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Policy Instruments and Institutional Mechanisms for Enhancing the Sustainable Production of Non-Market Forest Goods and Environmental Services

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Executive Summary

The object of this paper is to review the production interactions affecting non-commodity and other non-market outputs of forests. We want to account for interactions between market and non-market valued forest resources, and we want to identify the policy instruments and institutional mechanisms that reinforce the favorable interactions and mitigate the effects of negative interactions.

The paper contains four basic sections. The first provides definitions for some of the relevant terms: joint production or multifunctionality, externalities, public goods, and environmental Kuznets curves.

The second introduces a forest organization to serve our objective. It emphasizes market economic valuation, costs of ensuring property rights, and location. Therefore, it is a means for describing where market values arise in the forest sector and where competing values for forest land arise from other sectors. It also provides a means for examining the effects of expanding road systems and changing systems of property rights. There are at least three relevant categories of forest within this organization: mature natural forests, an area of degraded open access forests, and managed forests. Different economic 'markets' may contain the first, the first two, or all three of these depending on the stage of its forest sector development, and any one country may contain multiple local 'markets' in different stages of development. The 3-stage and three forest distinctions are important because markets, policies and institutions affects the different categories of forests differently and some policies have effects on forests in one stage of development but not in others. For example, price incentives (including taxes and subsidies) induce expansion in managed forests but deforestation of the natural forest. Of course, they only affect the natural forest in those markets that have not yet developed to the third stage where managed forests are economic. Agricultural incentives, for a different example, affect only the natural forest in the first stage of development, only the degraded open access forest in the second stage, and only managed forests in the third stage.

The third section examines five key non-market forest values: i) carbon sequestration to protect against global climate change, ii) biodiversity and critical habitat, iii) erosion control and general watershed protection, iv) tourism, and v) specialized local products such as fuelwood, forage and fodder, fruits and nuts, latex, etc. The organizational construct of the previous section provides a means of identifying the categories of forest where each of these values appear and,

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therefore, a means of identifying the market values and policies that can affect each. In brief, carbon sequestration is a global value that occurs in all forests and trees. Protecting carbon storage on two categories of forest, the open access forests and the mature natural forests, is most difficult because enforcing the local property rights to these two forests is so difficult. Biodiversity is also a global value and it suffers the same problem, but to a different extent, because the location of its occurrence, generally in the remaining natural forest, is more definable. Once its locations are identified they can be monitored and protected—given sufficient funds and personnel. However, the public funding to ensure the sustained protection of sites of important biodiversity remains a problem for most poor countries. The values of watershed protection can occur in any of the three forest categories. However, the value for protecting any particular watershed tends to be more local than the values for carbon sequestration or biodiversity. Local institutions created from the collection of locally affected citizens can often find the arrangements best-suited for protecting these values. Tourism and other forest-based recreation also tend to focus on the remaining natural forest. However, tourism includes a range of specific locations and a range of demands on the resource. Global tourism resources can only be managed through a combination of monitoring and enforcement by national or international institutions—while providing a stake in the management operations for local citizens. Local parks and sanctuaries are probably better-managed by local institutions according to acceptable local standards. Specialized forest products like fuelwood, fruits and nuts, etc. actually follow a pattern of consumption that is similar to the pattern of markets for commercial forest products like timber. Their consumption competes with forest protection for the previous four forest-based environmental services—unless there is an effective system of local monitoring and enforcement of the areas providing the first four.

Of course, this summary is simplistic. It is the complexity of the management problems for the provision of each of these five values plus the difficulty of effectively introducing the solutions we just identified that has restricted our success in protecting them in so many parts of the world.

The fourth section of the paper discusses the effects of changed in local infrastructure (especially roads) and institutions (especially those establishing property rights) on the non-market environmental services of the forest. Roads can help protect these environmental services as they assist in regional development—by attracting labor away from extractive forest activities and, thereby, simplify the task of protecting the environmental services. However, ill-designed roads can also increase the threat of trespass on the protected forests areas.

The widespread modern discussion of some form of forest transfers from state agencies to local communities (‘community forestry’, ‘joint forest management’, ‘public participation’) has property rights at its core. What should be clear (but often is not) is that a) the institution that can manage best is the institution that is most affected by the values at risk. For global treasures, like unique habitats or special national parks, national or even global institutions will be appropriate. For local values, like erosion control on a small watershed, then local institutions will be more effective managers.

Finally, we must recognize that a reduction in rural poverty would improve conditions for all non-market forest values. However, this is the most difficult task. It is the general objective

of all development activities. Reductions in poverty would mean improving the labor opportunities of the rural poor, and improved labor opportunities would attract them away from extractive activities in the forest. Furthermore, the most general global observations suggest that improving local economic welfare is eventually associated with expansions in local forest cover and increased protection of environmental values. Therefore, we anticipate that any broader policy or program that assists rural economic development will eventually have positive secondary effects on the forest and on many non-market forest values.

Policy Instruments and Institutional Mechanisms for Enhancing the Sustainable Production of Non-Market Forest Goods and Environmental Services

William F. Hyde*

Our objective in this paper is to review the production interactions affecting non-commodity and other non-market outputs of forests. We want to account for interactions between market and non-market valued forest resources, such as timber harvests that damage critical habitat for resources like biodiversity, and also interactions between activities in other, non-forest, sectors of the economy that influence the non-commodity and non-market products of the forest. The conversion of forest land to agricultural production is the common example, but activities in other sectors that indirectly affect the forest through their influences on timber harvests and agricultural land conversion can also have important effects on the non-market outputs of the forest.

