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Briefing papers on key issues in environmental economics

Economic Efficiency, Rent Capture and Market Failure in Tropical Forest Management

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Gatekeeper Series

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ECONOMIC EFFICIENCY AND RENT CAPTURE IN TROPICAL FOREST MANAGEMENT

As outlined by Hyde, Newman and Sedjo (1991), public policies influence the environmental effects of timber forest management through their impacts on:

- the level of *privately efficient* harvests,
- the level of *socially efficient* harvests when accounting for environmental externalities,
- alternative *royalty, contract and concessional* arrangements and their implications for trespass, high-grading and other environmental losses,[1] and
- the level of *rent distribution*.

The implications are illustrated in Figure 1[2] If p is the competitive price for delivered logs, V is the harvest volume and MC_1 is the short-run private marginal cost curve of the concessionaire for delivered logs, then V_1 is the optimal short-run and private harvest level. That is, the private concessionaire is concerned only with short-run financial returns from harvesting and not with the potential long-run returns from the stand or with any of the 'external' environmental effects of logging. However, this level of extraction, V_1, is not optimal from a social point of view because it excludes

- the *user costs* of short-run harvesting, i.e. the discounted future returns from leaving the residual stand undamaged and growing, or through avoidance of high-grading and other practices that degrade the stand, and
- any *external environmental costs* of timber extraction such as watershed degradation, downstream sedimentation, disruptions to nutrient cycling, loss of natural habitats, loss of non-timber products, etc.

Improved contractual arrangements between the forest ministry and the concessionaire could ensure that the latter internalizes any additional user costs. Long term contracts that coincide with optimal harvesting/regrowth rotations could ensure that the concessionaire has an incentive to take account of these user costs, denoted by MC_2 in Figure E.1. Other arrangements, such as imposing provisions for continuation of short-term contracts on condition of 'sustainable' practices or even outright sale of the land, could also be applied. If successful, such contractual arrangements would ensure that the concessionaire would attain the optimal long-run harvest level, V_2, and harvest less timber. Finally, if MC_3 is the additional off-site environmental costs of timber harvesting, then these costs can also be

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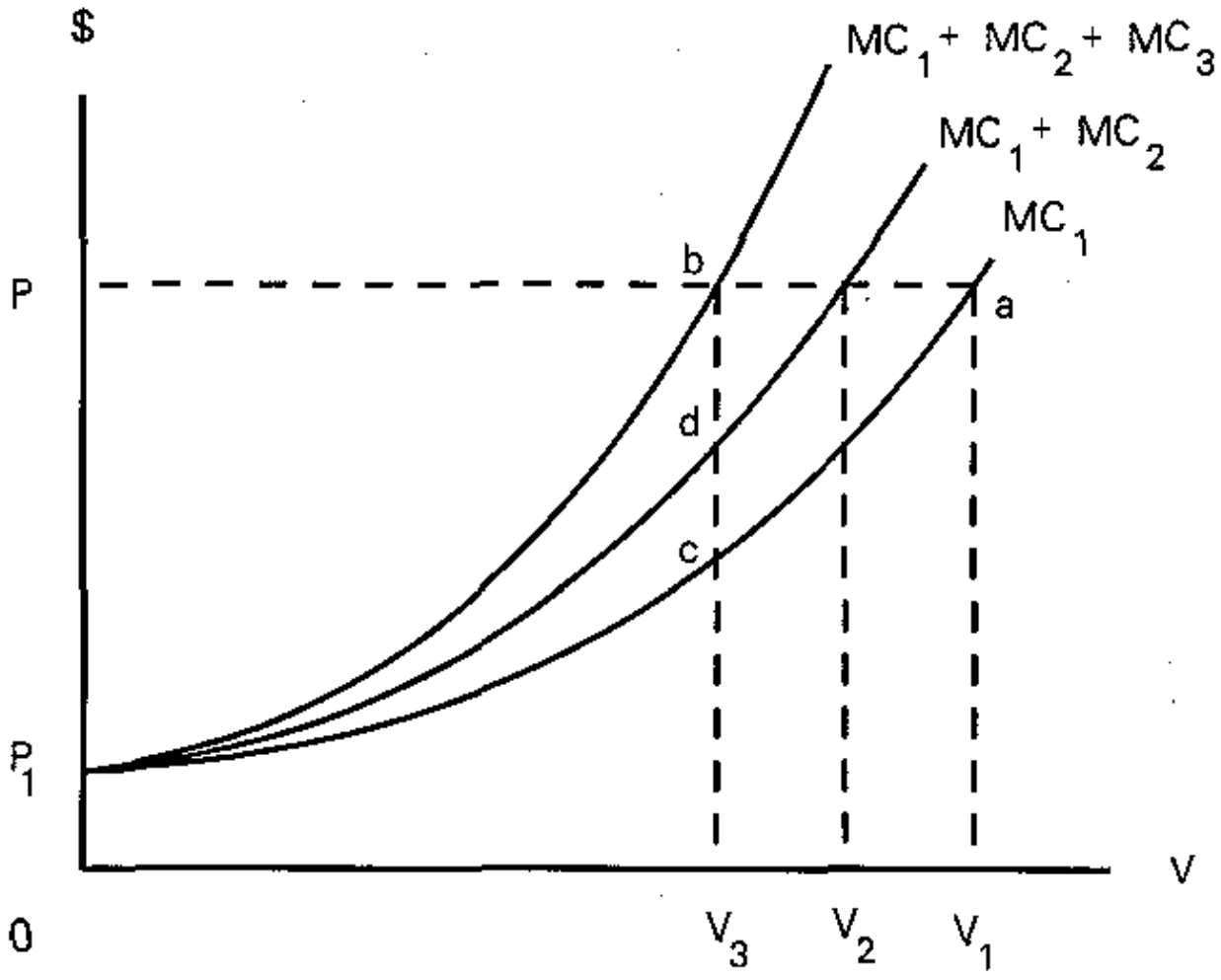
[1] Trespass is a forestry term that refers to losses due to logging theft, which could also be extended to included losses due to graft. High-grading refers to the removal of high-valued timber and leaving a degraded timber stand.

