Keynes Lectures
in Economics

Proceedings
of the British Academy

Author Index
of papers published in the Proceedings

Lecture Series
published in the Proceedings

British Academy publications
Catalogue Contents

Academy HomePage

The British Academy

KEYNES LECTURE IN ECONOMICS

The Economics of the Environment

Professor PARTHA DASGUPTA, FBA

Copyright © The British Academy, 1996
Read on 26 October 1995 at the British Academy
Published (December 1996) in *Proceedings of the British Academy*, Volume **90**, pp. 165–221

LECTURE CONTENTS

The Web version of this lecture is not identical to the version formally published in the Proceedings.

The British Academy : publications

Keynes Lectures in Economics

This is an annual series, proposed by the economists within the Academy and inaugurated in 1971. The lectures are devoted to an up-to-date survey of theoretical research and trends of thought in the field of economics.

The first lecture was delivered by Sir Austin Robinson on 'John Maynard Keynes: Economist, Author, Statesman'.

In recent years, the lectures have been followed by formal discussion.

Keynes Lectures in Economics published in the *Proceedings of the British Academy*

Year **Author**	Title	**Vol,** pages
2001 **Richard Blundell**	Welfare-to-Work: Which Policies Work and Why?	**117,** 477–524
2000 **John Sutton**	Rich Trades, Scarce Capabilities: Industrial Development Revisited (*with discussion*)	**111,** 245–273
1999 **Alan S Milward**	Keynes, Keynesianism, and the International Economy (*with discussion*)	**105,** 225–251 (*summary*)
1998 **C A E Goodhart**	Central Bankers and Uncertainty (*with discussion*)	**101,** 229–271
1997 **Robert M Solow**	What is Labour-Market Flexibility? What is it Good for? (*with discussion*)	**97,** 189–211
1995 **Partha Dasgupta**	The Economics of the Environment (*with discussion*)	**90,** 165–221
1994 **Alan Peacock**	A Future for the Past: The Political Economy of Heritage (*with discussion*)	**87,** 189–243
1993 **S J Prais**	Economic Performance and Education: The Nature of Britain's Deficiencies (*with discussion*)	**84,** 151–207
1992 **Frank Hahn**	Incomplete Market Economies	**80,** 201–219

1991 **A B Atkinson**	What is Happening to the Distribution of Income in the UK?	**82**, 317–351
1990 **J C R Dow**	The High-wage Theory of Unemployment: Theory and British Experience 1920–89	**76**, 283–309
1989 **Don Patinkin**	On Different Interpretations of the *General Theory*	**75**, 201–242
1988 **Donald MacDougall**	Fifty Years On: Some Personal Reflections	**74**, 285–309
1987 **G D N Worswick**	Industrial Change and Unemployment	**73**, 237–258
1986 **M FG Scott**	Explaining Economic Growth	**72**, 269–294
1985 **James Tobin**	A Keynesian View of the Stagnation of the 1980s	**71**, 235–250
1984 **R C O Matthews**	Animal Spirits	**70**, 209–229
1983 **Brian Reddaway**	How Useful are Keynesian Ideas in the 1980s?	**69**, 263–278
1982 **Lord Kaldor**	Limitations of the 'General Theory'	**68**, 259–273
1981 **Alec Cairncross**	The Relationship between Monetary and Fiscal Policy	**67**, 123–141
1980 **A J Brown**	Inflation in the World Economy	**66**, 121–134
1979 **R S Sayers**	Bank Rate in Keynes's Century	**65**, 191–206
1978 **Richard Stone**	Keynes, Political Arithmetic and Econometrics	**64**, 55–92
1976 **G L S Shackle**	Time and Choice	**62**, 309–329
1975 **Thomas Wilson**	The Political Economy of Inflation	**61**, 291–313
1974 **Lord Kahn**	On Re-reading Keynes	**60**, 361–391
1973 **J E Meade**	The Inheritance of Inequalities: Some Biological, Demographic, Social, and Economic Factors	**59**, 355–381
1972 **Lord Robbins**	The International Monetary Problem	**58**, 293–311
1971 **Austin Robinson**	John Maynard Keynes: Economist, Author, Statesman	**57**, 197–214

Click on volume number for details of the relevant *Proceedings* volume. Academy lectures are not published separately as offprints from the *Proceedings*, and the Academy does not provide a photocopying service.

© The British Academy 2002 | Privacy Statement

The British Academy

THE NATIONAL ACADEMY FOR THE HUMANITIES AND THE SOCIAL SCIENCES

The British Academy, established by Royal Charter in 1902, is the national academy for the humanities and the social sciences. It is an independent, self-governing fellowship of c 750 scholars, elected for distinction and achievement in one or more branches of the academic disciplines that make up the humanities and social sciences.

The Academy's objectives are:

- to represent the interests of scholarship nationally and internationally;
- to give recognition to excellence;
- to promote and support advanced research;
- to further international collaboration and exchange;
- to promote public understanding of research and scholarship; and
- to publish the results of research.

With the help of a Government grant-in-aid the Academy also acts as a grant-giving body, sponsoring its own research projects and facilitating the work of others, principally by offering research appointments and personal research grants.

---

10 Carlton House Terrace: click on the picture for a map showing

The British Academy
10 Carlton House Terrace
London SW1Y 5AH
Tel: 020 7969 5200
Fax: 020 7969 5300
secretary@britac.ac.uk

academy seal

Latest News from the Academy

Review of Research Assessment Exercise
Is the RAE too geared towards research in the natural sciences?..."

Forthcoming Deadline for International Activities
The British Academy invites applications in the following competitions...

Enlightenment faces Denial
Shortlist for 2002 British Academy Book Prize...

Creativity and the economy: the contributions of the arts and social sciences
The British Academy launches a review...

© The British Academy 2002 | Privacy Statement

Partha Dasgupta: 'The Economics of the Environment'
Copyright © The British Academy, 1996
Printed in *Proceedings of the British Academy*, Volume **90**, pp. 165-221

Contents

1. The Resource Basis of Human Activity
2. The Neglect of Ecological Economics
3. Poverty and Institutional Failure as Causes of Environmental Degradation
4. Markets and their Failure: Unidirectional Interactions
5. Markets and their Failure: Reciprocal Interactions and the Problem of the Commons
6. Public Failure and the Erosion of Local Commons
7. Economic Growth and the Environment
8. Trade and the Environment
9. Valuing Environmental Resources
10. Net National Product as an Index of Social Well-Being
11. International Institutional Failure and the Erosion of Global Commons
12. Collective Agreements and the Structure of Authority
Acknowledgements and Notes
References
Return to Title page

Partha Dasgupta: 'The Economics of the Environment'
Copyright © The British Academy, 1996
Printed in *Proceedings of the British Academy*, Volume **90**, pp. 165-221

---

1. The Resource Basis of Human Activity

All our activities are dependent ultimately on resources found in Nature. Whether it is consumption or production, or whether it is exchange, the commodities and services that are involved can be traced to constituents provided by Nature. Thus, the ingredients of a typical manufactured product are other manufactured products, labour time and skills, and resources found in Nature. Each of the constituent manufactured products is in turn a complex of yet other manufactured products, labour time and skills, and resources found in Nature. And so on. This means that the manufactured product with which we began is ultimately a combination of labour time and skills, and resources found in Nature.

But labour, too, is a produced good. Even raw labour is an output, manufactured by those resources that sustain life; resources such as the multitude of nutrients we consume, the air we breathe, and the water we drink. It follows that *all* commodities are traceable to natural resources. [note 1 (go to Notes)]

In many instances, natural resources are of direct value to us as needs or as consumption goods (e.g. breathable air, drinkable water, and fisheries); in others, they are of indirect value (e.g. plankton, which serve as food for fish, which we, in turn, consume); sometimes they are both (e.g. drinking and irrigation water). The "value" I am alluding to may be utilitarian (e.g. the resource may be a source of food, or a keystone species in an ecosystem), it may be aesthetic (e.g. the resource in question could be a landscape), or it may be intrinsic (e.g. a living animal); indeed, it may be all these things at once. Resource stocks are measured in different ways, depending on their character: in mass units (e.g. biomass units for forests, cowdung, and crop residues), in numbers (e.g. size of an animal herd), in indices of "quality" (e.g. water- and air-quality indicators), in volume units (e.g. acre-feet for aquifers), and so forth.

There is a small tribe of economists, known as *resource economists* (I happen to belong to this tribe), who tend to view the natural environment through the lense of *population ecology*. The focus in population ecology is the dynamics of interacting populations of different species; so it is customary there to take the background environmental processes as given and not subject to analysis. The most well-known illustration of this viewpoint is the use of the logistic function to chart the time path of the biomass of a single species of fish enjoying a constant flow of food. Predator-prey models (e.g. that of Volterra) provide another class of examples; as do the May-MacArthur models [note 2] of competition among an arbitrary number of species. Depending on the context, the flow of value we derive from a resource stock could be dependent on the rate at which it is harvested, or on the size of the stock; in many cases, it would be dependent on both. For example, annual commercial profits from a fishery depend not only on the rate at which it is harvested, but also on the stock of the fishery, because unit harvesting costs are typically low when stocks are large and high when stocks are low. The valuation of resources and the rates at which populations are harvested in different institutional settings are among the resource economist's objects of inquiry (Dasgupta and Heal, 1979; Dasgupta, 1982).

There is another small tribe of economists, known as *environmental economists* (I happen to belong to this tribe as well), who, in seeming contrast to resource economists, base their studies on *ecosystem*

ecology. [note 3] There, the focus is on such objects as energy at different trophic levels and its rate of flow among them, and the distribution and flows of biochemical substances in soils and bodies of water, and of gases and particulates in the atmosphere. The motivation is to study both the biotic and abiotic processes underlying the services ecosystems provide for us. As is now well known, these services are generated by interactions among organisms, populations of organisms, communities of populations, and the physical and chemical environment in which they reside. Ecosystems are the sources of water, of animal and plant food, and of other renewable resources. In this way, ecosystems maintain a genetic library, sustain the processes that preserve and regenerate soil, recycle nutrients, control floods, filter pollutants, assimilate waste, pollinate crops, operate the hydrological cycle, and maintain the gaseous composition of the atmosphere. [note 4] The totality of all the ecosystems of the world represents a large part of our natural capital-base, which, for vividness, I will refer to as our *environmental resource-base*. [note 5] Environmental problems are thus almost always associated with resources that are regenerative, but that are in danger of exhaustion from excessive use. It makes sense then to identify environmental resources with renewable natural resources. [note 6] The valuation of ecological services and the patterns in which they are available under different institutional settings are among the environmental economist's objects of inquiry. Economic studies of global warming, eutrophication of lakes, the management of rangelands, and the pollution of estuaries are examples of such endeavour (Costanza, 1991; Mäler *et al.*, 1992; Walker, 1993; Nordhaus, 1994).

In a formal sense, population and ecosystem ecology differ only by way of the variables ("state variables", as they are called) that are taken to characterise complex systems. In the former, the typical variables are population sizes (or, alternatively, tonnage) of different species; in the latter, they are indices of various services. As noted earlier, it is often possible to summarise the latter in terms of indices of "quality", such as those for air, soil, or water. Each such index should be taken to be a summary statistic (reflecting a particular form of aggregation) that enables the analyst to study complex systems by means of a few strategically chosen variables.

The viewpoint just offered, that of distinguishing population and ecosystem ecology in terms of the state variables that summarise complex systems, allows us to integrate problems of resource management with problems of environmental pollution and degradation. [note 7] It reminds us that resource economics and environmental economics are the same subject. It also suggests that the environmental resource-base should be seen as a gigantic capital stock. Animal, bird, and fish populations (including the vast array of micro-organisms), water, soil, forest cover, and the atmosphere are among the components of this stock. Since it would be convenient to refer to both resource and environmental economics by the overarching name, *ecological economics*, I will do so in this lecture.

