they could add on the certificate. The program would require about 18 credit hours; 9 credit hours for those already getting a degree.

Some of the required courses are: ecological economics; ecological economics modelling--both of these courses will be taught in a block mode, i.e., workshop. The courses will focus on particular problems rather than techniques and will go for two to four weeks in solid blocks. The courses will be taught by teams of people from different disciplines. The focus will be issues, and then the appropriate tools will be brought in. Courses will begin next January.

National Science Foundation will be funding, Costanza hopes, seven graduate students and one post-doctoral student. Once certificate programming is fully operating, they are anticipating about 20 students a year. Other faculty members involved in the program are: Darrell Hueth, Iver Strand, Nancy Bockstael, Ken McConnel, Wally Oats; from the World Bank: Herman Daly and Robert Goodland.

Wilfredo Cruz, World Resources Institute: March 26, 1991.

Wilfredo Cruz works with Robert Repetto at the World Resources Institute (WRI) Economics and Institutions Program on two major issues concerning the macroeconomics of sustainable development: natural resource accounting and structural adjustment policies. I spoke with Willy Cruz on the telephone about his and WRI's work in natural resource accounting.

The approach Cruz and WRI are using for natural resource accounting is formulated in WRI's publication Wasting Assets. Cruz explained how WRI's approach differs in practice with other applied resource accounting schemes:

The usual distinction that people try to make is whether you examine productive natural resources (productive sectors), i.e., forestry, coastal fishing, and watershed resources or whether you look at amenities, environmental concerns such as water quality, air quality, noise, pollution. WRI focuses on the production sectors while others focus on the second. For example, Henry Peskin's survey tries to do the whole bit for a particular country or a region: it looks at all resources with economic consequences and does an evaluation of what is being lost, including what is being lost in terms of the conditions of the urban environment, congestion, or water pollution.

Although Cruz finds that Peskin's approach works well in a conceptual framework, he stated that there are difficulties with it on a practical level. "In fact, what we have found in many developing countries is that there is not the data to make reasonable sense of what is happening."

Cruz said that one does not encounter this problem of quantifying values when dealing with key productive resources for developing countries. In his work with Robert Repetto, the difficult part is not primarily in determining economic evaluations. The main problem is calculating the physical relations, for example: how much soil erosion is occurring, what it is doing to irrigation channels, how much timber is actually being logged. They have found that these physical estimates take up about two-thirds to three-fourths of the project time. The remaining time is spent closing the study with economic evaluations. The economic evaluations are relatively easy to do since the productive sectors they deal with have important market links--such as for timber products. In the case of soil erosion, there is no price, but if it results in a decline in corn productivity, then one can measure the decline in terms of corn productivity losses.

Cruz used Indonesian petroleum, timber and agricultural soils to illustrate:

Just looking at these three sectors alone, you are already talking in terms of losses, asset depreciation in the order of 3-5 percent of gross national product (GNP). You are talking about a problem that is in the same magnitude as standard policy variables such as budget and trade deficits.

Cruz's and WRI's approach tries to identify the crucial economic sectors (other approaches try to take into account a wider spectrum). Cruz summarized their approach: they first work with resource managers to identify key subsets of important sectors, then they concentrate on identifying and including those accounts. "This allows us to get the important numbers out, and to get them out quickly." After the data is assembled and analyzed, it is integrated into the national income account. The process of integration, according to Cruz, is constrained by a statistical coordination problem. Generally accountants are conservative about adopting changes in the accounting conventions. "Most of the people we work with, in principle, see the value of these accounts. They think these accounts should be used in conjunction with the conventional system. What they hesitate to do is get their national income accounts for, say, 1990, and put in the amount of natural resources lost as part of capital consumption allowance."

Cruz has found that central bank personnel do not view the accounts as suspects. In Costa Rica, he explained, the database for the resources accounts are sometimes even better than those for crop accounts. "The problem is that the conventional accounts conform to the U.N. statistical system, which currently do not officially incorporate these accounts."