We are also interested in the policy instruments and institutional mechanisms that reinforce the favorable interactions and mitigate the effects of negative interactions—including both instruments and institutional mechanisms that affect forestry directly and those that create spillover effects from other sectors of the economy. Three examples are weak institutions that fail to protect all property rights including the rights to forest properties and, therefore, encourage unsustainable short-sighted exploitation of the various forest resources; agricultural policies that encourage land conversion and expansion into the forest; and tax, trade, and labor policies that induce migration into or out of rural forested areas and, therefore, affect forest use.

The source of our interest is the increasing global concern for long-term sustainable resource use and the recognition that changing demands over time (and with economic development) increase the importance of maintaining all future options for resource use. With changing demands, resources that were previously either unknown or of low value can take on new and greater value. Therefore, long-term sustainability requires that we protect the future availability of all resources. Those resources that have little or no current market value and those that are easily affected by inadvertent spillovers from other sectors of the economy are often the easiest to overlook and the most difficult to protect for future generations.

Unfortunately, forests and forestry occur at the margin of most other economic activity and many forest resources and forest-based environmental services are low-valued and dispersed. This means they are easily affected by inadvertent spillovers from macroeconomic planning, from institutional change, and from activities in higher-valued geographically adjacent sectors like agriculture. Furthermore, monitoring and enforcement to restrict undesirable activity in the forest is expensive relative to the values at risk—because forest resources are often dispersed and because undetected access to them is often very easy. Nevertheless, undeveloped natural forests are the only remaining sources of some fundamental resources and the social valuation of some of these apparently grows with time and with economic development. Therefore, our vigilance

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in protecting the forest from inadvertent spillovers is both difficult now and critical for future social well being.

The consensus opinion seems to be that spillover effects in general have important negative effects on the forest. However, the magnitudes of these effects have seldom been measured and there are mixed opinions, for example, regarding the potentially negative effects of agricultural policy or the potentially more favorable effects of transfers of forest management from state to local institutions. Furthermore, those few attempts to quantify spillover effects on the forest have generally focused on the entire forest. They do not usually consider differential local impacts on the specific non-commodity and non-market forest products and forest resource services. It is important that we take those differential effects into account in this paper. We will attempt to do that by building on a geographic classification system that identifies in a general manner the locational occurrences of the different the market and the non-market values of the forest.

The body of the paper contains four basic sections. The first provides definitions for some of the relevant terms of common usage and further justification for our inquiry. The second introduces a forest organization or taxonomy to serve our purposes. We are all familiar with the natural distinctions between temperate and tropical, hardwood and softwood forests, and between mature and juvenile forests. These are important biological distinctions, but they fail to capture the economic characteristics that are crucial for local use of the forest. The taxonomy we outline will feature three characteristics—location, labor (a variable that is related to population for some economic assessments), and local institutions—that determine which forest areas are the sources of most forest resource uses and, therefore, which forest areas are under greater risk and are of greater importance for immediate policy action. The third section of the paper incorporates this taxonomy in a discussion of five key non-market forest values: i) carbon sequestration to protect against global climate change, ii) biodiversity and critical habitat, iii) erosion control and general watershed protection, iv) tourism, and v) specialized local products such as fuelwood, forage and fodder, fruits and nuts, latex, etc. This is the major section of the paper. We will discuss these five non-commodity values individually because each has its own locational characteristics and each is affected differently by policy.

It will become clear from the second and third sections of the paper that the local infrastructure affecting forest access and the establishment and protection of property rights are critical for the production of the non-market values of the forest. These are particularly important wherever those non-market values are competitive with extractive market valued uses. Therefore, the fourth section of the paper will discuss the institution of property rights and also the changes in local infrastructure (especially roads) that can affect their enforcement.

The final section will summarize those policies and institutions that are most effective in mitigating negative or enhancing positive effects on the non-commodity and non-market values of the global forest. Various selective policies can have favorable consequences for the protection of particular forest resources. However, the discussion in this final section notes that the general problem of rural poverty may be the greatest source of deforestation and loss of the various non-market valued forest resources. Therefore, general economic development may have a greater positive effect on the protection of these resources than any set of selective and

specific policy or institutional improvements. As a corollary, policies that are detrimental to the rural poor may have the greatest negative influences.

Finally, a brief appendix refers to those analytical approaches that are most useful for estimating market and policy effects on the non-market values of the forest.

Background

Three economic concepts are at the core of our interest: joint production, public goods, and environmental Kuznets curves.

Joint production refers to productive activity that creates more than one output. The concept has been discussed as “multifunctionality” in agriculture and “multiple use” in forestry (Meyer and Shobayashi 2001). It can refer to two market-valued products created in the same process and for the benefit of the same producer, such as corn and beans grown in the same field, or sawtimber and pulpwood produced from the same stand of trees. In these cases, the task of determining the optimal level of production of each product is relatively simple because both products are sold in the market and the prices of each can be incorporated into the single producer’s production planning. The single producer personally obtains the benefit of both products and personally absorbs the effect of producing too much of one product and not enough of the other.