More: **2, The Neglect of Ecological Economics**
Return to **Contents**

Partha Dasgupta: 'The Economics of the Environment'
Copyright © The British Academy, 1996
Printed in *Proceedings of the British Academy*, Volume **90**, pp. 165-221

---

2. The Neglect of Ecological Economics

Given the importance of the environmental resource-base in our lives, you would think that ecological matters must be a commonplace furniture of economic thinking. But you would be wrong. Not only are environmental resources only perfunctorily referred to in economics textbooks, they are also cheerfully ignored in economists' public pronouncements. Indeed, as a profession, it has been normal practice for economists to regard the environmental resource-base as an *indefinitely* large and adaptable capital stock. This has enabled them not only to offer macroeconomic advice to political leaders, but also to encourage the lay public to aspire to levels of consumption, that are consistent only with unlimited growth possibilities in material output. Macroeconomic models involving long run production and consumption possibilities typically make no mention of the environmental resource-base; the implicit assumption being that natural resources aren't scarce now, and won't be scarce in the future. It is small wonder that ecological economics remains a fringe activity of what one could call "official" economics. It is an unfortunate state of affairs. [note 8 (go to Notes)]

The lacuna has not been restricted to the study of economics in advanced industrial countries: more than forty years of development thinking in poor countries has also neglected environmental matters. A prime reason, often aired, is that, in earlier days, environmentalists in western industrial countries tended to focus on such problems as local air-pollution (e.g. sulphur emissions) and deterioration of amenities (e.g. national parks, beaches and coast-lines). To the development economist environmental matters, therefore, appeared a trifle precious, not wholly relevant to the urgencies of poor societies. On innumerable occasions I have had this explanation offered to me by social scientists in developing countries. I wouldn't wish to doubt their claim, but the explanation doesn't tell us why, when they studied development problems, these same social scientists ignored their *own* environmental resource-base, nor why government planning models in poor countries so often have regarded this base to be of infinite size.

The neglect of the environment in development economics is ironic, because people in poor countries are in great part agrarian and pastoral. In 1988, rural people accounted for about 65 per cent of the population of what the World Bank classifies as low-income countries. The proportion of total labour force in agriculture was a bit in excess of this. The share of agriculture in gross domestic product in these countries was 30 per cent. These figures should be contrasted with those from industrial market economies, which are 6 per cent and 2 per cent, respectively, for the latter two indices. Poor countries are in large measure biomass-based subsistence economies, in that the rural poor eke out a living from products obtained directly from their *local* environment. For example, in their informative study of life in a microwatershed of the Alaknanda river in the central Himalayas in India, the (Indian) Centre for Science and Environment (C.S.E., 1990) reports that, of the total number of hours worked by the villagers sampled, 30 per cent was devoted to cultivation, 20 per cent to fodder collection, and about 25 per cent was spread evenly between fuel collection, animal care, and grazing. Some 20 per cent of time was spent on household chores, of which cooking took up the greatest portion, and the remaining 5 per cent was involved in other activities, such as marketing. In their work on Central and West Africa, Falconer and Arnold (1989) and Falconer (1990) have shown how vital are forest products to the lives of

rural people. Poor countries, especially those in the Indian sub-continent and sub-Saharan Africa, can be expected to remain largely rural economies for some while yet. The categories of natural resources that are of fundamental importance in advanced industrial countries no doubt differ from those in poor, agrarian societies; but nowhere is the environmental resource-base in unlimited supply. To treat the base as a free good is to practise bad economics.

Here is an example of how economic *analysis* can go awry when it neglects the environment. Barring sub-Saharan Africa over the past twenty-five years or so, gross income per head has grown in nearly all poor regions since the end of the Second World War. In addition, growth in world food production since 1960 has exceeded the world's population growth; by an annual rate of, approximately, 0.6 per cent. This has been accompanied by improvements in a number of indicators of human well-being, such as the under-5 survival rate, life expectancy at birth, and literacy. In poor regions all this has occurred in a regime of population growth rates substantially higher than in the past. These observations have led many economists to argue that the high rates of growth of population that have been experienced in recent years aren't a hindrance to economic betterment, but, rather, that economic development itself can be relied upon to bring down population growth rates.

But there is a problem with this argument. Statistics on past movements of gross world income and agricultural production say nothing about the environmental resource-base. They don't say if, for example, increases in gross national product (GNP) per head are not being realised by means of a depletion of natural capital; in particular, if increases in agricultural production are not being achieved by "mining" the soil. Thus, it is today customary for international organizations to estimate societal well-being by means of indices that capture only the current standard of living (e.g. GNP per head, life expectancy at birth, and the infant survival rate; see UNDP, 1993). But such measures bypass the concerns that ecologists have repeatedly expressed about the links that exist between continual population growth, increased material output, and the state of the environment. This is a serious limitation. In Section 10 I will suggest an aggregate measure of societal well-being that captures not only the current standard of living, but also the effect of changes in the composition of a country's natural capital on her *future* standard of living. This measure is called *net* national product (NNP).

Now the interesting point is this: *it is possible for measures of current well- being, such as the under-5 survival rate and GNP per head, to increase over an extended period of time even while NNP per head is declining*. We should be in a position to say if this has been happening in poor countries. But we aren't, precisely because of a neglect of ecological matters in economic modelling.

Despite this neglect, ecological economics has developed considerably over the years, as if by stealth. So far in this lecture I have sketched the terrain of the subject. In what follows, I will try to give you a feel for what the subject amounts to and what insights it has to offer. Over many years now, I have tried to develop ecological economics in a way that speaks to the problems of economic development in poor countries (Dasgupta, 1982, 1990, 1993, 1995a,b; Dasgupta and Mäler, 1991, 1995); so my treatment will be coloured by my own research interests. I don't think there is any harm in this. Even though many of the problems I will discuss here arise from a study of rural poverty in poor countries, their structure is generic, and I think this fact will be transparent to you.

The plan of the rest of this lecture is as follows: In Section 3 I will classify the reasons we face environmental problems, and in Sections 4–8 I will elaborate them. Sections 9–10 will explore prescriptions. In large part the discussion there will be confined to local environmental problems. In

Section 11 I will extend the discussion to global environmental problems. One overall conclusion we will arrive at is that it won't do to rely entirely on a decentralised economic environment for avoiding environmental problems: collective action at different levels is necessary. So in Section 12 I will speculate on the various pathways that could sustain agreements among peoples and nations.

More: **3, Poverty and Institutional Failure as Causes of Environmental Degradation**
Return to **Contents**

Partha Dasgupta: 'The Economics of the Environment'
Copyright © The British Academy, 1996
Printed in *Proceedings of the British Academy*, Volume **90**, pp. 165-221

---

3. Poverty and Institutional Failure as Causes of Environmental Degradation

The early literature on ecological economics identified market failure as the underlying cause of environmental problems (Pigou, 1920; Lindahl, 1958; Arrow, 1971; Meade, 1973; Mäler, 1974; Baumol and Oates, 1975; Dasgupta and Heal, 1979). Here, by markets I mean institutions that make available to interested parties the opportunity to negotiate mutually advantageous courses of action. But in order that someone is able to negotiate, they need to know the extent to which they are empowered to negotiate, the extent to which the other parties are empowered to negotiate, and so on. In other words, for you to be able to negotiate, you need to know what you can negotiate with, what the other parties can negotiate with, and so forth. So it should come as no surprise that the functioning of markets is linked closely to the structure of property rights. This observation was the starting point of early ecological economics.

Thus, it was noted by authors that for many environmental resources markets simply don't exist. In some cases they don't exist because the costs of negotiation are too high. One class of examples is provided by economic activities that are affected by ecological interactions involving long geographical distances (e.g. the effects of deforestation in the uplands on downstream activities hundreds of miles away; Section 4); another, by large temporal distances (e.g. the effect of carbon emission on climate in the distant future, in a world where forward markets are non-existent because future generations aren't present today to negotiate with us). [note 9 (go to Notes)] Then there are cases (e.g. the atmosphere and the open seas) where the nature of the physical situation (viz. the migratory nature of the resource) makes private property rights impractical and so keeps markets from existing; while in others (e.g. bio- diversity; see Perrings *et al.*, 1994), ill-specified or unprotected property rights prevent their existence, or make them function wrongly even when they do exist.

In each of these cases the market prices of goods and services fail to reflect their social scarcity-values. For example, the market price of a number of environmental resources, *in situ*, is zero, even though they are limited in supply. In short, *laissez-faire* economies are often not much good at generating public signals of a kind that would reflect social scarcities of environmental services. This has been a recurring theme in ecological economics. In Section 9 I will suggest ways of estimating social scarcity-values of such services.

Thus far, market failure. Recently, certain patterns of environmental deterioration have been traced to government failure, not market failure. For example, Binswanger (1989) has argued that, in Brazil, the exemption from taxation of virtually all agricultural income (allied to the fact that logging is regarded as proof of land occupancy) has provided strong incentives to the rich to acquire forest lands and to then deforest them. He has argued that the subsidy the government has thereby provided to the private sector has been so large, that a reduction in deforestation is in *Brazil's* interests, and not merely in the interest of the rest of the world. This has implications for international negotiations. The current consensus appears to be that, as a country, Brazil has much to lose from reducing the rate of deforestation she is engaged in.

If this were true, there would be a case for the rest of the world to subsidise her, as compensation for losses she would sustain if she were to restrain herself. But, as Binswanger's account suggests, it isn't at all clear if the consensus is correct.

This said, it is important to note that the causes of environmental problems are not limited to market and government failure; they also arise because such micro- institutions as the household can function badly. In poor communities, for example, men typically have the bulk of the political voice. We should then expect public investment in, say, environmental regeneration to be guided by male preferences, not female needs. On matters of afforestation in the drylands, for instance, we should expect women to favour planting for fuelwood and men for fruit trees, because it is the women and children who collect fuelwood, while men control cash income (and fruit can be sold in the market). This explains why, even as the sources of fuelwood continue to recede, fruit trees are often planted.

Taken together, these examples reflect the environmental consequences of *institutional failure*. They have a wide reach, and in recent years they have often been discussed within the context of the thesis that environmental degradation, such as eroding soil, receding forests, and vanishing water supplies, is a *cause* of accentuated poverty among the rural poor in poor countries. There is truth in this. But there is also much accumulated evidence that poverty itself can be a cause of environmental degradation (Dasgupta, 1993; Dasgupta and Mäler, 1995; Ehrlich, Ehrlich, and Daily, 1995). This reverse causality arises because some environmental resources (e.g. ponds and tanks) are essential for survival in normal times, while others (e.g. forest products) are a source of supplementary income in times of acute economic stress. This mutual influence can offer a pathway along which poverty, environmental degradation (and even high fertility) feed upon one another in a synergistic manner over time (Dasgupta, 1993, 1995a,b). The recent experience of sub-Saharan Africa would seem to be an illustration of this (Cleaver and Schreiber, 1994). Indeed, an erosion of the environmental resource-base can make certain categories of people destitutes even while the economy's gross national product (GNP) increases.

These two causes of environmental degradation (namely, institutional failure and poverty) pull in different directions and are together not unrelated to an intellectual tension between the concerns people share about an increased greenhouse effect and acid rains, that sweep across regions, nations and continents; and about those matters (such as, for example, the decline in firewood or water sources) that are specific to the needs and concerns of the poor in as small a group as a village community. Environmental problems present themselves differently to different people. In part, it is a reflection of the tension I have just noted and is a source of misunderstanding of people's attitudes. Some people, for example, identify environmental problems with population growth, while others identify them with wrong sorts of economic growth (Sections 7 and 10). Then there are others who view them through the spectacle of poverty. Each of these visions is correct. There is no single environmental problem; rather, there is a large collection of them. Thus, growth in industrial wastes has been allied to increased economic activity; and in industrialised countries (especially those in the former Socialist block), neither preventive nor curative measures have kept pace with their production. Moreover, the scale of the human enterprise, both by virtue of unprecedented increases in the size of the world's population and the extent of economic activity, has so stretched the capabilities of ecosystems, that humankind can today rightly be characterised as the earth's dominant species. These observations loom large not only in ecological economics, but also in the more general writings of environmentalists and in the professional writings of ecologists in the West. For example, Vitousek *et al.* (1986) have estimated that 40 per cent of the net energy created by terrestrial photosynthesis (i.e. net primary production of the biosphere) is currently being appropriated for human use. To be sure, this is a rough estimate. Moreover, net terrestrial primary

production isn't exogenously given and fixed; it depends in part on human activity. Nevertheless, the figure does put the scale of the human presence on the planet in perspective.