[2] This example concerns a concessionaire contracting with a forestry ministry to extract timber from public forest land. With modification, the example could easily be extended to describe a forest operation on private land.

Figure 1 Social and Private Harvesting Decisions



P = Competitive Price for Delivered Logs
V = Harvest Volume
MC = Marginal Cost Curve for Delivered Logs
1= Short-run Private MC of Timber Concessionaire
2= User Costs of Short-run Harvesting
3= Off-site environmental costs of timber harvesting

Source: Hyde, Newman and Sedjo (1991)

internalized by imposing a tax equal to *bd* on the concessionaire.[3] The result is that the concessionaire now harvests at the socially optimal level, V_3, which is lower than the private short or long-term level.

As indicated in Figure 1, the concessionaire is making an economic rent equal to pap_l, or pbp_l if all social costs are accounted for. The forestry ministry can capture all or part of this rent through harvest taxes. However, an *ad valorem* (flat rate) tax or royalty that is a percentage charge on net revenues does not affect the harvest level (i.e., will not move the concessionaire from V_1 to V_3) but will increase the incentive to high-grade, trespass and ignore off-site environmental costs. A uniform fixed royalty, which is a flat fee per unit of harvest, does alter the marginal harvest decision, but also increases the incentive to high-grade, trespass and ignore off-site environmental costs on the infra-marginal land. Moreover, increasing this royalty may actually *decrease* tax revenues if the elasticity of the marginal cost curve is greater than one, and could reduce harvests below the socially optimal level, V_3. To 'internalize' user and environmental costs *and* capture a greater share of rents would require a more sophisticated combination of policies of, first, sorting out long-run contractual arrangements and an environmental 'tax' equal to *bd* as outlined above, and second, charging a competitively bid lump sum fee for the right to harvest the stand, equal to pbp_l, in order to capture the economic rent generated at V_3.

MARKET FAILURE AND TROPICAL FOREST MANAGEMENT

As explained in the previous section improved contractual arrangements and forest management policies may improve the incentives for achieving private and socially efficient rates of timber extraction and trade. Clearly then - the opposite case applies - poor design and implementation of policy will have an adverse affect on forest management. But what is the root cause of short-run harvesting? In the absence of good or bad policy prescriptions what are the incentives that drive individuals and firms to 'mine' the forest? Neoclassical economics suggests that market systems are susceptible to a number of imperfections which - when they occur - will lead producers such as concessionaries to fail to attain private and/or socially efficient production levels. In such cases, the case for policy intervention rest with the underlying failure of the market. Policies designed to improve forest management should, therefore, be targeted at the correction of these market failures.

Market Failure

Neoclassical economic theory asserts that markets will achieve an optimal allocation of societal resources given that certain conditions are met in the marketplace. These conditions include:

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[3] It is possible that the forestry ministry might want to impose a single tax to cover both user and environmental costs, in which case the optimal tax would be *bc* in Figure 1; however, Hyde, Newman and Sedjo (1991) correctly argue that such a tax does nothing to 'extend' the horizon of an operator after short-run gains, and would actually encourage high-grading, trespassing and tax avoidance, especially for infra-marginal stems and stands.