The optimal levels of production are more difficult to calculate when one output occurs jointly with a second (market or non-market) output that affects someone other than the original producer. For example, one farmer’s fruit trees may improve the honey production of a neighbor’s bees. The first farmer has little incentive to select the number or species of trees to improve the second farmer’s honey production—unless the second farmer provides compensation to the first. In another case, one farmer’s agricultural activities may also produce erosion and a level of downstream sedimentation that damages a second farmer’s production. In this case, the joint product, sediment, is a negative output and the first farmer will produce in excess of the joint (or “socially”) optimal level because this farmer’s private accounting does not incorporate the negative effects on the second farmer’s activities.

In a third example that is specifically relevant for our purposes, agricultural production may require land conversion to agriculture from forestry and cause a loss of forest resource products and services such as carbon sequestration to mitigate global climate change or critical habitat for biodiversity. The negative effects in this case are public goods. They are “public” because no one can be excluded from their effects. In fact, these particular two losses affect everyone, regardless of whether anyone chooses to participate in or to be excluded from their affects.

The market does not successfully account for public goods because they cannot be bought or sold at their true value to all those who are affected. Either the original producer, the farmer in our examples, must be regulated or taxed or subsidized as an incentive to alter his/her production behavior, or else a public institution must protect the threatened resource itself, perhaps through public ownership and management.

The environmental Kuznets curve (EKC) is our third basic concept. It argues that, as a region or an economy begins its development, it draws down its stock of natural resources. However, the pattern of resource extraction eventually tapers off and, after some further level of development, the local economy begins to protect more of its natural environment. Its natural resources begin to recover. [See Dasgupta *et al.* (2002) for a survey or Bhattarai and Hammig (2001) for specific reference to forestry.]

The evidence supporting the idea of an EKC is strong—although not conclusive. The evidence for an EKC for forest resources in particular is largely composed of many regional examples. For example, the states of Vermont and New Hampshire in the US were largely deforested during their early development in the 19th Century. Their level of forest cover declined to approximately fifteen percent by the beginning of the 20th Century. However, after the development of the 20th Century, these states are more than 85 percent forested today. Indeed, the experience is even broader. The world's temperate forests in general, almost all of them in developed countries, have expanded over the last forty years, even in countries that have experienced population growth (FAO 2001).

India's Punjab is another example. The Punjab is India's most productive agricultural region. The region began a period of rapid and sustained development in 1960. Crop yields per hectare tripled by 1990 and income per capita doubled (in constant dollars). The land area in agricultural crops more than doubled while the principle agricultural prices remained relatively constant or declined—depending on the crop. Meanwhile, the rural share of the region's population remained steady at approximately 22 percent. Forest cover in the Punjab increased six-fold and horticultural tree cover increased more than 250 percent. Clearly, a large area had been cleared of its forest cover and existed only as wasteland before 1960. Some of that wasteland has been converted into cropland since then. Another large share of it has been reforested. The remaining natural forest is less threatened now than it was in 1960, and an extensive new managed forest has become a significant component of the landscape (Singh 1994).

The resource recovery postulated by the EKC occurs because further development eventually begins to draw on human capital more than natural capital, and because non-consumptive uses of natural resources and the environment begin to take on greater value for the local population. In particular, those non-market values having to do with environmental quality and those requiring longer planning horizons become more important to a population that is economically more secure. This means that forests become more important for environmental services like the sequestration of carbon and the provision of endangered habitat. Meanwhile, the wealthier local population also places higher value on forest-based recreation—which also requires the restoration of some forest resources.

Of course, there are limits to the restoration of some categories of environmental resources. Therefore, the expectation of an EKC-effect is not an argument that growth and development will solve all environmental ills. When economic development sets irreversible ecological processes in motion and causes the loss of unique biological habitats, then further development cannot alter or restore them.

All three concepts; joint production, public goods, and the EKC; are each relevant to the importance of preserving many characteristics of forests over time.

The existence of an EKC suggests that human preferences will change with time, and that it is important to preserve options for the future uses of all resources, including the options for some resource uses that may not even be known today. In order to preserve all options we must maintain a wide diversity of natural resources, including a wide variety of forest habitats. This logic is a justification for a greater level of conservation than current values would provide by themselves, and also a justification for forest conservation rather than development whenever there is doubt regarding choice between the two.¹ It is one reason for our general concern with global climate change and it is a particular reason for the early identification and vigilant protection of the most threatened of unique forest habitats.

The conservation task is difficult even with market prices as guides because of the uncertainties about future values. It is even more difficult because inadvertent joint production means that some products are not valued as highly by their managers as they are by the managers' neighbors who also gain or suffer from the impacts of their use. This condition describes most of the forest values of our greatest interest in this paper. It justifies our concerns for the non-market values of the forest and, particularly, the spillovers to the forest from markets and policies serving other sectors of the economy.

Box 1: Definitions

Joint production = multifunctionality = multiple use

The production of more than one output from the same underlying resource or the same productive activity: fruit and honey from the same orchard, sawtimber and pulpwood from the same stand of trees.

Externalities

Unintended effects of one producer on his/her neighbor(s): the orchardist's (positive) contribution to a neighboring beekeeper, the (negative) effects of timber harvesting on erosion and downstream sedimentation.

Public goods

Goods that cannot be privately exchanged in the market because no one can be excluded from their use: the benefits of carbon sequestration to protect the global climate.

Environmental Kuznets curve (EKC)

The idea that the process of development first draws down natural capital like forests, then further development draws less on this capital and, finally, begins to restore what it can.

A Taxonomy of Forest Development

¹ The environment literature refers to safe minimum standards (*e.g.*, Ready and Bishop 1991, Bishop 1993, Ciriacy-Wantrup 1968) and option values (Krutilla and Fisher 1975) and Porter (19).