On the other hand, economic growth itself has brought with it improvements in the quality of a number of environmental resources. The large-scale availability of potable water, and the increased protection of human populations against both water- and air-borne diseases in industrial countries, have in great measure come in the wake of growth in national income these countries have enjoyed over the past 200 years or so. Moreover, the physical environment inside the home has improved beyond measure with economic growth. For example, cooking in South Asia continues to be a central route to respiratory illnesses among women (see also Section 7 for further examples). Such positive links between economic growth and environmental quality often go unnoted by environmentalists in the West. I would guess that this lacuna is yet another reflection of the fact that it is all too easy to overlook the enormous heterogeneity of the earth's environmental resource-base, ranging as it does from the atmosphere, oceans, and landscapes to water-holes, grazing fields, and sources of fuelwood. This heterogeneity needs constantly to be kept in mind.

More: **4, Markets and their Failure: Unidirectional Interactions**
Return to **Contents**

Partha Dasgupta: 'The Economics of the Environment'
Copyright © The British Academy, 1996
Printed in *Proceedings of the British Academy*, Volume **90**, pp. 165-221

---

4. Markets and their Failure: Unidirectional Interactions

Since we economists understand market competition better than we do political competition, we understand market failure better than we do government failure. In fact, ecological economics has provided us with much insight into the nature of those allocation failures that arise from malfunctioning markets. In this and the next section, we will study this.

Market failure is prominent in those hidden interactions that are *unidirectional*; for example deforestation in the uplands, which can inflict damages on the lowlands in watersheds. It pays first to concentrate on the assignment of property rights before seeking remedies. The common law in many poor countries, if we are permitted to use this expression in a universal context, *de facto* recognises polluters' rights, not those of the pollutees. So, then, let us consider first the case where the law recognises polluters' rights. Translated into our present example, this means that the timber merchant who has obtained a concession in the upland forest is under no obligation to compensate farmers in the lowlands. If the farmers wish to reduce the risk of heightened floods, they will have to compensate the timber merchant for reducing the rate of deforestation. Stated this way, the matter does look morally bizarre, but that is how things would be with polluters' rights. Had property rights been the other way round, that is, one of pollutees' rights, the boots would have been on the other set of feet, and it would have been the timber merchant who would have had to pay compensation to the farmers for the right to inflict the damages that go with deforestation. However, even if the law were to see the matter in this light, there would be enforcement problems. When the cause of damages is hundreds of miles away, when the timber concession has been awarded to public land by the government, and when the victims are thousands of impoverished farmers, the issue of a negotiated outcome doesn't usually arise. The private cost of logging being lower than its social cost (see below), we would expect excessive deforestation.

But when the market prices of environmental resources are lower than their social scarcity values, resource-*based* goods can be presumed to be underpriced in the market. [note 10 (go to Notes)] Naturally, the less roundabout, or less "distant", is the production of the final good from its resource base, the greater is this underpricing, in percentage terms. Put another way, the lower is the value-added to the resource, the larger is the extent of this underpricing of the final product. But this in turn means that if the country were to export primary products, there would be an implicit subsidy on these exports, possibly on a massive scale. Moreover, the subsidy would be paid not by the general public via taxation, but by some of the most disadvantaged members of society: the sharecropper, the small landholder or tenant farmer, the forest dweller, the fisherman, and so on. The subsidy would be hidden from public scrutiny; nobody would talk of it. But it would be there; it would be real. We should have estimates of such subsidies in poor countries. As of now, we have no estimate. [note 11]

In some parts of the world, community leaders, non-government organizations, and a free press (where they exist) have been known to galvanise activity on behalf of the relatively powerless "pollutees". In

recent years this has happened on a number of occasions in different contexts. One of the most publicised was the Chipko Movement in India, which involved the threatened disenfranchisement of historical users of forest products. This was occasioned by the State's claiming its rights over what was stated to be "public property" and then embarking on a logging operation. The connection between environmental protection and civil and political rights is a close one. As a general rule, political and civil liberties are instrumentally powerful in protecting the environmental resource-base, at least when compared with the absence of such liberties in countries run by authoritarian regimes (Dasgupta, 1993).

More: **5, Markets and their Failure: Reciprocal Interactions and the Problem of the Commons**
Return to **Contents**

Partha Dasgupta: 'The Economics of the Environment'
Copyright © The British Academy, 1996
Printed in *Proceedings of the British Academy*, Volume **90**, pp. 165-221

---

5. Markets and their Failure: Reciprocal Interactions and the Problem of the Commons

Matters can be quite different for interactions that are *reciprocal*. Here, each party's actions affect all. Interactions of this sort are the hallmark of *common-property resources*, such as grazing lands, forests, fisheries, the atmosphere, aquifers, village tanks, ponds, lakes, and the oceans. They are often common property because private property rights are for a number of reasons difficult to define (e.g. in the case of mobile resources, such as air). Even when definable, they are on occasion difficult to enforce (e.g. in the case of forest products in mountainous terrains). However, unlike public goods, consumption of common property resources is rivalrous: it is possible for at least one party to increase its consumption at the expense of others' consumption of them. Resources such as local forests, grazing lands, village ponds, and rivulets, are often common property because that is how they have been since time immemorial. Moreover, in poor countries they have remained common property for long because they are basic needs and are at the same time geographically contained. Rivers may be long, but they don't flow through everyone's land. In any case, upstream farmers would have untold advantages over downstream ones if they were in a position to turn off the "tap". Exclusive private territoriality over them would leave non-owners at the mercy of the owners at the "bargaining table". [note 12 (go to Notes)] Society typically don't risk the institution of private-property rights over such resources. [note 13] However, since the private cost of using the resource falls short of its social cost, a common property is over- exploited, *unless there is collective action at some level* (Section 12). This was the point of a pioneering article by Gordon (1954). [note 14]

In a famous essay that popularised Gordon's analysis, the biologist, Garrett Hardin wrote:

"Picture a pasture open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the commons... As a rational being, each herdsman seeks to maximise his gain. Explicitly or implictly, more or less consciously, he asks, 'What is the utility to me of adding one more animal to my herd?'... Adding together the component partial utilities, the rational herdsman concludes that the only sensible course for him to pursue is to add another animal to his herd. And another; and another... But this is the conclusion reached by each and every rational herdsman sharing a commons. Therein is the tragedy. Each man is locked in a system that compels him to increase his herd without limit — in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the fredom of the commons. Freedom in the commons brings ruin to all." (Hardin, 1968, p. 1244.)

The metaphor appears compelling; it offers an example of the famous "prisoners' dilemma" game in a striking way (Section 12). But is it trustworthy?

The answer depends on how contained the commons happen to be geographically. Hardin's parable is apt for resources such as the atmosphere, the open seas, and urban pollution; but, as we will see in the next section, it is misleading for geographically-localised common-property resources, such as ponds,

threshing grounds and, ironically, grazing fields.

Economic analysis is thought by some to have implied that common-property resources can be managed only through centralised coordination and control, where by a "centralised agency" is meant the government, or some agency external to the community of users. Referring to solutions to the problem of the commons in the theoretical literature, Wade (1987, p. 220) writes: "The prevailing answer runs as follows: when people are in a situation where they could mutually benefit if all of them restrained their use of a common-pool resource, they will not do so unless an external agency enforces a suitable rule." And he proceeds to describe enforcement mechanisms in his sample of villages which do not rely on external agencies (Section 6).

Wades' is a bad reading of modern economic analysis. The theory of games has unravelled a number of institutional mechanisms (ranging from taxes to quantity controls) that can in principle support effective allocations of common-property resources. The theory makes clear, and has made clear for some time, that enforcement of the controlled allocation can in a variety of circumstances be undertaken by the users themselves (Dasgupta and Heal, 1979, Chapter 3). In many cases, such participatory arrangements of control may well be the most desirable option (see below). [note 15]

This said, the problem of the commons can rear its head through all sorts of unsuspected sources. The introduction of cotton as an export crop in Tanzania was successful in increasing farmers' incomes. But other than cattle, there were few alternative forms of saving available to farmers. So the quantity of livestock increased significantly, placing communal grazing lands under stress — to the extent that herds declined because of an increase in their mortality rate.

As would be expected, monitoring, enforcement, information, and transaction costs play a critical role in the relative efficacy of the various mechanisms that can in principle be used for controlling the exploitation of common-property resources. It was noted earlier that it matters whether the common property is geographically contained (contrast a village pond with the open seas); it matters whether the users know one another (contrast a village grazing ground with a tuna fishery; Section 12); and it matters whether individual use can easily be monitored, so as to prevent "free-riding" (contrast the use of a village tube-well with the littering of streets in a metropolis; or the grazing of cattle in the village commons with firewood collection from forests in mountainous terrain; Section 12). The confirmation of theory by current evidence on the fate of different categories of common-property resources has been one of the most pleasing features of modern economic analysis.

Public concerns about environmental degradation are often prompted by disasters, such as nuclear leakage or floods. The environmental impact of large undertakings (e.g. dams and irrigation systems, such as the Narmada Project in India) also catch the public eye. This is not surprising. Large-scale effects caused by single happenings are, often enough, easy to detect. So they invite debate. In contrast, environmental interactions that result in an overuse of common-property resources are not so easy to detect, at least, not unless some threshold is reached and catastrophies occur. The commons often involve large numbers of users, each inflicting only a tiny damage on each of the others, which, however, sum to a substantial amount; usually, over an extended period of time. There is now evidence that environmental degradation in poor countries is in large measure caused by those institutional failures whose deletarious effects accumulate slowly over time; it is caused less by large public projects (Repetto, 1988).

More: **6, Public Failure and the Erosion of Local Commons**

Return to **Contents**

Partha Dasgupta: 'The Economics of the Environment'
Copyright © The British Academy, 1996
Printed in *Proceedings of the British Academy*, Volume **90**, pp. 165-221

---

6. Public Failure and the Erosion of Local Commons

There is a difference between *global* and *local* commons. The open seas are common-property resources, as are usually village ponds; but what is a problem for the former isn't necessarily a problem for the latter. Hardin's metaphor, even though applicable to global commons, can be misleading in the case of the local variety. For unlike global commons, the source of the problems associated with the management of local commons is often not the users, but other agencies. The images invoked by "the tragedy of the commons" are mostly not the right ones when applied to local commons. Local commons (such as village ponds and tanks, pastures and threshing grounds, watershed drainage and riverbeds, and sources of fuelwood, medicinal herbs, bamboo, palm products, resin, gum, and so forth) are not open for use to all in any society. In most cases they are open only to those having historical rights, through kinship ties, community membership, and so forth. Not surprisingly, those having historical rights-of-use tend to be protective of these resources. Local commons are often easy enough to monitor, so their use can be regulated by the community; either through the practice and enforcement of norms of behaviour, or through deliberate allocation of use (Section 12). The idea of "social capital", viewed as a complex of interpersonal networks (Putnam, 1993), is telling in this context.

Wade (1987, 1988) has conducted an empirical investigation of community-based allocation rules. Forty-one South Indian villages were studied, and it was found, for example, that downstream villages had an elaborate set of rules, enforced by fines, for regulating the use of water from irrigation canals. Most villages had similar arrangements for the use of grazing land. In an earlier work on the Kuna tribe in the Panama, Howe (1986) described the intricate set of social sanctions that are imposed upon those who violate norms of behaviour designed to protect their source of fresh water. Even the iniquitous caste system of India has been found to provide an institutional means of checks and balances by which communal environmental resources have been protected (Gadgil and Malhotra, 1983).

This said, it is important to caution against romanticising local common-property resource management. Beteille (1983), for example, contains examples of how access to the local commons is often restricted to the privileged (e.g. caste Hindus). Rampant inequities exist in rural community practices. I am laying stress on the fact the local commons are not unmanaged; I am not claiming that they are invariably managed in an equitable way.

The extent of common-property resources as a proportion of total assets in a community varies considerably across ecological zones. In India they appear to be most prominent in arid regions, mountain regions, and unirrigated areas. They are least prominent in humid regions and river valleys (Agarwal and Narain, 1989; Chopra, Kadekodi and Murty, 1989). There is, of course, an economic rationale for this, one that is based on the common human desire to pool risks (Dasgupta, 1993, Chapter 10). An almost immediate empirical corollary is that income inequalities are less where common-property resources are more prominent. However, aggregate income is a different matter, and it is the arid and mountain regions and unirrigated areas that are the poorest. This needs to be borne in mind

when policy is devised. As may be expected, even within dry regions, dependence on common-property resources falls with rising wealth across households. The links between undernourishment, destitution, and an erosion of the rural common-property resource base are close. They have been explored analytically in Dasgupta (1993, 1996).