A variety of people are working on alternatives to conventional national income accounting. "Methods that WRI uses are not new. The economics have been there for a long time." Their method is to apply well-developed evaluation methods, including shadow pricing or opportunity cost pricing to arrive at the value of resource contributions.

The controversy arises among the different people working on national income accounting on the scope of what to value, according to Cruz. "The physical impacts can be conceptually very broad. It's a question of where you stop and draw the boundary. This is the major stumbling block." From his own work with different countries, Cruz has concluded that ultimately it will be practice that will determine the method relevant to policy markers.

WRI has performed national income accounts for Indonesia, Costa Rica, and is presently is assisting Chinese researchers.

Other sources: Cruz recommended Henry Peskin's survey of natural resource accounting (environment department of World Bank). The

Norwegians and the French are working on these issues. The U.N. Statistical Department in New York has come out with a publication on these issues. There is an organization called the International Association for Research on Income and Welfare. Individuals Cruz recommended: Partha Dasgupta, David Pearce, Ernst Lutz, Henry Peskin.

John Dixon, World Bank: March 26, 1991.

While he was at the East-West Center, John Dixon wrote, with Paul Sherman, a book entitled The Economics of Protected Areas, which discussed the management of protected areas. Currently, Dixon is at the World Bank in the Environment Division in the Latin America and the Caribbean Region researching the economic costs and policy decisions involved in urban pollution in Latin America. He's still doing follow-up work from his book on protected areas.

Dixon explained that his book's starting point is the decision by governments or societies to protect an area for whatever reason. The issue then becomes

...what are the economic questions associated with protecting it? We know a lot about the costs involved, financial expenditures by governments for protection, for guards, for facilities, but what about the benefits? This book tries to look at both the benefits and cost sides of protection.

When the protected area is forest, then there is also the question of can you have conjunctive use of the forest. Can you allow resource exploitation at the same time? I think many times the answer is yes, depending on for what use and what you are protecting it for. One of the important lessons to come out of this work is that the people who frequently pay the greatest cost for protecting an area are nearby residents, who are frequently poor, sometimes politically disenfranchised. In a sense you are asking these people, who usually receive very little benefits, to pay a disproportionate share of the cost of providing this social service to the community, the world. Therefore, if you want to be successful in managing an area, it is essential to take local residents into account, either by deriving benefits from the park or providing continued access to this facility, perhaps some limited resource extraction. It is very important to try and work with the groups because if you take a policing attitude--fences, guards--you polarize both sides, and frequently it is not very effective and is hard to monitor.

The reason a government has to protect an area is because the benefits are diffused. It does not pay for any individual to create a national park and sell admissions. The economics do not work out on a personal basis.

In terms of ecotourism, Dixon believes it is appropriate for certain areas. It can work when an area is unique enough that people are willing to pay and one can capture enough of their willingness to pay on a financial basis. This works well with such activities as scuba diving. "The nice thing about ecotourism, whether it is divers in the Caribbean or game parks in Africa, is that you can sell the same resource over and over again," Dixon said. The difficult part is the management of the facility.

I feel it is very important for countries to make a decision about protection based on a broad overview of the resources and within the framework of a system of protected areas. Rather than looking at each individual site of protected area or wildlife reserve and deciding whether or not it passes some benefit-cost test, you have to develop a package that balances the various assets and resources that you are trying to preserve. If you do simple financial analyses, some areas will win and some will lose. Some areas will lose because they are strict natural reserves where there is no tourism allowed, just scientific research or not even that. As a system, one can sell the package to policy makers. One can balance revenues from the more attractive sites to help support the other ones.

Dixon cited a parallel example from Washington, D.C.--the Smithsonian system of museums sponsored by the government. Some museums, such as the National Air and Space Museum, are extremely popular, while others, such as the Folger Library, are less frequented by visitors.

By using a systems approach, a country can be assured of protecting an array of natural resources, which Dixon said is a concern of his. If a country has limited resources, economics can be used for deciding among several alternative sites that provide the same generic benefits.