This next section of the paper reviews the fundamental market economic characteristics of the forest and develops an organization for identifying the most likely spillover effects from other sectors of the economy. This organization is useful for judging where non-market forest values are under greatest risk—as well as for identifying the source of risk and the means for its mitigation.

Consider how economic activity in general affects the structure of forests. A common pattern emerges from observations taken almost anywhere around the world. This is a pattern of new settlement, followed by deforestation and increasing scarcity of forest products eventually combined with regional development, rising process, and the forest investment that limits further depletion of the remaining natural forest. This pattern describes development of any region over time, but it also describes a cross-section of the world today. All regions of the world fit within one stage or another in this pattern. Indeed, many countries contain regions that fit different stages of the pattern, with some of their regions containing only natural forests on the frontier of economic development while other regions of the same country may contain aggressively managed modern forest plantations.

Figures 1-3 capture the basic elements of this pattern. They conform with the general pattern of economic geography first proposed by von Thunen in the 19th Century. [See Samuelson (1983) for a review.] They also provide the key reference points necessary for further reflection on investment timing, institutional constraints, and the markets and policies affecting forest products and their values.

A New Frontier, Stage I

Figure 1 describes a simple landscape of agriculture and forests at the time of the first permanent settlement. Consider agricultural land first. The value of agricultural land is a function of the net farmgate price of agricultural products—which is greatest when the farmgate is nearer the local market at point A. Land value in agricultural use declines with more limited access (which is closely related to increasing distance) as described by the function V_a . That is, the periodic crop value per hectare minus the costs of growing that crop creates a net value function that declines as we move to less and less accessible land farther and farther from the value center at A.

Households and communities have to absorb a transactions cost C_r for establishing and maintaining secure rights to this land. This is not a part of the net value calculation represented by V_a . This cost increases as the level of public infrastructure and effective control declines and the cost of excluding trespassers increases as we move farther and farther from the value center at A (Anderson and Hill 1975, Alston *et al.* 1999).

The functions explaining agricultural land value and the cost of secure property rights intersect at point B. Farmers manage land between points A and B for permanent and sustainable agricultural activities. They use land between points B and C (where agricultural land value declines to zero) as an open access resource to be exploited for short-term advantage. Local households and communities may protect some lands beyond point B to a limited degree—as by having children shepherd their grazing livestock. Nevertheless, C_r continues to rise after

point B until eventually no reasonable number of shepherds or other resource guards can fully exclude illegal loggers and other open access users of remote forests.

Local consumers harvest the products that grow naturally in this region between B and C, crops like fodder for their grazing animals, native fruits and nuts, and fugitive resources like wildlife. They will not invest even in modest land improvements in the region between B and C because the costs of protecting their investments would be greater than the return on these investments. Their use of this open access region is unsustainable except for periodic removals from pulses of regrowing natural vegetation.

At the time of initial settlement, the mature natural forest at the frontier of agricultural development at point B has a negative value because it gets in the way of agricultural production and its removal is costly. The first settlers remove trees whenever the agricultural value of converted forest plus the value of the trees in consumption exceeds the cost of their removal. In fact, farmers in some frontier settlements farm in and around the trees they have not yet removed in preference to absorbing the costs of removal. Therefore, the function V_f describing forest value must begin below the agricultural value gradient V_a and, in this initial stage of development, it does not extend as far as the intersection of the agricultural value gradient with the horizontal axis.

Developing Frontiers, Stage II

Both market demand and subsistence household demand justify the removal of some forest products, and they will continue to justify additional removal at each new moment in time. Therefore, the forest frontier must gradually shift outward. The most accessible forest resources are always removed first. This is true whether those resources are timber, fuelwood, bamboo, fruits, nuts, latex, or whatever. The forest value gradient continues to shift upward and outward over time until it intersects the horizontal axis at some point like D in figure 2. The price of the forest product in the market at A is now just equal to the sum of its cost of removal plus its delivery to the market. Products will be removed until their *in situ* value at point D is zero. Therefore, the value of forestland at D is also zero. The area of unsustainable open access activities now extends from point B out to points C or D, whichever is farther. The costs of obtaining and protecting the property rights insure that the resources within the area described by BD will remain open access resources.

Forest degradation, a feature of the open access region: The area of open access will not be fully deforested. Rather, the forest on these lands will be degraded to the level where the expected return from lower quality products would be less than the opportunity cost of the labor and capital used in their extraction. The picture below figure 2 illustrates the effect on the forest. The remaining degraded resource tends to be larger and the forest is more fully stocked (degradation is less) at point D than at point B because the opportunity costs of labor and capital used in resource extraction are greater at the greater distance represented by point D.

These opportunity costs are important explanatory factors for the levels of deforestation and forest degradation. We can anticipate that both the extent of deforestation and the severity of forest degradation are greater in markets where the opportunity costs of extraction are smaller.

Consider two regions that are similar in agricultural and forest values, in applications of property rights, and in forest characteristics. They differ only in the opportunity costs of extraction from the forest. Loggers and harvesters of other forest resources extract from the forest out to the point where their compensation equals their opportunity cost. The lower their opportunity costs, the further they are willing to go to extract products of the same value. Therefore, the forest value gradient in the higher wage and higher capital cost market will intersect the horizontal axis closer to the market at point A, while the forest value gradient in the lower wage and capital cost market will intersect further to the right. (Point D will be farther to the right.) Deforestation will be more extensive in the lower opportunity cost market and the alternative labor and capital opportunities are critical determinants of deforestation.