In an important and interesting article, Jodha (1986) used data from over eighty villages in twenty-one dry districts from six dry tropical states in India to estimate that among poor families the proportion of income based directly on common-property resources is for the most part in the range 15–25 per cent (see also Jodha, 1995). This is a substantial proportion. Moreover, as sources of income they are often complementary to private-property resources, which are in the main labour, milch and draft animals, cultivation land and crops, agricultural tools (e.g. ploughs, harrows, levellers, and hoes), fodder-cutting and rope-making machines, and seeds. Common-property resources also provide the rural poor with partial protection in times of unusual economic stress. For landless people they may be the only non-human asset at their disposal. A number of resources (such as fuelwood and water for home use, berries and nuts, medicinal herbs, resin and gum) are the responsibility of women and children. [note 16 (go to Notes)]

A similar picture emerges from Hecht, Anderson and May (1988), who describe in rich detail the importance of the extraction of babassu products among the landless in the Brazilian state of Maranho. The support such extraction activity offers the poorest of the poor, most especially the women among them, is striking. These extractive products are an important source of cash income in the period between agricultural-crop harvests (see also Murphy and Murphy, 1985; and for a similar picture in the West African forest zone, see Falconer, 1990).

It isn't difficult to see why common-property resources matter greatly to the poorest of the rural poor in a society, or therefore, to understand the mechanisms by which such people may well get disenfranchised from the economy even while in the aggregate the society enjoys economic growth. If you are steeped in social norms of behaviour and understand communitarian obligations, you do not calculate every five minutes how you should behave. You follow the norms. This saves on costs all round, not only for you as an "actor", but also for you as "policeman" and "judge". [note 17] It is also the natural thing for you to do if you have internalised the norms. But this is sustainable so long as the background environment remains pretty much constant. It will not be sustainable if the social environment changes suddenly. You may even be destroyed. It is this heightened vulnerability, often more real than perceived, which is the cause of some of the greatest tragedies in contemporary society. They descend upon people who are, in the best of circumstances, acutely vulnerable.

Sources that trigger destitution by this means vary. The erosion of common-property resource bases can come about in the wake of shifting populations (accompanying the growth process itself), rising populations and the consequent pressure on these resources, technological progress, unreflective public policies, predatory governments, and thieving aristocracies. There is now an accumulation of evidence on this range of causes, and in what follows I shall present an outline of the findings in three sets of studies.

1. In his work on the drylands of India, Jodha (1986) noted a decline in the geographical area covering common-property resources ranging from 26 to 63 per cent over a twenty-year period. This was in part due to the privatisation of land, a good deal of which in his sample had been awarded to the rural non-poor. He also noted a decline in the productivity of common-property resources on account of population growth among the community. In an earlier work, Jodha (1980) identified an increase in

subsistence requirements of the farming community and a rise in the profitability of land from cropping and grazing as a central reason for increased desertification in the state of Rajasthan. Jodha argued that, ironically, it was government land reform programmes in this area, unaccompanied by investment in improving the productive base, that had triggered the process.

2. Ensminger's (1990) study of the privatisation of common grazing lands among the Orma in northeastern Kenya indicates that the transformation took place with the consent of the elders of the tribe. She attributes this willingness to changing transaction costs brought about by cheaper transportation and widening markets. The elders were, quite naturally, from the stronger families, and it does not go unnoted by Ensminger that privatisation has accentuated inequalities.

3. In an earlier, much-neglected work on the Amazon basin, Feder (1977, 1979) described how massive private investment in the expansion of beef-cattle production in fragile ecological conditions has been supported by domestic governments in the form of tax concessions and provision of infrastructure, and loans from international agencies, such as the World Bank. The degradation of vast tracts of valuable environmental resources was accompanied by the disenfranchisement of large numbers of small farmers and agricultural labourers from the economy. At best it made destitutes of traditional forest dwellers; at worst it simply eliminated them (see also Barraclough, 1977; Hecht, 1985). The evidence suggests that during the decades of the 1960s and 1970s protein intake by the rural poor declined even while the production of beef increased dramatically. Much of the beef was destined for exports, for use by fast-food chains.

The sources that transformed common-property resources into private resources, as described in these studies, were different. Consequently, the ways in which they had an impact on those with historical rights were different. But each is understandable and believable. Since the impact of these forms of privatisation are confirmed by economic theory, the findings of these case studies are almost certainly not unrepresentative. They suggest that privatisation of village commons and forest lands, while hallowed at the altar of economic efficiency, can have disastrous distributional consequences, disenfranchising entire classes of people from economic citizenship. They also show that public ownership of such resources as forest lands is by no means necessarily a good basis for a resource allocation mechanism. Decision-makers are in these cases usually far removed from site (living as they do in imperial capitals), they have little knowledge of the ecology of such matters, their time-horizons are often short, and they are in many instances overly influenced by interest-groups far removed from the resource in question.

All this is not at all to suggest that rural development is to be avoided. It is to say that resource allocation mechanisms that do not take advantage of dispersed information, that are insensitive to hidden (and often not-so-hidden) economic and ecological interactions, that do not take the long-view, and that do not give a sufficiently large weight to the claims of the poorest within rural populations (particularly the women and children in these populations) are going to prove environmentally disastrous. It appears that, during the process of economic development there is a close link between environmental protection and the well- being of the poor, most especially the most vulnerable among the poor. Elaboration of this link has been one of the most compelling achievements at the interface of anthropology, economics, and nutrition science.

More: **7, Economic Growth and the Environment**
Return to **Contents**

Partha Dasgupta: 'The Economics of the Environment'
Copyright © The British Academy, 1996
Printed in *Proceedings of the British Academy*, Volume **90**, pp. 165-221

---

7. Economic Growth and the Environment [note 18 (go to Notes)]

Since economists have neglected the environment, it shouldn't come as a surprise that national economic policies have also neglected it. Interestingly, the idea that economic growth is perhaps even good for the environment has recently been stressed by the finding that, for a number of pollutants there would appear to be an empirical relationship between income per head and environmental quality: as income per head increases, environmental quality deteriorates up to a point, beyond which environmental quality improves (World Bank, 1992). In short, the relationship has a bell shape.

This is how one is tempted to explain the finding. People in poor countries can't afford placing emphasis on amenities over material well-being. Therefore, in the early stages of economic development, increases in pollution are regarded as an acceptable side-effect of economic growth. However, when a country has attained a sufficiently high standard of living, people care more about amenities. This leads them to pass environmental legislation, instal new institutions for the protection of the environment, and so forth.

The argument hasn't been invoked for the environmental resource-base, but rather, for amenities. In any event, the bell shaped curve has been uncovered for a selected set of pollutants only. But as it is consistent with the notion that as their incomes rise people spend proportionately more on environmental quality, economists have conjectured that the curve applies to environmental quality, more generally. [note 19] It is as well to be clear, though, about the kinds of conclusion that can be drawn from these empirical findings. While the findings do indicate that economic growth can be associated with improvements in some environmental indicators, they imply neither that economic growth is sufficient to induce environmental improvement in general, nor that the environmental effects of growth may safely be ignored, nor, indeed, that the earth's resource base is capable of supporting indefinite economic growth. On the contrary, if the resource base were irreversibly degraded, economic growth itself could be at risk.

There are other reasons for caution in interpreting such bell-shaped curves. First, the relationship has been shown to be valid for pollutants involving local short-term costs (e.g. sulphur, particulates, fecal coliforms), not for the accumulation of stocks of waste, nor for pollutants involving long-term and more dispersed costs, such as carbon dioxide, which typically increase with income (World Bank, 1992).

Second, the bell-shaped curves have been uncovered for emissions of pollutants, not resource stocks. The relationship is less likely to hold wherever the feedback effects of resource stocks are significant, such as those involving soil and its cover, forests, and other ecosystems, such as mangroves.

Third, the bell-shaped curves, as they have been estimated, say nothing about the system-wide consequences of reductions in emission. (For example, reductions in one pollutant in one country may involve increases in other pollutants in the same country or transfers of pollutants to other countries.) And fourth, in most cases where emissions have declined with rising income, the reductions have been due to local institutional reforms, such as environmental legislation and market-based incentives to

reduce environmental impacts. But such reforms often ignore international and intergenerational consequences. Where the environmental costs of economic activity are borne by the poor, by future generations, or by other countries, the incentives to correct the problem are likely to be weak. The environmental consequences of rising economic activity may, accordingly, be very mixed.

The solution to environmental degradation lies in such institutional reforms as would compel private users of resources to take account of the social costs of their actions. The bell-shaped relation is a suggestion that this can happen in some cases. It doesn't constitute evidence that it will happen in all cases, nor that it will happen in time to avert the irreversible consequences of growth. I will discuss these matters further in Section 10, where we will see that growth in gross national product is a wrong objective. I will then ask *what sort* of economic growth we ought to be seeking, if indeed it is economic growth of some kind we ought to seek. In short, we will try to identify an operationally useful index of societal well-being.

More: **8, Trade and the Environment**
Return to **Contents**

Partha Dasgupta: 'The Economics of the Environment'
Copyright © The British Academy, 1996
Printed in *Proceedings of the British Academy*, Volume **90**, pp. 165-221

---

8. Trade and the Environment

Thus far national economic policy. But even in areas where the environment is beginning to impinge on international economic policy, as in GATT and NAFTA, [note 20 (go to Notes)] it has remained a tangential concern, and the presumption has often been made that the liberalisation of international trade is, in some sense, good for the environment. This notion has meant that policy reforms designed to promote trade liberalisation have been encouraged with little regard to their environmental consequences; presumably, on grounds that these consequences would either take care of themselves or could be dealt with separately. [note 21]

As a reaction to this, I would imagine, it has not been uncommon to view international trade liberalisation as a harbinger of a deteriorating environment (e.g. Daly, 1994). When stated so baldly, the view is false: it doesn't recognise the heterogeneity of environmental problems; it doesn't distinguish between the volume and composition effects of a growth in trade on the world's production of goods and services; it doesn't say if the growth is allied to international agreements on transfrontier pollution and a reduction in domestic market failure; and it is silent on whether the growth is brought about by a removal of government-induced distortions. To be sure, increased world trade is often associated with a relocation of production units in accordance with relative international labour, capital, and resource costs. One would expect free trade to shift polluting industries to poor countries (Copeland and Taylor, 1994), but insofar as the resulting pollution is local, this is a matter of national sovereignty. The argument that lobbies would succeed in lowering environmental standards in countries that have high standards, in order to meet competition from countries with low standards, is not dissimilar to the concern people have that trade with low-wage countries would eventually lower wages in high-wage countries. However, it is possible to design tax-subsidy schemes to offset the additional cost of higher standards while retaining some of the gains from trade. [note 22] Above all, the argument for trade protection arising from the thought that countries with lower environmental standards will become sinks for other countries' pollutants is to be resisted because of the kinds of considerations that were outlined earlier in this lecture.

A variant of these economic considerations formed the intellectual background of an argument in a widely-publicised memorandum issued in 1991 by the Chief Economist of the World Bank to his staff for discussion. It suggested that trade in pollutants should be encouraged between rich and poor nations because of at least two reasons: (i) poor countries (e.g. sub-Saharan Africa) suffer from lower industrial pollution than those in the West; and (ii) being poor, they could be expected to value environmental quality less at the margin.

The memorandum was much criticised in the international press, mostly along the lines that it read altogether too much like saying, "let the poor eat pollution". The arguments I have offered in this lecture imply that this is misplaced criticism. On the other hand, there are two reasons why we should be wary of the suggestion. First, it is based implicitly on the thought that there are no significant threshold effects associated with environmental pollution. If thresholds were important, it would not make sense to spread pollution evenly across geographical locations. Within municipalities, for example, household and

industrial waste are typically deposited in rubbish dumps. This is a social response to the presence of environmental thresholds. We may now enlarge on this observation: assuming that it is true that poor countries currently enjoy a better environment as regards industrial waste, it could well be that global well-being would be enhanced if their environment were protected and promoted, and if selected sites in rich countries were used as global centres of deposits for industrial effluents.