Dixon pointed out when dealing with issues concerning protected areas that a strict benefit-cost analysis is not enough, since so many of the benefits are difficult to quantify. However, to ignore economic constraints is also foolish.

Sometimes it is worse to protect a site and not manage it properly than to use those scarce resources for fewer sites. Some countries have set very ambitious goals, 15 percent of their national area. Thailand, which we studied, has 10 percent as national areas. They want to expand to 15

percent, but I think they would be well advised not to expand. The costs of doing so are probably prohibitive and they would spread their resources too thinly.

From Dixon's perspective, economics does not determine the value of a site because resources have intrinsic, nonmeasurable values. However, economics can be used to justify allocating scarce public funds for management of these resources. Dixon explained that when natural scientists are asked how great are the benefits from protected areas and how important it is to preserve it, they generally respond "very important." That answer is not useful to government officials. "If you can say to an official that last year in Kenya nature tourism generated \$600 million in foreign exchange earnings, then they realize the importance of these resources, their fragile nature, and the need for an investment in management."

Dixon has also co-authored a number of books on the subject of valuation techniques for nonmarketed goods. "Economics is an organic discipline, flexible, not fixed. What's happening out there is the interaction of people, resources, societies. Economics is just trying to understand part of that using an organized approach and certain analytical tools. One is not creating the reality, just trying to understand it."

Concerning the question of valuation and which approach to use, broad guidelines are commonly accepted. In general, however, different analysts apply different approaches. According to Dixon, it is important for analysts to make the assumptions explicit, explain why they chose a particular approach, and then work through the approach to see if the results are useful.

Dixon favors approaches that are generally applicable or rely on observed behavior, approaches that reflect people actively making decisions. "It is true that the approach you pick will have an effect." Dixon explained that choosing an approach "is still more an art than a science."

Dixon mentioned the following people in the field of environmental and natural resource economics: David Pearce, Jeffrey Vincent, Jan Laarman, Richard Norgaard, Ernest Lutz, Henry Peskin, Dennis Anderson, Kerry Smith, Tony Fisher, Partha Dasgupta, Karl-Goeren Maeller. Regarding institutions for graduate education, he recommended the University of Wisconsin at Madison, Cornell, and the University of California at Berkeley.

He mentioned that much of the interesting work in the field of environmental and natural resource economics is taking place outside of the United States. The United Kingdom, the Netherlands, Sweden and other Nordic countries are among the centers for interesting work in this field.

At the East-West Center, Dixon worked with Maynard Hufschmidt on several books on applied economic analysis of natural resources and environmental effects. Jim Nickum is an economist working on water at the Center. Larry Hamilton is a forester who works on watershed management and protected areas.

Richard Norgaard, University of California at Berkeley, and the World Bank: April 2, 1991.

Richard Norgaard is presently a visiting Research Fellow at ASIVP of the World Bank, on leave from the Resource and Energy Program of the University of California at Berkeley. He described his research for the Bank, ecological economics, and other related topics.

He began by discussing environmental and natural resource economics:

Environmental and natural resource economics are both neoclassical economics. Environmental economics is concerned with environmental systems; natural resource economics tends to be concerned with the use of natural resources, such as coal, water, and oil. Generally environmental economics has more of an ecosystem orientation, but it's still trying to be neoclassical economics. Both of these disciplines never question economics itself. Their assumption is that economic thinking is correct and, furthermore, that economic thinking can be merged with other thinking without any inherent conflicts between those patterns of thinking. People working in these areas may ask 'what if the markets are not working this way or that way,' but they do not question 'what if markets are a figment of economists' imaginations?'

Norgaard explained that neoclassicists tend to try to make everything fit into the same framework (e.g., give valuation for nonmarket goods).

This is neoclassical in the context that it is presuming that economic problems are problems of inefficiency. There is no reason in theory why neoclassical economics can not look at the distribution of rights. In any economy, if you redistribute land or power or capital or give different educations, the economy will behave differently--but it will behave efficiently--and that solution is a new efficient solution.