Forest degradation will also be more severe in the lower cost market because smaller and lower quality products still offer sufficient rewards to offset the opportunities forgone while extracting harvests from the open access region.

Illegal logging, a second feature of the open access region: Some governments protect some lands past point B but they must absorb the increasing protection costs—and even then trespass and *de facto* open access activity occurs. For example, forested parklands around the world suffer encroachment and timber reserves around the world experience illegal logging. An almost unlimited number of well-trained and well-motivated forest guards could not prevent these activities entirely. For example, illegal logging is an issue of serious policy concern in developing countries like Bolivia and Indonesia, where it may be the source of eighty and 51 percent, respectively, of all wood harvests, but it occurs in the US as well (Smith 2002). For example, some local citizens illegally harvest Christmas trees from the well-managed national forests in the eastern US. The US Forest Service does not extend greater effort to prohibit this theft because the costs of enforcement would be greater than the potential gain—which is another way of saying that the function C_r is above the function V_f .

Summary: The construct of figure 1 conforms to the common description of any initial settlement. Trees actually impede agricultural development and the forest rent gradient is very low. Net forest resource values are sufficiently low that point D, where the forest rent gradient intersects the horizontal axis, is to the left of point C. This described new settlement in the Ohio Valley in the US in the early 19th Century (Richter 1966). Apparently, it describes the forest frontier in Cote d'Ivoire (Lopez 1998) and Bolivia's Amazon region today (Rice *et al.* 1997). It probably also describes upland settlement in the Philippines (Amacher *et al.* 1998) and new settlements in Indonesia's Sumatra (Heydir 1999).

In other cases, described by figure 2, the lands between points B and D may be large and seriously degraded [*e.g.*, in Nepal's hills (Cooke 1998) or India's Rajasthan (Jodha 2000)]. The positive net value of the original resource, together with the open access character of these lands, has assured removal of the best resources. Some degraded vegetation remains and with time it will regrow naturally. The lowest wage households will continue to exploit this resource as the scattered vegetation grows to a minimum exploitable size or as its fruits begin to ripen (*e.g.*, Amacher *et al.* 1999, Foster *et al.* 1998, Bluffstone 1995). These open access lands exist in both developed and developing countries. They are more degraded in some developing countries

(typically South Asia and some countries in sub-Saharan Africa, but not Latin America) only because the relative rural wages are lower in these countries, substitute opportunities for low wage laborers are less attractive, and pursuing and extracting these lower-valued resources is the best opportunity available to the collectors of these forest resources.²

The use of the natural forest continues over time, the forest is gradually depleted, and the forest margin at D slowly extends farther and farther from the market center. Deforestation continues, and the delivered costs of forest products continue to rise. However, the incentives of higher prices remain insufficient to induce tree planting and any attempt at forest management will be unsustainable. As Godoy (1992) points out, the prices of forest products may be rising, but they are not yet sufficient to induce forest management.

Mature Frontiers, Stage III

Eventually the margin at D extends far enough—and delivered costs and local prices become great enough—to induce substitution. This occurs when the costs of removal at a point like D and delivery to the market equal the backstop cost of some substitute. Substitution may take the form of new consumption alternatives to forest products (for example, kerosene or improved stoves as substitutes for fuelwood or concrete block as a substitute for construction timber), or it may be production-related (as in planting and sustainable forest management on some land closer to the market). Very clearly, the evidence of planting and sustainable forest management is not ubiquitous—but the physical presence of sustainable management is not trivial either. FAO estimates that forest plantations cover more than 187 million hectares worldwide—more than four percent of the world’s total forest area and more than 1.4 percent of the total area in all land uses. The land area in plantations is growing by almost 4.5 million hectares annually, and plantations now supply approximately 22 percent of the world’s industrial roundwood (FAO 2001). For specifically tropical and sub-tropical plantations, Sedjo (1994) observed that the share of industrial wood production doubled from 1977 to 1992. Undoubtedly, that share has increased since 1992.

The forest value gradient rises with the increase in delivered costs (from the dashed line to the new solid forest rent gradient in figure 3) until, at some moment in time, it intersects the agriculture rent gradient to the left of agriculture’s intersection with the cost function for secure property rights. We might call figure 3 a description of the “mature” frontier of primary forest. For communities at mature frontiers, forest product prices will be sufficient to justify the substitution of managed forests for the resources of the open access natural forest. The new sustainably managed forests occur in the area described by B'B” of figure 3. They may take the form of industrial timber plantations or of agroforestry or of just a few trees planted around individual households or in homegardens. The latter are excluded from most measures of the forest stock but their economic importance can be large. In the semi-arid Denver metropolitan area in the US, for example, trees comprise only seven percent of the land cover, but they act as a \$44 million regional storm-water management system, remove \$2.2 million pounds of air pollutants annually, and save \$50 per household in annual air conditioning costs (Stein 2001).

² Regions with higher populations per unit of area or unit of forest tend to have relatively lower wages and lower opportunity costs of labor. Therefore, others (e.g., Meyer and Shobayashi 2001) have observed that forest degradation and deforestation are greater in regions of greater population density.