The second reason one should be circumspect about the suggestion is that it doesn't note that the poor in poor countries are not the same as poor countries. There are both rich and poor people in poor countries. Typically, the rich in these countries don't absorb anything like the environmental risks the poor are forced to accept (e.g. health risks at work). In addition, the rich enjoy political advantages. Furthermore, there is nothing resembling a free press, nor open debate, in a majority of poor countries. It is then all too possible to imagine that if trade in industrial pollutants were to be encouraged, the poor in poor countries would be made to absorb the health risks (industrial pollutants are usually spatially localised), and the rich in poor countries would grasp the income accruing from the trade (a private benefit). This should make for a difference in our attitude towards the proposal. As elsewhere in economics, the issue of governance lies somewhere at the heart of the matter.

More: **9, Valuing Environmental Resources**
Return to **Contents**

Partha Dasgupta: 'The Economics of the Environment'
Copyright © The British Academy, 1996
Printed in *Proceedings of the British Academy*, Volume **90**, pp. 165-221

9. Valuing Environmental Resources

As noted earlier, each of these questions is prompted by the observation that prices in a decentralised economic environment often do not reflect social scarcities of goods and services. For if they did, the criterion of private profitability would suffice, and there would be no need to pay special attention to the environmental resource-base. As they don't, a project's private profitability can't be regarded as an adequate indicator of its social worthiness.

So then, what criterion should we use for choosing public policy? One idea, much pursued in recent years, is to go to the heart of the matter and estimate social scarcities. Quantitative measures of social scarcity are called *accounting prices*. These prices are notional, and the idea is to use *them*, rather than market prices, when evaluating public policies. To state it another way, the suggestion is that economic policies should be selected on the basis of their *accounting profits*. [note 23 (go to Notes)]

How we should estimate accounting prices is a complex matter, but it isn't uniformly complex. There are now standard techniques for commodities like irrigation water, fisheries, timber, and agricultural soil. [note 24] The same techniques can be used for estimating losses associated with water-logging and overgrazing. For commodities such as firewood, and drinking and cooking water, the matter is more complex: they are inputs in household production. This means that we need estimates of the way households convert inputs into outputs; that is, we need to estimate household production functions. As an example, transportation costs (in particular energy costs, as measured in calories) for women and children would be less if the sources of fuelwood and water were not far away and receding. As a (very) first approximation, the value of water or fuelwood for household production can be estimated from these energy needs. In some situations (as on occasion with fuelwood), the resource is a substitute for a tradable input (for example, paraffin or kerosine); in others (as with cooking water) it is a complement to tradable inputs (for example, food grain). Such facts enable one to estimate accounting prices of non-marketed goods in terms of the accounting prices of marketed goods (Mäler, 1974). [note 25]

The approach outlined above allows us to capture only the direct use-value of a resource. As it happens, its accounting price may well exceed this. Why? The reason is that there may be additional values "embodied" in a resource. One additional value, mentioned in Section 1, is applicable to living resources: it is their intrinsic worth as living resources. (It is absurd to suppose that the value of a blue whale is embodied entirely in its flesh and oil, or that the value of the game in Kenyan safari parks is simply the present-discounted value of tourists' willingness-to-pay.) The idea of "intrinsic worth" of living things is inherent not only within traditional religious systems of ethics, but also in the modern utilitarian tradition. The question is not so much whether living things possess intrinsic worth, but rather, about ways of assessing this worth. It is almost impossible to get a quantitative handle on intrinsic worth. So the right thing to do is to take note of it, keep an eye on it, and call attention to it in public debate if the resource is threatened with extinction.

What is the point of basing accounting prices solely on use-value when we know that resources often possess intrinsic value as well? The answer is that it provides us with *biased* estimates of accounting

prices, and this can be useful information. For example, in a beautiful paper on the optimal rate of harvest of blue whales, Spence (1974) took the accounting price of these creatures to be the market value of their flesh, a seemingly absurd and repugnant move. But he showed that under a wide range of plausible parametric conditions, it would be most profitable commercially for the international whaling industry to agree to a moratorium until the desired long-run population size were reached, and for the industry to subsequently harvest the creatures at a rate equal to the population's (optimal) sustainable yield. [note 26] In other words, in Spence's analysis, preservation was recommended solely on commercial ground. But if preservation is justified when the accounting price of blue whales is estimated from their market price, the recommendation would, obviously, be reinforced if their intrinsic worth were to be added. This was the point of Spence's exercise.

There is another source of value for environmental resources, one which is more amenable to quantification. It arises from a combination of two things common to them: uncertainty in their future use-values, and irreversibility in their use. (Genetic material in tropical forests provides a prime example.) The twin presence of uncertainty and irreversibility implies that preservation of its stock has an additional value — the value of extending society's set of future options. Future options have an additional worth because, with the passage of time, more information is expected to be forthcoming about the resource's use-value. This additional worth is often called an *option value*. The accounting price of a resource is, at the very least, the sum of its use-value and its option value. [note 27]

More: **10, Net National Product as an Index of Social Well-Being**
Return to **Contents**

Partha Dasgupta: 'The Economics of the Environment'
Copyright © The British Academy, 1996
Printed in *Proceedings of the British Academy*, Volume **90**, pp. 165-221

---

10. Net National Product as an Index of Social Well-Being

Ideally, institutions should be in place that make it possible for market prices and accounting prices to coincide. In practice, they don't coincide, and private agencies choose their actions on the basis of market prices (augmented by taxes and subsidies). But it is public agencies with which I am concerned here, and the idea is that they should rely on accounting prices in reaching decisions.

The argument that the right criterion for choosing among alternative policies is their *social* profitability, evaluated on the basis of *accounting* prices, is closely related to the recent suggestion that in measuring changes in societal well-being, we should estimate changes in *net* national product (NNP); that is, gross national product (GNP) corrected for the value of changes in the country's *entire* capital base, including its environmental resource-base. This suggestion is based on a well-known theorem in modern economics. The theorem states that, provided certain technical restrictions are met (on which, see below in the text), for any conception of societal well-being, and for any set of technological, transaction, information, and ecological constraints, there exists a set of accounting prices of goods and services that can be used in constructing an index of social well-being. The index in question has the following property: *small policy changes (including small investment projects) that improve the index are at once those that increase social well-being*. [note 28 (go to Notes)] This all-inclusive index is often called "green NNP" in the popular literature.

I cannot enter into details here, but (green) NNP, in a closed economy, reads as:

NNP = *Consumption + value of net investment in physical capital + the value of the net change in human capital + the value of the net change in the stock of natural capital the value of current environmental damages*. [note 29]

Current estimates of NNP are biased because depreciation of environmental resources is not deducted from GNP. To put it another way, NNP estimates are biased because a biased set of prices is in use: prices imputed to environmental resources on site are usually zero, and this amounts to regarding the depreciation of environmental capital as zero. But this in turn means that profits attributed to projects that degrade the environment are higher than their social profits. A consequence is that wrong sets of projects get selected — in both the private and public sectors.

The extent of the bias will obviously vary from project to project, and from country to country. But it can be substantial. In their work on the depreciation of natural resources in Costa Rica, Solorzano *et al.* (1991) have estimated that, in 1989 the depreciation of three resources — forests, soil, and fisheries — amounted to about 10 per cent of gross domestic product and over a third of gross capital accumulation. Since, under current practice, environmental resources are often unpriced, resource-intensive projects look better than they actually are. In consequence, installed technologies are often unfriendly towards the environment.

One can go further: the bias extends to the prior stage of research and development. When environmental resources are underpriced, there is little incentive on anyone's part to develop technologies that economise on their use. The extent of the distortion created by this underpricing will vary from country to country. Poor countries inevitably have to rely on the flow of new knowledge produced in advanced industrial economies. Nevertheless, poor countries need to have the capability for basic research. The structure of accounting prices there is likely to be different from those in advanced industrial countries, most especially for non-traded goods and services. Even when it is publicly available, basic knowledge is not necessarily usable by scientists and technologists, unless they themselves have a feel for basic research. Often enough, ideas developed in foreign lands are merely transplanted to the local economy; whereas, they ought instead to be modified to suit local ecological conditions before being adopted. This is where the use of accounting prices is of help. It creates the right set of incentives both among developers and users of technologies. Adaptation is itself a creative exercise. Unhappily, as matters stand, it is often bypassed. There is loss in this.

There is further loss associated with a different kind of bias, something we noted earlier: that arising from biased demand. For example, wherever household demands for goods and services in the market reflect in the main male (or for that matter, female) concerns, the direction of technological change would be expected to follow suit. Among poor countries, we would expect technological inventions in farm equipment and techniques of production to be forthcoming in regions where cultivation is a male activity (there would be a demand for them); we would not observe much in the way of process innovations in threshing, winnowing, the grinding of grain in the home, and in the preparation of food. Entrepreneurs have little incentive to bring about such technological innovations. Household demand for them would be expected to be low.

Such biases in NNP as I have identified here occur in advanced industrial countries as well. So then why do I stress their importance in the context of poor countries? The reason is that poor people in poor countries cannot cope with the same margin of error as people living in rich countries can: a 10 per cent drop in the standard of living imposes greater hardship on a poor household than a rich one. Recall too that the rural poor are especially dependent upon their local environmental resource-base. Losses in well-being due to an underpricing of this base are absorbed by them disproportionately. The estimation of accounting prices of environmental resources should now be high on the agenda of research in the economics of poor countries.

There is an important qualification to all this. The principles underlying the construction of (green) NNP assume, among other things, that ecological processes do not display *threshold effects*. [note 30] If threshold effects were important, a purely decentralised economic environment wouldn't do: accounting prices would need to be augmented by quantity controls on the use of certain environmental resources. This would be a way of ensuring that the magnitude of economic activity does reach a level that places undue stress on key ecosystems.

We conclude that economic liberalisation and other policies that promote growth in *gross* national product are not substitutes for environmental policy. On the contrary, it may well be desirable that they are accompanied by stricter policy reforms. Of particular importance is the need for reforms that would improve the quality of the signals (e.g. the array of prices and public information about stocks of various resources) on the basis of which resource users reach decisions. Environmental damages, including the loss of resilience of ecosystems, often occur abruptly. They are often not reversible. But abrupt changes can seldom be anticipated from systems of signals that are typically received by decision-makers in the

world today. Moreover, the signals that do exist are often not observed, or are wrongly interpreted, or are not part of the incentive structure of societies. This is due to ignorance about the dynamic effects of changes in the variables that characterise ecosystems (e.g. thresholds, buffering capacity, and loss of resilience). It is also due to the presence of institutional impediments, such as lack of well-defined property rights. The development of appropriate institutions depends, among other things, on understanding ecosystem-dynamics. Above all, given that we are vastly ignorant about the extent to which ecosystems are resilient, we should act in a precautionary way so as to maintain their diversity.

Economic growth is not a panacea for environmental quality; indeed, it is not even the main issue. What matters is not economic growth *per se*, but the *content* (i.e. the composition of inputs and outputs) of growth. The content is determined by, among other things, the economic institutions within which human activities are conducted. Such measures will not only promote greater efficiency in the allocation of environmental resources at all income levels, but would also assure a sustainable scale of economic activity within the ecological life-support system. Protecting the capacity of ecosystems to sustain human well-being is of as much importance to poor countries as it is to those that are rich.

More: **11, Institutional Failure and the Erosion of Global Commons**
Return to **Contents**

Partha Dasgupta: 'The Economics of the Environment'
Copyright © The British Academy, 1996
Printed in *Proceedings of the British Academy*, Volume **90**, pp. 165-221

---

11. Institutional Failure and the Erosion of Global Commons

Global commons in general pose a different type of problem from that posed by local commons. Free access to the atmosphere, to watersheds, and to the open seas, are a cause of inefficiency in the allocation of resources. Here, Hardin's metaphor is apt. In the case of the atmosphere (for example, over global warming), even the option of "voting with one's feet" is unavailable. [note 31 (go to Notes)]

It appears that the most complicated international environmental problems are characterised by reciprocal interactions: countries both contribute to environmental damages and suffer from them. Emissions of greenhouse gases are an instance of this. Now, a central problem with greenhouse emissions is that, even though reciprocal, countries do not inflict damages on others in equal amounts. Thus, for a cooperative outcome to be achievable, some financial transfers are necessary, if only in an implicit manner. Several alternatives suggest themselves, debt relief for the preservation of the Amazon being one that has most frequently been discussed.