- the absence of *public goods* and *common pool resources*,
- the absence of *externalities* (e.g. no non-marketed goods)
- perfect information (e.g. no uncertainty or undiversifiable risk),
- perfect competition (e.g. no market concentration),

'Market failure' is said to occur when these conditions are not fulfilled. That is, the failure to meet these conditions invalidates the basic assumptions for the market to function as an efficient allocator of societal resources. Under such circumstances the market will not achieve a *pareto-efficient* outcome - it will still be possible to make one participant in the market better off without causing another participant to be equally worse off. Thus, in the case of market failures that lead to short-run harvesting of timber, movement towards privately and socially efficient harvest levels would actually make society better off as a whole. Before indicating a few of the market failures that produce inefficient outcomes in tropical forest management a brief exposition of the theory behind each type of market failure is presented.

Inefficient allocation of natural resources often arise when the resource is a common pool resource or a public good. Both types of resources are *non-exclusive*; i.e. they are available to all who wish to consume them. Public goods are also *non-rival*; i.e. consumption by one user does not impinge on the quantity or quality of consumption by others. Public goods will be under-supplied by the market, since the costs incurred by any private producer exceed the benefits they might obtain. If one producer were to undertake to provide a public good all other potential consumers could obtain the good for free - a phenomenon called 'free-riding.' This situation leads to a stalemate of inaction as each producer waits for someone else to provide the public good. Collective action is required to overcome this free-riding that occurs in the marketplace presence of public goods. Many tasks traditionally undertaken by governments fall into the area of public goods such as the provision of defense, transport infrastructure, and basic needs support to the impoverished.

Common pool resources, on the other hand, are *rival*, i.e. exploitation by one user impairs the consumption of others. When the cost of excluding potential users or of coordinating joint use is high, common pool resources may be subject to *open access* exploitation. Open access refers to the unmanaged exploitation of a resource by multiple users. Because each user suspects that others would benefit from any self-imposed restraint, all users rush to consume the resource as fast as possible. Regulatory approaches to the open access problem stress enforcement of property rights, through limits on exploitation and use of the resource. Alternatively, management may be devolved to local user groups which are often better placed to define regulations or to administer incentives and dispute resolution schemes than central authorities.

Externalities take the form of costs or benefits arising in a process of production or consumption which are not reflected in the market prices of the relevant goods and services. Typically externalities affect third party 'victims,' who lack the means to obtain compensation for foregone benefits or imposed costs. Externalities may be positive as well, in which case a benefit is enjoyed without payment to the producer. Externalities persist due to the absence of markets in which such costs and/or benefits may be valued and exchanges made. The ideal response to an externality is to 'internalize' costs and benefits affecting third parties, so that market prices will reflect the full social costs and benefits of production

and consumption. This may be achieved either by applying the *polluter pays principle* or by altering property rights or contractual agreements so that the negative impacts are incorporated directly into production or consumption decisions.

The neo-classical market model also assumes perfect information, but undiversifiable risk and uncertainty violate this assumption. Risk implies that the relative likelihood of alternative outcomes is known, while uncertainty is akin to ignorance - it is impossible to specify probabilities of potential outcomes. Market failure occurs where there are no mechanisms for diversifying or hedging risk, or if absolute uncertainty (which cannot be hedged) prevails. Under such circumstances individuals and firms will tend to curtail their investment. Society as a whole, on the other hand, can pool and diversify risk, which suggests that it will prefer a higher level of investment. Uncertainty and risk thus drive a wedge between private and social rates of time preference. Potential solutions to these problems involve investing in information generation, creating markets to hedge risk, and reducing uncertainty over property rights and their enforcement.

Monopolies, oligopolistic cartels and monopsonies violate the neo-classical assumption of perfect competition. The lack of competition typically leads to levels of production and supply below the social optimum, a transfer of welfare to the monopolist or monopsonist, and a deadweight loss to society. Monopolies or monopsonies in natural resource markets are often considered benign precisely because they lead to conservative use of resources, in order to maximize scarcity rents. Tax and regulatory instruments can be used to ensure that monopolistic scarcity rents accrue to society, although public intervention more often creates conditions of imperfect competition that dissipate resource rents.

Market Failures in Tropical Forest Management

Market failure in tropical forest management can lead to privately and socially inefficient forest management in several ways.