Throughout South and Southeast Asia, trees that grow in plots that are too scattered and too sparse to meet the measurement standards for inclusion in official measures of forest stock account for 65-85 percent of all market timber and fuelwood production (FAO RWEDP 2000). They are major sources of fuelwood in Malawi (Hyde and Seve 1993) and timber production in Kenya (Scherr 1995). On the densely populated island of Java, they may account for tree cover on 47 percent of the land area—in addition to the 24 percent that comprises the official estimate of forestland.³ The 47 percent is not part of the official estimate because it is composed of scattered trees and stands rather than continuous forest and because its value is for shade, fuel, fruit and estate crops like coconut and palm oil rather than commercial timber.

In all cases, removals from the mature natural stock are concentrated in the neighborhood of point D. Mature natural stocks from more accessible lands were removed in earlier times because they were open access resources. In most cases, a mature natural forest of no market or subsistence value exists beyond D. Sometimes the total area of this land beyond point D is negligible (*e.g.*, in Ireland or Cape Verde). Sometimes it extends well beyond the frontier of economic activity at D (Siberia, Alaska, northern Canada, much of the Amazon, a large component of the Rocky Mountains in the US, and much of Kalimantan in Indonesia) until it becomes the largest share of reported physical stocks.

Implications for Forest and Environmental Policy Analysis

The three figures trace an inter-temporal progression but, at any moment in time, they also describe static snapshots of local conditions. And, at any moment in time, all three local conditions may exist simultaneously in different regions of some countries. They can exist simultaneously because most basic commercial forest products are either bulky or perishable and do not transport well before they reach the location of their next level of processing. Their markets are geographically contained. Therefore, standing natural forest reserves remain in some regions of a country (*e.g.*, Siberia, Alaska, northern Canada, the eastern Amazon, Kalimantan in Indonesia) while the forests in other regions of the same country are depleted and some landowners may have begun to plant trees on their own lands (*e.g.*, the Caucasus, the US South, southern Ontario in Canada, the developed part of Brazil's Paragominas, central Java in Indonesia).

In sum, this characterization identifies three stages of forest development and the three categories of forests that exist today: managed forests (including industrial forest plantations, more scattered household trees, and agroforestry plantings) over the land area described by B'B", depleted forests from point B (or B") to point D, and an unmarketable mature natural forest beyond point D. For most commercial uses of the forest, we could identify a fourth category: the general area of current harvests from mature natural forests in the neighborhood of D. Commercial timber and fuelwood, the most common wood products of the forest, generally originate from the first (managed forests) and fourth categories. Most forest policy and management is concerned with effects on the first three forest categories. Environmental and aesthetic concerns feature either the last category (*e.g.*, biodiversity and natural preserves) or select locations within any of the first three (parks, erosion control, sustainability).

³ The 47 percent is an estimate from personal communication with D. Garrity in May 2000. The official estimate of 24 percent is from GOI/MFEC (1998).

The critical points are that

- we must differentiate the forest into these three (or four) categories before we discuss specific policy or market impacts and
- the appropriate measure of the forest depends on the policy objective.

The differentiation is crucial because the same policy can have opposite effects on different categories of forest. Consider a few examples: Timber price incentives are an inducement to improve and expand the managed forests for regions in stage III, but they are also an incentive to expand the deforestation of natural forests. For regions in stages I and II, price incentives have only their negative impact on natural forests. There are no managed forests in these regions to take advantage of the price incentive.

Similarly, forest cost-sharing and technical assistance programs are inducements to improve and expand the managed forests in regions in stage III, but they have no effect on regions in stages I or II which only contain natural forests. Agricultural incentives, another example, induce land conversion from the forest to agriculture for regions in new frontiers, stage I. They cause some agricultural conversion from previously degraded lands for regions in stage II—but whether these degraded lands are included in the official forest inventory depends on the local measurement standards. Agricultural incentives have no effect on the natural forest for mature regions in stage III, but they do cause agriculture to out-compete managed forests at their intensive margin (B').

The importance of the particular measure of forest inventory can be illustrated in a comparison of policies intended a) to improve carbon sequestration or b) to protect endangered habitat. All trees sequester carbon. Therefore, an accurate measure of the effect of a policy designed for this objective must include those managed trees contained in orchards, back yards, city parks, windbreaks, along roadsides, and in agroforestry cropping systems. These trees are excluded from most official national forest inventories. Overlooking them would grossly misestimate the total amount of carbon sequestered.

On the other hand, most forest-based endangered habitat is contained in the remaining natural forest past point D in our three figures. Measures of the forest that include all three categories of forest would not be good indicators of the remaining natural habitat, and policies designed to affect forests in general but which concentrated their effects on extending the area of managed forests and or improving the condition of the depleted open access area have little effect on endangered habitat.

In conclusion, the 3-stage classification of forest development and the three (or four) categories of forest that emerge from it create a means for tracing both policies and spillovers from commercial activities onto the various components of the forest. We will rely on this classification in our assessment of the effects of market and policy spillovers and institutional modifications on the non-market uses of the forest in the next two sections of the paper.

Box 2: Stages of forest development

Forestry goes through three distinct stages of development. I) New frontiers are characterized by clearing of the natural forest for agricultural settlement. II) Emerging frontiers are characterized by harvests of the natural forest for its own products; products like timber, fuelwood, and latex; but agriculture no longer infringes on the natural forest. III) Mature frontiers are characterized by both managed trees and forests, and also by a remaining natural forest. Marketed forest products are extracted from both managed forest and from the natural forest frontier.

A region of open access exploitation exists between the area of managed land use (agriculture in I and II, managed forests in III) and the natural forest. The extent of this region and the degree of its degradation depends on the strength of the local institutions insuring property rights and the opportunity cost of rural labor and capital.