This isn't to say that agreements can't be reached without side-payments; it is only to say that they will tend to be less efficient. Barrett (1990) has argued, for example, that one shouldn't expect all countries to sign the Montreal protocol on emissions of chlorofluorocarbons (CFCs). The reason is that if only a few countries were to sign the protocol, national benefits from further reduction in CFC emission would be high. This would induce more countries to sign. However, if many countries were to sign the protocol, national benefits from further reduction would be small, and it wouldn't then be worth a country's while to sign the agreement.

Direct side payments among countries for solving environmental problems have not been common. When made, side payments have tended to be non-pecuniary; for example, trade and military concessions (Krutilla, 1966; Kneese, 1988). Recently, an agreement has been reached on reducing the production and use of CFCs in developing countries. This has involved the creation of an international fund for technological transfers to these countries. It is a promising development.

One broad category of allocation mechanisms well worth exploring in the international context involves making the global commons quasi-private. The basic idea, which originated in Dales (1968), is similar to the principle currently being experimented with in the U.S.A. The idea, if extended to the international sphere, would have the community of nations set bounds on the total use of the global commons, such as the atmosphere; have it allocate a proper initial distribution of transferable national rights which add up to the aggregate bound; and allow the final allocation among different users to be determined by competitive markets.

To give an example, consider the emission of greenhouse gases. Suppose it is desired by the community of nations that emissions should be reduced to a prescribed global level. Units of the various gases would then be so chosen that all gases have the same (expected) effect on global climate. (In other words, at the

margin the emission of one unit of any one gas would have the same expected climatic effect as the emission of one unit of any other gas.) The scheme would allow countries to exchange permits for one gas for permits for any other. Countries would receive an initial assignment of marketable permits. It transpires that under a wide range of circumstances, this scheme has informational advantages over both taxes and quantity controls on individual emissions. Furthermore, if the permits were to refer to *net* emissions (i.e. net of absorption of carbon dioxide by green plants), the scheme would provide an incentive for countries with fast-growing tropical rain forests to earn export revenue by encouraging forest growth and then selling permits to other countries. The scheme also has the advantage that the necessary side-payments required to induce all (or most) countries to participate in the agreement can be made through the initial distribution of emission permits. Countries that do not expect severe damages from global warming would also wish to participate if they were to be provided initially with a sufficient number of permits.

The sticking point will clearly be over reaching an agreement on the initial distribution of permits among nations. [note 32] But if the bound that is set on annual aggregate greenhouse emissions were approximately optimal, it would always be possible *in principle* to distribute the initial set of rights in such a way that all countries have an incentive to join the scheme. Having said this, it is important to note that in practice it is difficult to come up with a *rule* that would accomplish the assignment of initial rights. So progress in this sphere of international co-operation can be expected to be slow. Nevertheless, one cannot overemphasise the fact that there are large potential gains to be enjoyed from international co-operation. A scheme involving the issue of marketable permits in principle offers a way in which all nations can enjoy these gains. The argument that "national sovereignty" would be endangered is in fact no argument, for the point about global commons is precisely that they are beyond the realm of national sovereignty. [note 33]

More: **12, Collective Agreements and the Structure of Authority**
Return to **Contents**

Partha Dasgupta: 'The Economics of the Environment'
Copyright © The British Academy, 1996
Printed in *Proceedings of the British Academy*, Volume **90**, pp. 165-221

---

12. Collective Agreements and the Structure of Authority

A striking difference between local and global environmental problems is this: unlike agreements on the use of, say, local commons, there is no obvious central authority that can enforce agreements among nations over the use of transnational commons. To be sure, there are international authorities that have the mandate to act as overseers. But they don't, at least *in principle*, possess the coercive powers that national governments ideally enjoy. This has implications on the extent to which international authorities are able to enforce agreements.

Insights into the range of options open in the international sphere can be obtained by asking a prior question: How are agreements enforced in the case of local environmental problems? Broadly speaking, there would appear to be three mechanisms by which this is achieved. (Of course, none may work in a particular context, in which case people will find themselves in a hole they can't easily get out of, and what could have been mutually beneficial agreements won't take place.)

In the first mechanism the agreement is translated into a contract, and is enforced by an established structure of power and authority. As noted in Section 6, this may be the national government, but it need not be. In rural communities, for example, the structure of power and authority are in some cases vested in tribal elders (as within nomadic tribes in sub-Saharan Africa), in others in dominant landowners (such as the zamindars of eastern India), feudal lords (as in the state of Rajasthan in India), chieftains, and priests. On occasions there are even attempts at making rural communities mini-republics. Village Panchayats in India try to assume such a form. The idea there is to elect offices, the officials being entrusted with the power to settle disputes, enforce contracts (whether explicit or only tacit), communicate with higher levels of State authority, and so forth. Wade's account (Wade, 1987) of the collective management of common-property resources in South India describes such a mechanism of enforcement in detail. [note 34 (go to Notes)]

The question why such a structure of authority as may exist is accepted by people is a higher-order one, akin to the question why people accept the authority of government. The answer is that general acceptance itself is a self-enforcing behaviour: when all others accept the structure of authority, each has an incentive to accept it. [note 35] Contrariwise, when a sufficiently large number don't accept it, individual incentives to accept it weaken, and the system unravels rapidly. General acceptance of the structure of authority is held together by its own bootstraps, so to speak.

The second mechanism consists in the development of a disposition to abide by agreements, a disposition that is formed through the process of communal living, role modelling, education, and the experiencing of rewards and punishments. This process begins at the earliest stages of our lives. We internalise social norms, such as that of paying our dues, keeping agreements, returning a favour; and higher-order norms, as for example frowning on people who break social norms (even shunning them), and so forth. By internalising such norms as keeping agreements, a person makes the springs of his actions contain the

norm. The person therefore feels shame or guilt in violating a norm, and this prevents him from doing so, or, at the very least, it puts a break on his violating it unless other considerations are found by him to be overriding. In short, his upbringing ensures that he has a disposition to obey the norm. When he does violate it, neither guilt nor shame is typically absent, but the act will have been rationalised by him. A general disposition to abide by agreements, to be truthful, to trust one another, and to act with justice is an essential lubricant of societies. Communities where the disposition is pervasive save enormously on transaction costs. There lies its instrumental virtue. In the world as we know it, such a disposition is present in varying degrees. When we refrain from breaking the law, it isn't always because of a fear of being caught. On the other hand, if relative to the gravity of the misdemeanour the private benefit from malfeasance were high, some transgressions could be expected to take place. Punishment assumes its role as a deterrence because of the latter fact.

However, where people repeatedly encounter one another in similar situations, agreements could be reached and kept even if people were not trustworthy and even if a higher authority were not there to enforce the agreements. This is a third kind of mechanism.

How does it work? A simple set of contexts in which it works is where far- sighted people know both one another and the environment, where they expect to interact repeatedly under the same circumstances, and where all this is common knowledge. [note 36] For expositional purposes, it helps to simplify further and to consider circumstances where actions are observable, and where there is perfect recall on each person's part of how others have behaved in the past. [note 37] One idea is to require norms of behaviour to be supplemented by an entire sequence of meta- (i.e. higher-order) norms, all of which can be succinctly stated in the form of a basic norm, requiring each party to abide by the agreement with any other party if and only if that other party were *deserving*. We now assume that the social norm requires all parties to start the process of repeated interactions by co-operating. By recursion, it is then possible for any party at any date to determine who is deserving and who is not. If someone is found to be non-deserving in any period, the norm enjoins each of the other parties to impose a sanction on him for that period. (This amounts to non-cooperation with him for that period.) In long, the norm requires that sanctions be imposed upon those in violation of an agreement; upon those who fail to impose sanctions upon those in violation of the agreement; upon those who fail to impose sanctions upon those who fail to impose sanctions upon those in violation of the agreement; ... and so on, indefinitely. (This is the sequence of meta-norms mentioned earlier.) Provided agents are sufficiently far-sighted, in that they place sufficient weight to their future gains from co-operation, this basic norm, which tells each agent to cooperate with (and only with) deserving agents, can lift communities out of a number of potentially troublesome social situations, including the repeated prisoners' dilemma. The reason each party conforms to the basic norm when a sufficient number of others conform is pure and simple self-interest. If a party doesn't conform, he will suffer from sanctions for the duration of his non-conformism. It will be noticed, however, that since continual co-operation is self-enforcing, there will be no deviance along the path of co-operation, and so no sanctions will be observed. The meta-norms pertain to behaviour off the path of co-operation.

This sort of argument, which has been established in a general setting only recently (e.g. Friedman, 1971; Aumann and Shapley, 1976; Fudenberg and Maskin, 1986; and Abreu, 1988), has been put to effective use in explaining the emergence of a number of institutions which facilitated the growth of trade in medieval Europe. Greif (1993), for example, has shown how the Maghribi traders during the eleventh century in Fustat and across the Mediterranean acted as a collective to impose sanctions on agents who violated their commercial codes. Greif, Milgrom and Weingast (1994) have offered an account of the rise of merchant guilds in late medieval Europe. These guilds afforded protection to members against

unjustified seizure of their property by city-states. Guilds decided if and when a trade embargo was warranted against the city. In a related work, Milgrom, North and Weingast (1990) have analysed the role of merchant courts in the Champagne fairs. These courts facilitated members in imposing sanctions on transgressors of agreements.

A somewhat reverse set of actions occurred as well in medieval Europe, where transgressions by a party were sometimes met by the rest of society imposing sanctions on the entire kinship of the party, or on the guild to which the transgressor belonged. The norm provided collectives with a natural incentive to monitor their own members' behaviour. (For a different instance of this, the context being the use of local common-property resources, see Howe, 1986.)

As matters stand, international agreements on environmental matters could be expected to be sustained by the latter two mechanisms in the list I have just discussed, not by the first. Ultimately, it is the second route that offers the strongest hopes for the emergence of collective responsibility over transnational commons. However, institutional changes are easier to bring about than changes in personal and collective attitudes; or so it would seem. Economists generally take "preferences" and "demands" as given and try to devise policies that would be expected to improve matters collectively. This is the spirit in which ecological economics has developed, and there is an enormous amount to be said for it. But in the process of following this research strategy we shouldn't play down the strictures of those social thinkers who have urged the rich to curb their material demands, to alter their preferences in such ways as to better husband the earth's limited resources. If such strictures seem quaint in today's world, it may be because we are psychologically uncomfortable with this kind of vocabulary. But that isn't an argument for not taking them seriously.

Go to **Acknowledgements and Notes**
Return to **Contents**

Partha Dasgupta: 'The Economics of the Environment'
Copyright © The British Academy, 1996
Printed in *Proceedings of the British Academy*, Volume **90**, pp. 165-221

Acknowledgements

I am grateful to Kenneth Arrow, Scott Barrett, John Dixon, Paul Ehrlich, Carl Folke, Frank Hahn, Geoffrey Heal, C.S. Holling, Bengt-Owe Jansson, Simon Levin, Mohan Munasinghe, Charles Perrings, Jonathan Roughgarden, Ismail Serageldin, Robert Solow, David Starrett, Andrew Steer and, in particular, Karl-Göran Mäler, discussions with whom over the past many years have improved my understanding of the subject matter of this lecture.

Go to References . . . . Return to Contents

Notes

1. This etymology of produced goods and services does not yield a "resource theory of value". Like Marx's labour theory of value, any such theory would run into ground. One reason is that there are many natural resources, not one; and this alone would make the putative theory incoherent. Koopmans (1957) contains a simple proof of why.

2. See May (1972) and May and MacArthur (1972).

3. The contrast is illusory, as will become apparent below. That's why one can belong to both tribes with ease.

4. Ehrlich, Ehrlich and Holdren (1977) remains the outstanding treatise on both population and ecosystem ecology.

5. The natural capital-base includes in addition minerals and ores underground.

6. Minerals and fossil fuels aren't renewable. For reasons of space, I will ignore non- renewable resources in this lecture. For an account of what economics looks like when we include exhaustible resources in the production process, see Dasgupta and Heal (1979), Hartwick and Olewiler (1986), and Tietenberg (1988). For an account of both the theory and the historical role of the substitution of new energy resources for old, see Dasgupta (1989).

7. For a formal demonstration of this, see Dasgupta (1982).

8. By the same token, it has proved all too congenial for ecologists to regard the human presence as an inessential component of the ecological landscape. This has enabled them to ignore the character of human decisions and, so, of economics. Thus, ecologists in great part continue to think that environmental degradation resulting from increased human encroachment on ecosystems can be stemmed effectively by centralised command-and-control modes of operation (see below in the text). For further discussion of the interface of economic and ecological concerns, see Dasgupta and Ehrlich (1996).