Norgaard went on to discuss this in terms of his approach.

I'm arguing that sustainability is a redistribution of

rights to future generations. That would result in a different allocation of resources. Everything that is happening in the neoclassical literature of today takes the distribution of rights as given. According to them, the problem is not redistribution of rights but that the market is inefficient or the market is not working completely everywhere. I'm saying that's hog wash or a very small part of the story. I'm also asserting that we are seriously hurting as an environmental movement to go in the direction that environmental economists are leading. When economists go out and measure those values, they are accepting the distribution of rights. I'm proposing it's a political decision about how the market works. Neoclassical economics has only been using half their theory by looking at efficiency and not distribution. Even within the neoclassical mode, I'm debating neoclassicalism. That's my job at the Bank to work with their framework but open up economists to think about distributions.

Norgaard explained that within neoclassical economics we should be thinking of sustainability as a transfer to future generations. This transfer of rights has to be a political decision. "Since the Fifties when economists became political advisors, they have been ignoring distributional questions and instead have been talking about efficiency."

From Norgaard's perspective neoclassical economics is one way of thinking and "it's foolish to use only one way of thinking." He advocates not replacing it, but using other approaches along side it.

Norgaard then discussed ecological economics:

One of the things that holds ecological economics together is that there isn't a right way to think. Within economics there are different ways of thinking but people tend to be of one school or another. My viewpoint is that large, intricate, complex systems cannot be understood using one pattern of understanding. Every pattern of understanding is a simplification of the complexity.

Norgaard has also worked on coevolutionary development, which links economic and environmental factors in the context of development. He discussed an article he wrote that looked specifically at the Amazon.

[The article] doesn't mess around with valuation at all, instead it tries to present another analysis. My questions are: Why do the social systems imposed on the Amazon collapse themselves and destroy ecosystems? What type of starting point would you need in a tropical rain forest, what type of social organization at the beginning, so it

doesn't destroy the ecosystem? What cultural systems might develop with the ecosystem that won't destroy each other? Starting with these questions I did ecological and sociological analysis of the question in respect to the Amazon. I came up with recommendations as to what is needed for development. It is not a decision-making framework in the sense of economics as decision-making framework, rather, it is a way of looking at the whole system and thinking about how you can set up development. Decision-making frameworks tend to have the attitude that the system is okay, only what needs to be done in this particular case needs to be considered. I think that's the problem with neoclassical economics. It tends to presume that the problem is should we cut this rain forest or not, while everything else is held constant, but everything else held constant is going to destroy the forest. Even if you make a good decision you are going to create a bad situation.

Norgaard's recommendations to the Bank will be

The Bank cannot make transfer decisions or redistribute rights to future generations, but at least it can engage in dialogue with countries about policies. It can investigate whether institutions, which historically have protected future generations, are being eroded by development. The Bank should ask, when it looks at its own projects, to what extent is this project an investment in this generation's resources; which needs a return to this generation; and to what extent is this project a transfer to the future. They should not discount the transfer. They should also ask how their activities are affecting institutions that have tried to grant transfers in the past.

Regarding the Energy and Resource Program at Berkeley:

The Energy and Resource Program started in the Seventies as a response to the energy crisis. It emphasized conservation, environmental and health consequences, problems of proliferation of nuclear materials, issues of international security and some emphasis on alternative energy. It did not examine the primary sources, coal, oil, and gas. Since its initiation, the program has gotten broader and broader. It now has students studying international security, global climate change, environment, and development. Some work has begun on the questions of fuelwood resources, alcohol program, theoretical ecology, and conservation biology. The program has about 50 students split evenly between Masters students and Ph.D. students--about 10 Masters students per year, 3 or 4 Ph.D.s a year. This year they had to reduce enrollment to 8 positions for Masters students. The students come from a range of diverse background, from physics to theology. Some of the students are

interdisciplinary, integrating everything into their dissertations; some students are crossovers, for example, they start from physics and end up in political science.