The distinction of three stages of development and at least three categories of forest (managed forest, open access degraded forest, and remaining mature natural forest) is important because each category of forest contains different forest-based goods and environmental services. Therefore, the appropriate measure of “forest” depends on the good or service in question and the policy objective. Some incentives (*e.g.*, timber prices) have opposite effects on different categories of forest. Other actions (*e.g.*, agricultural land conversion) affect some forest categories in one stage of development but not in others.

Markets, Policies, Institutions, and the Production of Non-market Forest Goods and Environmental Services

The primary non-market forest products are: i) carbon sequestration to mitigate the conditions of global climate change, ii) biodiversity and critical habitat, iii) erosion control and general watershed protection, iv) tourism, and v) specialized local products such as fuelwood, forage and fodder, fruits and nuts, latex, etc. Sometimes these are discussed as “multiple use” products of the forest and their production is often considered to be the result of a joint production process involving two or more forest products. Commercial timber is often discussed as one of those joint products but activities outside the forest sector can also have important effects on each of these non-market products.

Fortunately, each of the five non-market products has its own combination of economic and physical characteristics and, in locations where more than one occur, the value of one generally tends to dominate. Therefore, the occurrence of joint production tends to involve only a small number of products on any particular site—often one market-valued product like an agricultural crop or timber, and one non-market valued product.⁴ Of course, the particular

⁴ Indeed, as Bowes and Krutilla (1989) prepared their classic book on the economics of multiple use forestry, they began with the complex theory that could address problems of numerous beneficial and detrimental outputs produced together on the same land unit (Bowes 1983). However, they found that reality was simpler. The most complex cases for any local site tend to involve only two outputs of high and competitive value for that site.

combination of products with higher-values varies from site to site. For these reasons, we can consider the typical locations of each of the five non-market products in turn and inquire as to the likely joint production or spillover effects involving each independently.

Carbon Sequestration and Global Climate Change

The discussion of forestry and global climate change has two components: a) the effect of climate change on forests—which has to do with changes in the extent of forest cover in response to anticipated global climate change (Sedjo and Solomon 1990)—and b) the mitigating effects of the forest on climate change. The latter is probably of greater interest. It can help preclude the former.

Increases in atmospheric levels of CO₂ cause global warming. On this much most are in agreement. The level and importance of global warming, to date or in the foreseeable future, remain debatable issues (Mendelsohn and Neumann 1998, Nordhaus and Boyer 1999). The importance of the forest in mitigating global warming also remains a debatable issue.⁵ However, it is clear that fossil fuel combustion and land use change (mostly agricultural conversion of the forest) release CO₂ into the atmosphere. The acts of harvesting timber and processing wood products also release CO₂, although not nearly at the rates of fossil fuel combustion and land use change (Houghton *et al.* 1987). Indeed, wood processing releases only a portion of the carbon originally contained in a tree because so much is stored in the soil (roots, soil carbon, detritus on the forest floor), in the product (lumber), or in landfills (paper).

Reducing the rate of forest conversion to agriculture, particularly where conversion involves burning the forest cover, would decrease the rate of atmospheric build up of CO₂. Growing trees in new plantations, harvesting, and storing the final biomass would retain additional CO₂. However, growing trees and storing them on the stump would only yield a short-term increment to stored carbon because little additional storage occurs once the trees achieve maturity and the rate of tree growth declines. Nevertheless, additional tree planting and tree growth could be a means of buying time until world markets substitute other energy sources for fossil fuels.

The problem confronting any attempt to use trees to control global climate change is the mismatch between the non-exclusive global public impact and the more identifiable but still general location of the forest activities to control it. Protection from climate change is a public good in the broadest sense of the concept. Literally everyone everywhere benefits, and the exclusion of anyone from the benefit is impossible. However, the depletion of mature natural forests, and the loss of carbon stored in forests, is most rapid at the forest frontier of the developing tropical countries—or at the margin of point D in figures 1-3.

Various import restrictions, taxes, and subsidies have been suggested for addressing the problem. Import restrictions such as certification are in favor today, but enforcing the forest management requirement for certification must be difficult while less expensive harvests from

Therefore, their book focuses on empirical examples of produced timber produced jointly with one other single product: i) water, ii) grazing, iii) minerals, iv) hunting, and v) non-consumptive forest recreation.

⁵ For example, see the discussion by F. Bohlin on the RESECON listserv June 25, 2000.

the natural forest remain available to local loggers. The natural solution for economists would be to tax the negative externalities, land conversion and fossil fuel consumption, while using the tax revenues to subsidize the positive externality, forest management. Taxes on land conversion would be difficult because they largely occur in developing countries as a response to population growth, insecure land tenure, or domestic development policy. Taxes on fossil fuel consumption have attracted more attention. Weimar (1990) showed that even a small tax on fossil fuel emissions comparable to 0.5 percent on the price of a barrel of petroleum would extract US\$9 billion annually from the developed countries. However, we can anticipate that even this large sum would be rapidly dissipated in a) the transfers necessary to induce each of the many many marginal users of the tropical forest to halt their extractive activities, b) the additional transfers necessary to encourage a significant expansion in tropical forest plantations, plus c) the costs of monitoring and enforcing (M&E) the promised behavior by so many individuals spread over a vast forest landscape, as well as d) the administrative costs of the entire transfer.