In the absence of an enforceable system of formal property rights and tenure, forested land becomes essentially an open access resource from which no one can be excluded. Even if an individual wanted to conserve the forest, or set it aside for future use, another individual would still be able to intervene and extract timber from the plot for personal gain. In addition, the risk and uncertainty over the future availability of timber makes it difficult for an individual to exercise restraint and creates an incentive to maximize short term returns by extracting timber immediately. Thus, the individual fails to account for the 'user cost' of timber and exploits the forest in a privately inefficient manner. With the exception of more remote frontier areas of tropical forests, very little forested land exploited for timber is subject to 'pure' open access conditions. However, the failure to design appropriate concession arrangements for public forest lands and insecurity of ownership can create similar conditions as the 'open access' situation. That is, concessionaires will make harvesting decisions based on short-term profit-maximizing decisions and have little regard for the potential for greater future returns from the timber stand.

If market failures leading to privately inefficient harvest levels are not corrected the powerful incentive to 'mine' tropical forests is likely to overcome any efforts to put forest management on a socially-efficient footing. However, assuming that these failures are

corrected allows a discussion of market failures that 'cause' socially inefficient forest management - i.e the presence of public goods, common pool resources and externalities; and uncertainty over the value of alternative uses of tropical forests.

The market prices of most widely traded timber products typically do not reflect the environmental costs of their production. Market prices fail to account for the degradation or loss of non-timber forest products, indirect use values (e.g. watershed protection or nutrient cycling), as well as future and non-use values (e.g. option value or existence values), that occurs during timber harvesting. When such costs are consistently ignored throughout an industry, prevailing market prices will tend to fall below the socially optimal level, leading to excessive exploitation.

The root cause of this problem may be subdivided according to whether or not the alternative uses are primarily on-site or off-site uses. Logging companies, for example, may neglect the impact of their activities on local non-timber uses of the forest. This may occur due to a lack of information on the part of logging companies of the potential gains from these forest uses. This is in part a result of the lack of transparency of these uses due to their subsistence nature. The loss of subsistence value falls outside the private cost and benefit calculations of the timber firm. Where non-timber products (e.g. rattan) are of obvious commercial value they tend to be internalized into the production decision.

The benefits of tropical forests that are realized at a distance from the forest include watershed values, carbon sequestration, the use of biodiversity in biotechnology and the existence values of tropical forests.[4] Where forest managers lack the means to appropriate such values, they will tend to ignore them. It is extremely difficult to exert property rights over the off-site benefits of tropical forests, that is, it is these benefits are typically non-exclusive public goods or common pool resources. The appropriation problem is made even more difficult in the case of timber concessions where the operator has only use rights - not ownership rights. As a result the market provides little incentive for concessionaires to internalize the social costs that may be incurred by the degradation of these off-site values.

Imperfect competition in the forestry industry can also have important effects on forest management. Barriers to entry and exit can prevent the most efficient firms from operating in the industry, thus leading the industry as a whole to extract more timber than necessary to provide a given supply of products. Inefficiencies in the processing sector are particularly damaging in this respect, as they directly impact on the scale of timber exploitation through poor log conversion rates and overexpanded capacity. Imperfect competition and information may also have implications in terms of failure to improve or adopt technologies and forest management practices that minimize forest depletion and environmental degradation.

In sum, market failure is likely to be a root cause of failure to attain private and socially efficient harvest levels in tropical timber producing countries. The existence of market failure is usually cited as the primary justification for intervention in the marketplace whether in the form of public or collective action. Intervention to redress market failure may

[4] Existence values are those benefits of a resource that are completely divorced from the physical use of the resource.

involve regulation, economic incentives or institution-building. An important caveat, however, is that intervention is only justified if the cost of correcting market imperfections does not exceed the potential welfare benefits. In other words, policy interventions should yield net benefits or else they are not worth undertaking from an economic perspective.

References

Hyde, W.F., Newman, D.H. with Sedjo, R.A. 1991. *Forest Economics and Policy Analysis: An Overview.* World Bank Discussion Paper 134, The World Bank, Washington, DC.

DISCUSSION PAPERS

LEEC Discussion Papers examine a wide range of issues in environmental economics, including theoretical questions as well as applications, case studies and policy analysis. They are directed mainly at academics and researchers. Discussion Papers may be purchased for £3.50 each unless otherwise stated.

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BOOKS

Edward B. Barbier
Economics, Natural-Resource Scarcity and Development: Conventional and Alternative Views, Earthscan, London, 1989 (paperback £17.50)

The history of environmental and resource economics is reviewed; then using insights from environmentalism, ecology and thermodynamics, Barbier begins the construction of a new economic approach to the use of natural resources, particularly to the problem of environmental degradation. With examples from the global greenhouse effect, Amazonian deforestation and upland degradation on Java, Barbier develops a major theoretical advance and shows how it can be applied. This book breaks new ground in the search for an economics of sustainable development.