Besides the Berkeley program, Norgaard suggested organizing a six-week workshop with Bob Costanza, himself, and others. He recommended that the group be a mix of economists and ecologists along with a philosopher, and should include an economist with a strong conventional neoclassical economics background.

Roger Sedjo, Resources for the Future: March 20, 1991.

Roger Sedjo is the director of the Forest Economics and Policy Program, part of the Energy and Natural Resources Division, at Resources for the Future. The program deals with a variety of forestry issues ranging from industrial forestry, private forestry, international forestry, international trade in forestry, and more recently, global environmental problems that have an important forestry component such as the greenhouse effect and biodiversity. Sedjo himself has been involved in most of these things. His original work was related to the trade of international forestry products.

When I was brought to Resources for the Future it had a fairly good capacity in certain private forestry areas, public forestry, but it didn't have any capacity in international forestry. My background is in international economics with some work on natural resource issues. Eventually, I worked my way into the forestry issues.

We have done a lot of work on long-term timber supply, and the economics of plantation forestry. More recently we have worked on the economics of natural tropical forest management, biodiversity, and other issues such as global carbon cycles.

Generally Resources for the Future deals with economics and policy research. In terms of forestry, the institution has become increasingly involved with natural science research. The forestry program has been involved in multidimensional projects for such issues as global warming; these projects involve researchers from various fields, including natural scientists.

Sedjo has worked on the economics of natural forest management. His belief is that there are places, under certain conditions, where it is financially viable to manage tropical forests.

There are some places where natural tropical forest management makes sense. This has implications for biodiversity, and externalities, especially when you are

talking about selective logging. If you have countries operating in such a way that they're stressing natural forest management of tropical forests, you may be able to have your cake and eat it, too, in terms of maintaining biodiversity and getting financial returns.

Sedjo and the forestry program have been examining the issues concerning financial viability of managing natural tropical forests and hope to be able to bring together different authors for a book on these topics. Sedjo stated that there is strong evidence to support the idea of financial viability of managing natural tropical forests. If this idea is valid, according to Sedjo, it then becomes a question of domestic policy and land tenure rights.

Sedjo also discussed capturing the value of genetic resources. "The problem is, if you are a country with unique genetic resources, there has been traditionally no mechanism to capture the value of these resources." He further explained that, although pharmaceutical companies may receive financial gains from collecting species from a tropical forest and the world might benefit from new medicines, there might not be any financial rewards for the country where the forest is located. If the country is not financially benefiting from preserving these resources, then there are no incentives for them to protect the resources.

One solution is to set aside reserves and control the collections of species of those reserves and work out arrangements. Some arrangements have been set up where collectors pay countries to undertake collections. Countries have a contractual arrangement with pharmaceutical companies and other companies that if the companies develop a commercially viable product that uses some of the natural chemicals or genetic information from these forests, they collect a percentage of the gross receipts.

The major criticism against this arrangement is that it is difficult to police. "It's like patents or copyrights. They have difficulties and you can circumvent them, but the world is full of patents and copyrights and people collecting royalties on them. There is some circumvention, but the system in most places is working," Sedjo pointed out. He also stated that, regardless of the criticism, these types of systems are being established.

Concerning the fields of natural resource economics and environmental economics, Sedjo emphasized the need for property rights to be recognized when discussing natural resources. He also mentioned that the notion of tradable permits is being discussed in the fields. This idea, which according to Sedjo has been around for 20 years, is now getting a great deal of

attention in the area of permits to pollute, and could be used for the management of forest on an international level.

Sedjo works periodically on forestry issues with Mike Bowes, who is also in the forestry program, and Norm Rosenberg, in the climate division.

Resources for the Future is primarily a research institute; training or education is available through the conferences or seminars they host. They also have foreign researchers working at Resources for the Future, which allows exchanges of ideas and expertise.

Tom Tietenberg, Colby College: April 22, 1991.