9. Problems arising from an absence of forward markets for the distant future are no doubt ameliorated by the fact that we care about our children's well-being and know that they in turn will care for theirs, and so on, down the generations. This means, by recursion, that even if we don't care directly for the well-being of our distant descendants, we do care for them indirectly. Arrow *et al.* (1995a) contains a succinct account of these considerations.

10. This example is taken from Dasgupta (1990). Chichilnisky (1994) provides an extended discussion of it.

11. But see Hodgson and Dixon (1992) for an attempt at such an estimation for the Bacuit Bay and the El Nido watershed on Palawan, in the Phillipines. The cause of damages (to tourism and fisheries) was due to logging in the uplands. The authors' computations were incomplete, but such as they were, the analysis did point to the desirability of a reduction on logging.

12. And they are so left under the hundred-year old water laws in South Africa, where small groups of upstream farmers enjoy ownership rights over the water that flows through their lands. See Koch (1996).

13. Rulers had control over such resources in many early societies. But that was not the same as private property rights. Rulers were obliged to make them available to the ruled. Indeed, one of the assumed duties of rulers was to expand such resource bases.

14. It should be noted that a resource being common property doesn't mean that people have free access to it. Often, only those households with a historical right of access are permitted by the community to avail themselves of local common-property resources (see below in the text).

15. Not everyone writing on the subject has misread the literature. For illuminating accounts of the way communities have jointly controlled common-property resources, see Feeny et al. (1990), Oström (1990), and Stevenson (1991). Seabright (1993) contains a good theoretical discussion of the problems; as does Putnam (1993), who also provides empirical substance to the notion of "social capital" as an engine of local collective action (see below in the text).

16. The most complete account I have read of the centrality of local forest products in the lives of the rural poor is Falconer and Arnold (1989) and Falconer (1990) on Central and West Africa. The importance of common-property resources for women's well-being in historical times has been stressed by Humphries (1990) in her work on 18th century rural England. The parallels with modern-day poor societies are remarkable.

17. Provided people are sufficiently far-sighted, norms of behaviour that sustain co- operation can be shown to be self-enforcing in stationary environments. See Section 12 for further discussion.

18. This section is taken from Arrow *et al.* (1995b).

19. Whether the proportion of expenditure devoted to environmental amenities increases with rising income is an empirical matter, and little is known. The one study I have seen on this question, namely Kanninen and Kriström (1993), suggests otherwise: the proportion of expenditure devoted to amenities *decreases* with rising income!

20. The General Agreement on Tariffs and Trade and the North Atlantic Free Trade Agreement, respectively.

21. Unless it is accompanied by judicious environmental policy, expansion of international trade should be expected to result in an increased stress on the global commons. Copeland and Taylor (1995) provide a formal analysis of the pathway through which this occurs.

22. Low (1992) contains discussions of these matters.

23. The accounting price of a resource (whether or not it is an environmental resource) is the increase in the maximum value of social well-being if a unit more of the resource were made available costlessly. An accounting price of a commodity is, thereby, the difference between its market prices and the tax (or subsidy) that ought to be imposed on it. Dasgupta, Marglin and Sen (1972) and Little and Mirrlees (1974) offer procedures for estimating accounting prices. Neither book, however, has anything to say about environmental resources.

24. See, for example, Brown and McGuire (1967) for irrigation water; Clark (1976) and Cooper (1977) for fisheries; Magrath and Arens (1989) and Repetto *et al.* (1989) for soil fertility; Newcombe (1984) and Anderson (1987) for forestry; and Solorzano *et al.* (1991) for the latter three. Dixon and Hufschmidt (1986) and Dixon *et al.* (1988) are excellent sets of case-studies on these matters.

25. A second approach to the estimation of accounting prices of environmental resources is based on contingent valuation methods (or CVMs). They involve asking concerned individuals to reveal their valuation of hypothetical changes in the flow of environmental services. CVMs are useful in the case of amenities, and their applications have so far been confined to advanced industrial countries. As I'm not focusing on amenities in this lecture, there isn't any point in developing the idea underlying CVMs any further here. The most complete acccount to date on CVMs is Mitchell and Carson (1989). See also the report on the NOAA Panel on Contingent Valuation (co-chaired by K.J. Arrow and R.M. Solow) in the *Federal Register*, 58(10), 15 January 1993.

26. During the moratorium the whale population grows at the fastest possible rate. In his numerical computations, the

commerically most-profitable duration of the moratorium was found to be some 10–15 years.

27. The pioneering works on quasi-option values are Arrow and Fisher (1974) and Henry (1974).

28. For a formal account of this, see Dasgupta and Heal (1979), Dasgupta and Mäler (1991, 1995), and Mäler (1991). Lutz (1993) contains a collection of articles that explore the practicality of moving to a system of national accounts that includes the environmental resource-base.

29. All values are assumed to be measured in terms of consumption. This involves no loss of generality, since all remaining objects that help realise social well-being (including distributional considerations) can in turn be valued in terms of consumption (Dasgupta, 1993). Note also that, in an open economy, the value of net exports ought to be deducted from the expression for NNP in the text (Sefton and Weale, 1993). Furthermore, the expression is correct only if labour is supplied inelastically (in this case it is a matter of indifference whether or not we include the wage bill). However, if the supply of labour is responsive to wages, the wage bill should be deducted from the expression (Nordhaus and Tobin, 1972).
By the value of net "investment" in the expression in the text, I mean the value of net changes in capital assets, not changes in the value of these assets. This means that anticipated capital gains (or losses) should not be included in NNP. As an example, the value of the *net* decrease in the stock of oil and natural gas (net of new discoveries, that is) ought to be deducted from GNP when NNP is estimated.
Finally, it has been argued by Putnam (1993) that, in addition to manufactured, environmental, and human capital, "social" capital (involving, among other things, trust and interpersonal networks) matters in the production of goods and services. Assuming that a suitable index of social capital were in hand, the expression for NNP in the text would include net investment in social capital. Answer to the question how we should estimate NNP should not be a matter of opinion today, it is a matter of fact; the problem isn't that we don't know what items NNP should ideally contain, rather, it is that we don't have adequate estimates of various accounting prices.

30. The existence of thresholds means that an ecosystem can flip to a quite different state in a short space of time when subjected to stress. Formally, and more generally, an exclusive reliance on accounting prices is justified only if production technologies are convex. Threshold effects are a prime example of non-convexities. Key articles on this matter are Baumol and Bradford (1972) and Starrett (1972).

31. See Mäler (1990) for a more detailed discussion of these issues.

32. How a national government allocates the nation's rights among agencies within the country is a different matter.

33. Barrett (1990, 1994) contain fine discussions of these problems. The latter, in particular, identifies reasons why agreement on the use of CFCs has been easier to reach than on carbon emissions.

34. See also Gadgil and Guha (1992) for a narrative on India's ecological history as seen from this perspective.

35. Formally, it is a Nash equilibrium.

36. See Kreps and Wilson (1982), Milgrom and Roberts (1982), Kreps *et al.* (1982), and Benoit and Krishna (1985) for demonstrations that co-operative behaviour is possible even when people know that the interactions will be for a (large) finite number of periods. For a non-technical discussion of the force of the assumption of common knowledge, see Binmore and Dasgupta (1986) and Aumann (1987).

37. Each of these qualifications can be relaxed. See Radner (1981) for weakening the first qualification, and Sabourian (1988) for relaxing the second.

Go to References
Return to Contents

Partha Dasgupta: 'The Economics of the Environment'
Copyright © The British Academy, 1996
Printed in *Proceedings of the British Academy*, Volume **90**, pp. 165-221

Return to Contents

References

Abreu, D. (1988), "On the Theory of Infinitely Repeated Games with Discounting", *Econometrica*, 56.

Agarwal, A. and S. Narain (1989), *Towards Green Villages: A Strategy for Environmentally Sound and Participatory Rural Development* (New Delhi: Centre for Science and Environment).

Anderson, D. (1987), *The Economics of Afforestation* (Baltimore: Johns Hopkins University Press).

Arrow, K.J. (1971), "Political and Economic Evaluation of Social Effects of Externalities", in M. Intriligator ed., *Frontiers of Quantitative Economics*, Vol. I (Amsterdam: North Holland).

Arrow, K.J. and A. Fisher (1974), "Preservation, Uncertainty and Irreversibility", *Quarterly Journal of Economics*, 88.

Arrow, K.J. *et al.* (1995a), "Intertemporal Equity, Discounting and Economic Efficiency", in M. Munasinghe ed., *Global Climate Change: Economic and Policy Issues*, World Bank Environmental Paper No. 12, Washington, D.C.

Arrow, K.J. *et al.* (1995b), "Economic Growth, Carrying Capacity, and the Environment", *Science*, 268(5210).

Aumann, R. (1987), "Game Theory", in J. Eatwell, M. Milgate and P. Newman eds., *The New Palgrave* (London: MacMillan).

Aumann, R. and L. Shapley (1976), "Long-Term Competition: A Game Theoretic Analysis", mimeo., Department of Mathematics, Hebrew University.

Barraclough, S. (1977), "Agricultural Production Prospects in Latin America", *World Development*, 5.

Barrett, S. (1990), "The Problem of Global Environmental Protection", *Oxford Review of Economic Policy*, 6.

Barrett, S. (1994): "On Biodiversity Conservation", in C. Perrings *et al.*, *Biodiversity Loss: Economic and Ecological Perspectives* (Cambridge: Cambridge University).

Barrett, S. (1996), *Environment and State-Craft*, mimeo., London Business School.

Baumol, W.M. and D. Bradford (1972), "Detrimental Externalities and Non- Convexity of the Production Set", *Economica*, 39.

Baumol, W.M. and W. Oates (1975), *The Theory of Environmental Policy* (Englewood Cliffs, NJ: Prentice-Hall).

Benoit, J.-P. and V. Krishna (1985), "Finitely Repeated Games", *Econometrica*, 53.

Beteille, A. ed. (1983), *Equality and Inequality: Theory and Practice* (Delhi: Oxford University Press).

Binmore, K. and P. Dasgupta (1986), "Game Theory: A Survey", in K. Binmore and P. Dasgupta eds., *Economic Organizations as Games* (Oxford: Basil Blackwell).

Binswanger, H. (1989), "Brazilian Policies that Encourage Deforestation in the Amazon", World Bank Environment Department Paper No. 16.

Brown, G. and C.B. McGuire (1967), "A Socially Optimal Pricing Policy for a Public Water Agency", *Water Resources*

Research, 3.

Chichilnisky, G. (1974), "North-South Trade and the Global Environment", *American Economic Review*, 84.

Chopra, K., G.K. Kadekodi and M.N. Murti (1989), *Participatory Development: People and Common Property Resources* (New Delhi: Sage).

Clark, C.W. (1976), *Mathematical Bioeconomics: The Optimal Management of Renewable Resources* (New York: John Wiley).

Cleaver, K. M. and G.A. Schreiber (1994), *Reversing the Spiral: the population, agriculture, and environment nexus in sub-Saharan Africa* (Washington, D.C.: World Bank).

Cooper, R. (1977), "An Economist's View of the Oceans", *Journal of World Trade Law*, 9.

Copeland, B.R. and M.S. Taylor (1994), "North-South Trade and the Environment", *Quarterly Journal of Economics*, 109.

Copeland, B.R. and M.S. Taylor (1995), "Trade and Transboundary Pollution", *American Economic Review*, 85.

Costanza, R. ed. (1991), *Ecological Economics: The Science and Management of Sustainability* (New York: Columbia University Press).

C.S.E. (1982), *The State of India's Environment: A Citizens' Report* (New Delhi: Centre for Science and Environment).

Dales J.H. (1968), *Pollution, Property and Prices* (Toronto: University of Toronto Press).

Daly, H.E. (1994), "The Perils of Free Trade", *Scientific American*, 270(2).

Dasgupta, P. (1982), *The Control of Resources* (Oxford: Basil Blackwell).

Dasgupta, P. (1989), "Exhaustible Resources", in L. Friday and R. Laskey eds., *The Fragile Environment* (Cambridge: Cambridge University Press).

Dasgupta, P. (1990), "The Environment as a Commodity", *Oxford Review of Economic Policy*, 6.