David W. Pearce, Anil Markandya and Edward B. Barbier
Blueprint for a Green Economy, Earthscan, London, 1989 (paperback £8.95)

This book was initially prepared as a report to the Department of Environment, as part of the response by the government of the United Kingdom to the Brundtland Report, *Our Common Future*. The government stated that: '...the UK fully intends to continue building on this approach (environmental improvement) and further to develop policies consistent with the concept of sustainable development.' The book attempts to assist that process.

Edward B. Barbier, Joanne C. Burgess, Timothy M. Swanson and David W. Pearce
Elephants, Economics and Ivory, Earthscan, London, 1990 (paperback £10.95)

The dramatic decline in elephant numbers in most of Africa has been largely attributed to the illegal harvesting of ivory. The recent decision to ban all trade in ivory is intended to save the elephant. This book examines the ivory trade, its regulation and its implications for elephant management from an economic perspective. The authors' preferred option is for a very limited trade in ivory, designed to maintain the incentive for sustainable management in the southern African countries and to encourage other countries to follow suit.

Gordon R. Conway and Edward B. Barbier
After the Green Revolution: Sustainable Agriculture for Development, Earthscan Pub. Ltd., London, 1990 (paperback £10.95)

The Green Revolution has successfully improved agricultural productivity in many parts of the developing world. But these successes may be limited to specific favourable agro-ecological and economic conditions. This book discusses how more sustainable and equitable forms of agricultural development need to be promoted. The key is developing appropriate techniques and participatory approaches at the local level, advocating complementary policy reforms at the national level and working within the constraints imposed by the international economic system.

David W. Pearce, Edward B. Barbier and Anil Markandya
Sustainable Development: Economics and Environment in the Third World, London and Earthscan Pub. Ltd., London, 1990 (paperback £11.95)

The authors elaborate on the concept of sustainable development and illustrate how environmental economics can be applied to the developing world. Beginning with an overview of the concept of sustainable development, the authors indicate its implications for discounting and economic appraisal. Case studies on natural resource economics and management issues are drawn from Indonesia, Sudan, Botswana, Nepal and the Amazon.

David W. Pearce, Edward B. Barbier, Anil Markandya, Scott Barrett, R. Kerry Turner and Timothy M. Swanson
Blueprint 2: Greening the World Economy, Earthscan Pub. Ltd., London, 1991 (paperback £8.95)

Following the success of *Blueprint for a Green Economy*, LEEC has turned its attention to global environmental threats. The book reviews the role of economics in analyzing global resources such as climate, ozone and biodiversity, and considers economic policy options to address such problems as global climate change, ozone depletion and tropical deforestation.

E.B. Barbier and T.M Swanson (eds.)
Economics for the Wilds: Wildlife Wildlands, Diversity and Development, Earthscan Pub. Ltd., London, 1992 (paperback £12.95).

This collection of essays addresses the key issues of the economic role of natural habitat and wildlife utilization in development. The book argues that this role is significant, and composes such benefits as wildlife and wildland products, ecotourism, community-based wildlife development, environmental services and the conservation of biodiversity.

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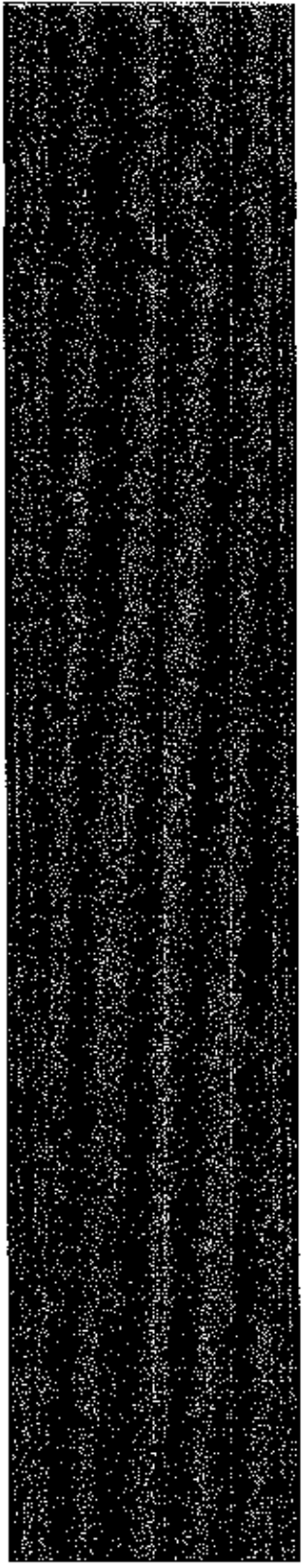

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