Tom Tietenberg has written one of the most popular textbooks on environmental and natural resource economics.* To keep up with this fast paced, ever-changing field, he is currently working on a third edition. On sabbatical from Colby College, Tietenberg is presently a Senior Fellow at the Woods Hole Oceanographic Institution and a consultant to the World Bank.

His work for the World Bank is to assist in integrating environmental concerns into all areas of the World Bank's work. He led a two-day seminar in July on environmental economics. He explained that the economists at the Bank do not need a textbook style information seminar on how to do this integration, rather they are seeking help in expanding their perception to include environmental concerns. The World Bank economists will then take this awareness and figure out the particulars of how to apply this information to their own situations and issues. He stated that a recent Philippines study on natural resources by the Bank demonstrated that this awareness was already being applied in some mission work.

Tietenberg is presently involved in the following research areas: environmental law, including such issues as private enforcement, criminal penalties, oil spill and lender liability; ocean policy; in conjunction with the Soviet Union; and global warming, for example, CO₂ transfer permit issues, and emission charges.

Regarding the field of environmental and natural resource economics, Tietenberg clarified that environmental and natural resource economics generally go together and are considered one field. Economists in the field are usually trained in both

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

areas although later they may specialize in one area. Courses at the universities are sometimes in environmental or natural resource economics, and sometimes in both. Tietenberg explained that there are two major components to environmental and natural resource economics: economic policy and its instruments; and the valuation side (e.g., cost-benefit analysis). According to Tietenberg, environmental and natural resource economics is primarily derived from neoclassical economics. Other schools of economic thought, such as institutionalism, humanism, and Marxism, have influenced and enlarged environmental and natural resource economics, but its core remains neoclassical economics.

Ecological economics, Tietenberg believes, is trying to bring ecologists and economists together to deal with pertinent issues. Ecology and economics have traditionally approached issues from very different perspectives. The hope of ecological economics is to have the sum of these two disciplines greater than the parts; in other words, the value system of ecology will seep into economics and the tools of economics used to preserve ecological systems.

In respect to Herman Daly and John Cobb's book, For the Common Good, Tietenberg described it as a powerful and useful book that moves toward ecology economics. The book's criticism of neoclassical economics is directed primarily at the valuation part of the field.

Tietenberg suggested that whether one believes in using valuation methods to make an environmental decision, once an environmental decision has been made (e.g., what to preserve), economics can be helpful in deciding how to do it. Tietenberg explained that the cost-effectiveness approach is favored by ecological economists since no valuation is asked and economics is not used to make a policy decision. Rather, the policy decision is made, the goal defined, and economics is employed to discover the best way to get from here to there.

Tietenberg also spoke about the work of Howarth and Norgaard on intergenerational rights. Their work demonstrates that efficiency is part of sustainable development but not synonymous with it. More is involved in sustainable development than efficiency, especially when dealing with allocation of resources across time.

Jeffrey Vincent, HIID: April 4, 1991.

Jeffrey Vincent, an Institute Associate at Harvard Institute for International Development (HIID), discussed his past and present research work in tropical forests and economics.

Initially, the work I did was focused on international trade of forest products, largely looking at the tropical timber trade. This is an interest that continues, and I have a number of research projects in this area. Increasingly I've been doing consulting in this area, particularly for the World Bank. The next area I got involved in and am still working on is tropical timber concessions, including concession allocation and royalty systems. I currently have a project funded by World Wildlife Malaysia. The third and most recent area is looking at nonmarket valuation in developing countries, mainly nonmarket valuation associated with tropical forests. I have not yet done a lot of work in this area. I have a book I'm editing and a study in Sri Lanka examining recreational values. An interest area of mine, but one that I have not done a great deal of research on, is tropical forest management. I have edited a book on this topic and my work with Peter Ashton falls under that heading. My work with Ashton is basically pure economics, but it is related to management issues.

He went on to elaborate on specific research projects in which he is currently involved. Vincent recently wrote a paper with Clark Binkley for the World Bank Forest Policy on forest-based industrialization. He is presently working on a follow-up to this paper that examines in a conceptual manner the issues covered in that paper. The present paper is exploring the issue of sustainable development and the development of the forest sector.