Dasgupta, P. (1993), *An Inquiry into Well-Being and Destitution* (Oxford: Clarendon Press).

Dasgupta, P. (1995a), "Population, Poverty, and the Local Environment", *Scientific American*, 272(2).

Dasgupta, P. (1995b), "The Population Problem: Theory and Evidence", *Journal of Economic Literature*, 33.

Dasgupta, P. (1996), "On Poverty Traps", in D. Kreps and K. Wallis eds., *Advances in Modern Economic Analysis* (Cambridge: Cambridge University Press).

Dasgupta, P. and P.H. Ehrlich (1996), "Nature's Housekeeping and Human Housekeeping", Discusion Paper, Beijer International Institute of Ecological Economics, Stockholm.

Dasgupta, P. and G.M. Heal (1979), *Economic Theory and Exhaustible Resources* (Cambridge: Cambridge UNiversity Press).

Dasgupta, P. and K.-G. Mäler (1991), "The Environment and Emerging Development Issues", *Proceedings of the Annual World Bank Conference on Development Economics* (Supplement to the *World Bank Economic Review and the World Bank Research Observer*).

Dasgupta, P. and K.-G. Mäler (1995), "Poverty, Institutions, and the Environmental Resource-Base," in J. Behrman and T.N. Srinivasan eds., *Handbook of Development Economics*, Vol. IIIA (Amsterdam: North Holland).

Dasgupta, P., S. Marglin and A. Sen (1972), *Guidelines for Project Evaluation* (New York: United Nations). **Dixon, J.A. and M.M. Hufschmidt** eds. (1986), *Economic Valuation Techniques for the Environment* (Baltimore: Johns Hopkins

University Press).

Dixon, J.A. *et al.* (1988), *Economic Analysis of Environmental Impacts* (London: Earthscan).

Ehrlich, P.R., A.H. Ehrlich and G. Daily (1995), *The Stork and the Plow: The Equity Answer to the Human Dilemma* (New York: G.P. Putnam's Sons).

Ehrlich, P.R., A.H. Ehrlich and J.P. Holdren (1977), *EcoScience: Population, Resources, Environment* (San Francisco, CA: W.H. Freeman).

Ensminger, J. (1990), "Co-opting the Elders: The Political Economy of State Incorporation in Africa", *American Anthropologist*, 92.

Falconer, J. (1990), *The Major Significance of 'Minor' Forest Products* (Rome: FAO).

Falconer, J. and J.E.M. Arnold (1989), *Household Food Security and Forestry: An Analysis of Socio-Economic Issues* (Rome: FAO).

Feder, E. (1977), "Agribusiness and the Elimination of Latin America's Rural Proletariat", *World Development*, 5.

Feder, E. (1979), "Agricultural Resources in Underdeveloped Countries: Competition between Man and Animal", *Economic and Political Weekly*, 14.

Feeny, D. *et al.* (1990), "The Tragedy of the Commons: Twenty-two Years Later", *Human Ecology*, 18.

Friedman, J. (1971), "A Non-Cooperative Equilibrium for Supergames", *Review of Economic Studies*, 38.

Fudenberg, D. and E. Maskin (1986), "The Folk Theorem in Repeated Games with Discounting and with Incomplete Information", *Economterica*, 54.

Gadgil, M. and R. Guha (1992), *This Fissured Land: An Ecological History of India* (Delhi: Oxford University Press).

Gadgil, M. and K.C. Malhotra (1983), "Adaptive Significance of the Indian Caste System: An Ecological Perspective", *Annals of Human Biology*, 10.

Gordon, H. Scott (1954), "The Economic Theory of Common-Property Resources", *Journal of Political Economy*, 62.

Greif, A. (1993), "Contract Enforceability and Economic Institutions in Early Trade: The Maghribi Traders' Coalition", *American Economic Review*, 83.

Greif, A., P. Milgrom and B. Weingast (1994), "Coordination, Commitment, and Enforcement: The Case of the Merchant Guild", *Journal of Political Economy*, 102.

Hardin, G. (1968), "The Tragedy of the Commons", *Science*, 162.

Hartwick, J. and N. Olewiler (1986), *The Economics of Natural Resource Use* (New York: Harper & Row).

Hecht, S. (1985), "Environment, Development and Politics: Capital Accumulation and the Livestock Sector in Eastern Amazonia", *World Development*, 13.

Hecht, S., A.B. Anderson and P. May (1988), "The Subsidy from Nature: Shifting Cultivation, Succcesssional Palm Forests and Rural Devellopment", *Human Organization*, 47.

Henry, C. (1974), "Investment Decisions under Uncertainty: the Irreversibility Effect", *American Economic Review*, 64.

Hodgson, G. and J. Dixon (1992), "Sedimentation Damage to Marine Resources: Environmental and Economic Analysis", in J.B. Marsh ed., *Resources and Environment in Asia's Marine Sector* (London: Taylor & Francis).

Howe, J. (1986), *The Kuna Gathering* (Austin, Tex.: University of Texas Press).

Humphries, J. (1990), "Enclosures, Common Rights, and Women: The Proletarianization of Families in the Late Eighteenth and Early Nineteenth Centuries", *Journal of Economic History*, 50.

Jodha, N.S. (1980), "The Process of Desertification and the Choice of Interventions", *Economic and Political Weekly*, 15.

Jodha, N.S. (1986), "Common Property Resources and the Rural Poor", *Economic and Political Weekly*, 21.

Jodha, N.S. (1995), "Common Propert Resources and the Environmental Context: Role of Biophysical versus Social Stree", *Economic and Political Weekly*, 30.

Kanninen, B.J. and B. Kriström (1993), "Welfare Benefit Estimation and Income Distribution", revised version of Beijer Discussion Paper Series No. 20, Beijer International Institute of Ecological Economics, Stockholm.

Kneese, A. (1988), "Environmental Stress and Political Conflict: Salinity in the Colorado River", mimeo., Resources for the Future, Washington, D.C.

Koch, E. (1996), "A Watershed for Apartheid", *New Scientist*, 2025 (12 April).

Koopmans, T.C. (1957), "The Price System and the Allocation of Resources", in *Three Essays on the State of Economic Science* (New York: McGraw Hill).

Kreps, D. *et al.* (1982), "Rational Cooperation in the Fintely Repeated Prisoners' Dilemma", *Journal of Economic Theory*, 27.

Kreps, D. and R. Wilson (1982), "Reputation and Incomplete Information", *Journal of Economic Theory*, 27.

Krutilla, J. (1966), "The International Columbia River Treaty: An Economic Evaluation", in A. Kneese and S. Smith eds., *Water Research* (Baltimore: Johns Hopkins University Press).

Lindahl, E.R. (1958), "Some Controversial Questions in the Theory of Taxation", in R.A. Musgrave and A.T. Peacock eds., *Classics in the Theory of Public Finance* (London: MacMillan). Originally published in Swedish, in 1928.

Little, I.M.D. and J.A. Mirrlees (1974), *Project Appraisal and Planning for Developing Countries* (London: Heinemann).

Low, P. ed. (1992), *International Trade and the Environment*, World Bank Discussion Papers 159 (Washington, DC: World Bank).

Lutz, E. ed. (1993), *Toward Improved Accounting for the Environment* (Washington, DC: World Bank).

Magrath, W. and P. Arens (1989), "The Costs of Soil Erosion in Java: A Natural Resource Accounting Approach", World Bank Environmental Department Working Paper No. 18.

Mahar, D. (1988), "Government Policies and Deforestation in Brazil's Amazon Region", World Bank Environment Department Working Paper No. 7.

Mäler, K.-G. (1974), *Environmental Economics: A Theoretical Enquiry* (Baltimore: Johns Hopkins University Press).

Mäler, K.-G. (1990), "International Environmental Problems", *Oxford Review of Economic Policy*, 6.

Mäler, K.-G. (1991), "National Accounting and Environmental Resources", *Journal of Environmental Economics and Resources*, 1.

Mäler, K.-G. *et al.* (1992), "The Baltic Drainage-Basin Programme", mimeo., Beijer International Institute of Ecological Economics, Stockholm.

May, R.M. (1972), "Will a Large Complex System be Stable?", *Nature*, 238.

May, R.M. and R.H. MacArthur (1972), "Niche Overlap as a Function of Environmental Viariability", *Proceedings of*

the National Academy of Sciences of the U.S., 69.

Meade, J.E. (1973), *The Theory of Externalities* (Geneva: Institute Universitaire de Hautes Etudes Internationales).

Milgrom, P., D. North and B. Weingast (1990), "The Role of Institutions in the Revival of Trade: The Law Merchant, Private Judges, and the Champagne Fairs", *Economics and Politics*, 2.

Milgrom, P. and J. Roberts (1982), "Predation, Reputation and Entry Deterrance", *Journal of Economic Theory*, 27.

Mitchell, R.C. and R.T. Carson (1989), *Using Surveys to Value Public Goods: The Contingent Valuation Method* (Washington, DC: Resources for the Future).

Murphy, Y. and R. Murphy (1985), *Women of the Forest* (New York: Columbia University Press).

Newcombe, K. (1984), "An Economic Justification of Rural Afforestation: The Case of Ethiopia", Energy Department Paper No. 16, World Bank, Washington, D.C.

Nordhaus, W.D. (1994), *Managing the Global Commons: The Economics of Climate Change* (Cambridge, MA.: MIT Press).

Nordhaus, W.D. and J. Tobin (1972), "Is Economic Growth Obsolete?", in *Economic Growth*, 5th Anniversary Colloquium of the NBER (New York: Columbia University Press).

Oström, E. (1990), *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge: Cambridge University Press).

Perrings, C. *et al.* (1994), *Biodiversity Loss: Ecological and Economic Perspectives* (Cambridge: Cambridge University Press).

Pigou, A.C. (1920), *The Economics of Welfare* (London: Macmillan).

Putnam, R. D., with R. Leonardi and R.Y. Nanetti (1993), *Making Democracy Work: Civic Traditions in Modern Italy* (Princeton, NJ: Princeton University Press).

Radner, R. (1981), "Monitoring Cooperative Agreements in a Repeated Principle- Agent Relationship", *Econometrica*, 49.

Repetto, R. (1988), "Economic Policy Reform for Natural Resource Conservation", World Bank Environment Department Working Paper No. 4.

Repetto, R. *et al.* (1989), *Wasting Assets: Natural Resources and the National Income Accounts* (Washington, DC: World Resources Institute).

Sabourian, H. (1988), "Repeated Games: A Survey", in F.H. Hahn ed., *The Economic Theory of Missing Markets, Information, and Games* (Oxford: Basil Blackwell).

Seabright, P. (1993), "Managing Local Commons: Theoretical Issues in Incentive Design", *Journal of Economic Perspectives*, 7.

Sefton, J. and M. Weale (1995), "The Net National Product and Exhaustible Resources: the Effects of Foreign Trade", *Journal of Public Economics* (forthcoming).

Solorzano, R. *et al.* (1991), *Accounts Overdue: Natural Resource Depreciation in Costa Rica* (Washington, DC: World Resources Institute).

Spence, A.M. (1974), "Blue Whales and Optimal Control Theory", in H. Göttinger ed., *Systems Approaches and Environmental Problems* (Göttingen: Vandenhoek and Ruprecht).

Starrett, D.A. (1972): "Fundamental Non-Convexities in the Theory of Externalities", *Journal of Economics Theory*, 4.

Stevenson, G.G. (1991), *Common Property Resources: A General Theory and Land Use Applications* (Cambridge: Cambridge University Press).

Tietenberg, T. (1988), *Environmental and Natural Resource Economics*, 2nd edn. (Glenview, Ill.: Scott, Forsman).

UNDP (1993), *Human Development Report, 1993* (New York: Oxford University Press).

Vitousek, P. *et al.* (1986), "Human Appropriation of the Product of Photosynthensis", *BioScience*, 36.

Wade, R. (1987), "The Management of Common Property Resources: Finding a Cooperative Solution", *World Bank Research Observer*, 2.

Wade, R. (1988), *Village Republics: Economic Conditions for Collective Action in South India* (Cambridge: Cambridge University Press).

Walker, B.H. (1993), "Rangeland Ecology: Understanding and Managing Change", *Ambio*, 22.

World Bank (1992), *World Development Report* (New York: Oxford University Press).

Return to **Contents**