It is actually studying what sustainable development means when you have a forest as part of the economy. You could develop a forest for other uses, e.g., agriculture, cash in the trees for a source of capital which could fuel the economy, but growth may not be sustainable. We are looking at conditions where the forests are used in such a way that growth is sustainable. This is purely a theoretical paper--there will not be any numbers or cases.

Vincent is currently involved with Peter Ashton, an ecologist at HIID, in a project that integrates ecological and economic research to develop systems of forest management that are sustainable and raise the net benefits provided by tropical forests. The project has research sites in Malaysia, Thailand, and Sri Lanka. Vincent described the ecological part of the project.

Peter and others working on the project are collecting information on an individual tree basis from a given area of forest and doing intensive measurements of trees and locations of species. The hope is to use this information to build a better model of how the forest grows and how it responds to harvesting and other management treatments.

Economists could possibly take this model and use it to predict what is the best use of the forest. Also they could try to predict what type of harvesting sites for timber give the greatest return and look at nontimber values. Ultimately they could decide what mix of timber and nontimber products is appropriate.

This work is the outcome of an HIID report to the International Tropical Timber Organization entitled The Case for Multiple-Use Management of Tropical Hardwood Forests by Peter Ashton, Theo Panatoyou, Vincent, and others.

From this report, Peter, Theo, and I decided that integrated ecological and economic research was needed with the ecological research targeted toward developing a better understanding of how forests grow in response to treatments and compiling data that can be used to build forest models. The economics comes in through the manipulation of those models, supplemented by studies of what products from the forest are being used and how valuable they are. At present, the work is much farther along in the ecological area than in the economic area.

The economic work relating to this project includes studying a site in Sri Lanka from a recreational point of view. They hope to also study the important minor forest products from this site and a site in Peninsular Malaysia.

Another study Vincent is involved in examines concession and royalty systems in Malaysia. It looks at "how governments give out timber concessions, and how they charge for them." Vincent hopes the study will go a step further than Robert Repetto's and Malcolm Gillis' work on these topics to discover what possible systems there are and how they compare in terms of promoting sustainable management of forests, and capturing more revenue for the government. In Malaysia the different states have their own royalty system. This situation has allowed Vincent and his Malaysian colleagues to use the forest as a constant and have the different policies as variables. They are analyzing the data and Vincent expects findings will contradict the broad conclusions of Repetto and Gillis.

Vincent will be doing work this year with Malaysia revising their national income accounts to incorporate resource depletion and environmental degradation. Vincent believes that many aspects of World Resources Institute's approach to national income accounting are flawed in a number of fundamental ways. "National income accounting is an interesting area because so many people are doing things incorrectly. Unless we get it straightened out there are going to be many countries that will continue to make incorrect policy decision based on wrong accounts."

Vincent believes that the best work concerning national income accounting has been done by Shantayanan Devarajan and Karl Mäler in conjunction with Partha Dasgupta.

Both Devarajan and Mäler go back to basic principles and say if we want national accounts to provide a better measure of social welfare, then we need to correct a number of problems in the accounts (the accounts are based on Keynesian models). If you start from a welfare standpoint and resources are being depleted, then as long as markets are efficient, resources are going to be depleted at the rate they ought to be depleted given that market prices reflect scarcity value. You don't really gain anything by modifying the account. What is happening is what should happen from the standpoint of good economics. Another point is defensive expenditures. Some people argue if a factory pollutes the air and needs to buy air cleaners, then we should not count both the output of the factory and the expenditure on air pollution cleaners. They call this double accounting but it really isn't. Defensive expenditures should be counted as part of the national income account.

According to Vincent, the different approaches to national income accounting are more than academic quibbles because some of the new approaches show a large discrepancy from the traditional approaches, whereas within the work of Devarajan the differences are not so great.

Vincent is working on another project: examining structural adjustment, agricultural development, and resource degradation in West Africa. "Basically the project is looking at regional water resource management when countries are undergoing structural adjustment," Vincent said.

Vincent provided a brief sketch of the field of natural resource economics and forestry economics, in particular. Historically, natural resource economists have not looked at developing countries. Economists who were interested in development tended to study macroeconomic policies, international finance, and trade. In the last few years this trend has started to change and more natural resource economists are interested in the developing world.

Presently, Vincent is teaching a course at Harvard on natural resource economics in developing countries. The course covers a wide range of environmental and natural resource economics topics relevant to developing countries. Specific topics include tropical forests, air pollution, and nonmarket evaluation.

Since HIID is a research institute, it does not offer degree

courses, but faculty members at HIID teach through the Kennedy School of Government, the Economics Department, and other schools and departments at Harvard. HIID offers specialized training, for example, workshops. Every summer HIID has workshops ranging from one week to a few months in duration that are attended by people from developing countries. If funding is available, special workshops can be created.

ENDNOTES

1. David Pearce, Edward Barbier, and Anil Markandya. Sustainable Economics: Economics and Environment in the Third World. (Hants, England: Edward Elgar Publishers Limited, 1990) pp. ix-x.
2. Based on the author's experience in economic development classes at graduate and undergraduate levels.
3. David Pearce and R. Kerry Turner. The Economics of Natural Resources and the Environment. (Baltimore: The Johns Hopkins University Press, 1990) p. 6.
4. Ibid, p. 5.
5. Ibid, p. 3.
6. From a telephone interview on April 22, 1991. For more details see appendix.
7. David Pearce and Karl-Goeran Maeler. "Environmental economics and the developing world." Ambio. April 1991.
8. Ibid.
9. Tom Tietenberg. Environmental and Natural Resource Economics. (Baltimore: The Johns Hopkins University Press, 1990) p. 3.
10. Christian Schubert, post-doctorate, M.I.T., Center for Theoretical Physics, stated on May 3, 1991: "Economics uses higher level mathematics but not in a very successful or conclusive way. In physics, mathematical models are applied successfully in the following sense: usually if several models are proposed to describe the same experimental effects after a period of 5 or 10 years, one model becomes the dominant one. While in economics, there seem to be several different models which keep competing indefinitely."
11. Herman Daly and John Cobb. For the Common Good: Redirecting the Economy Toward Community, the Environment, and a Sustainable Future. (Boston: Beacon Press, 1989) p. 33.
12. Ibid, p. 38.
13. Robert Costanza, ed. Ecological Economics: The Science and Management of Sustainability. (New York: Columbia University Press, forthcoming) pp. 2-3.
14. Ibid, p. 3.

15. For details see appendix.
16. Economics. p. 971.
17. Tom Tietenberg, Environmental and Natural Resource Economics. p. 45.
18. Herman Daly and John Cobb. For the Common Good. p. 37.
19. See Tietenberg's Environmental and Natural Resource Economics, Chapter 11.
20. Harvard Institute for International Development. The Case for Multiple-use Management of Tropical Hardwood Forests. January 1988.
21. Ibid, p. i.
22. Ibid, p. iii.
23. Ibid, p. 139.
24. Ibid, p. 146.
25. Ibid. pp. 159-163. See also J. Dixon and P. Sherman, Economics of Protected Areas: A New Look at Benefits and Costs. (Washington, D.C.: Island Press, 1990) and appendix of this work for details of Dixon interview, in which he discusses using valuation approaches.
26. Ibid. p. 149.
27. Ibid. p. 158.
28. Randall Kramer, Robert Healy, and Robert Mendelsohn. Forest Valuation. World Bank Forest Policy Study. October 1990.
29. Ibid, p. 1.
30. Ibid, pp. 26-27.
31. Ibid, p. 5.
32. Theodore Panayotou. The Economics of Environmental Degradation: Problems, Causes and Responses. Harvard Institute for International Development Discussion Paper No. 335, April 1990.
33. Ibid, p. 105.
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76. Note that citations may not follow standard bibliographic form. Much information was gathered by telephone and may be incomplete.