The three figures from the previous discussion of the stages of forest development illustrate these difficulties. They also illustrate two potential but challenging solutions.

For regions in all three stages of development, the costs of establishing and maintaining property rights C_r are greater than the market value of the resource at the natural forest frontier (point D). In the two less developed stages (figures 1 and 2), these costs also exceed the value of marginal agricultural land use (from point B to point C). This means that M&E, for carbon sequestration or any other purpose, will be more costly than the market value of the protected resource. Few developing country resource management agencies will have the budgetary means to accomplish the M&E task under these conditions, while the local population will have competing private incentives to convert land and extract forest resources.

However, this same description also suggests an institutional solution: improved property rights. Any policy improvement that **reduces** the costs of establishing and maintaining property rights (reducing the height of the function C_r) will extend the area of sustainable management (shifting B or B'' to the right in the figures). This will decrease the level of forest conversion for regions in stage I, reduce the area of open access forest degradation for regions in stage II, and expand managed forests for regions in stage III—thereby protecting threatened forests and stored carbon for regions in stages I and II and adding new forests and sequestering more carbon for regions in Stage III. Two changes that could satisfy this description are the institutional adjustments that would permit local farmers to register their land use claims more easily, and the transfers of these lands from public agencies to private land management. Successful community forestry is an example of the latter. General improvements in the overall macroeconomic policy environment are a third example. These are the kinds of improvements that increase the confidence of local land managers in their future prospects in general, and cause them to extend their planning horizons and invest in conservation improvements in their land. We will consider all three in greater detail in the subsequent section on infrastructure and institutional arrangements.

The second set of potential solutions is related to unplanned spillovers from agricultural activity. Decreases in the general class of incentives that induce agricultural expansion (*e.g.*, crop subsidies) would decrease agriculture's infringement on the natural forest for regions in

stage I (shifting point C to the left), decrease agricultural infringement on the degraded open access forest for regions in stage II (also shifting C to the left), and permit forest management to out-compete agriculture and expand into some former agricultural land for regions in stage III (shifting point B' to the left). Of course, altering these agricultural incentives will not be an easy task as strong political interests support them in almost all developed countries.

The issue of agricultural incentives becomes even more complex when we recognize that some incentives, such as those that induce shifts to higher yield varieties, induce agricultural intensification. These would have the same beneficial effects on the forest and on carbon sequestration as those achieved by ridding the world of the incentives for agricultural expansion! Furthermore, agricultural intensification generally increases the demands for labor, raises rural wages, and attracts workers away from the forest. This too saves on forest exploitation and controls the destruction of carbon already stored in mature trees. Therefore, any proposal to modify agricultural incentives for the purpose of improving carbon sequestration must be selective regarding the incentives in question. Some agricultural incentives reduce agriculture's competition with forests, extend forest area, and improve carbon sequestration, and some decrease carbon sequestration.

Box 3: Carbon sequestration

In sum, the problem of protecting and expanding forests to improve carbon sequestration is complex. Our figures demonstrate the importance of focusing on shifts at the margins of forest land use. Both improvements in forest and agricultural property rights and incentives for agricultural intensification can create the desired forest protection and expansion. Decreasing the incentives for agricultural expansion has the same favorable effect, but this adjustment in incentives will be politically difficult to arrange. The potential of each of these policy or institutional modifications is greater than the various suggestions for carbon taxes and land use subsidies that tend to focus on the full forest rather than on marginal shifts in land use. Improvements in the property rights and in the selection of agricultural incentives are probably less expensive as well because carbon taxes coupled with land use subsidies would impose large administrative, monitoring and enforcement costs before they induced the desired behavior from the many land users who are widely dispersed across a remote forest landscape.

Biodiversity and Critical Habitat

The protection of biodiversity is based on the idea that currently undeveloped, and even unknown, species possess characteristics of potential future value. Preserving their habitats helps preserve the species and the option to obtain future advantage from them once we learn more about them. Numerous examples demonstrate the great social and economic gain from preserving select species for which we had no prior scientific knowledge (*e.g.*, Putz 199)—although some doubt remains regarding the significance of the very probabilistic value to be gained from preserving unknown species in general (Simpson *et al.* 1996).

If we accept the importance of preserving species, then we know that the remaining natural forest, the forest beyond the frontier at point D in our three figures, contains most of the critical habitat. That is, natural forests (rather than forest plantations, other managed forests and trees, and the degraded open access lands) must be the focus of most of our preservation effort because only these forests contain undisturbed habitat. Furthermore, among natural forests, the tropical moist forest contains over one-half of all species of flora and fauna, including many that are still unknown. This particular forest is all the more important because its marginal habitats are more threatened than those of either the tropical dry forests or the temperate and boreal forests. Therefore, the remaining mature tropical moist forest is an appropriate focus for a large share of our interest in protecting biodiversity.

The economic problem, once more, is the mismatch between the locations of the most concerned public and the critical habitats. It contains elements of similarity with the carbon sequestration problem we just discussed. That is, the greater wealth of the developed countries puts them in a better position to act on the potential future value of biodiversity and to pay the price necessary to protect endangered habitats, while the poorer local farmers and extractive users of tropical forests bear most of the costs of foregone development and habitat protection.

However, these elements of similarity diminish in importance when we focus on the physical sources of carbon and biodiversity. Carbon sequestration improves with the protection and expansion of forests and trees on all marginal forest lands. Most lands and trees are of similar value for carbon sequestration, but all lands and trees are definitely not similar for biodiversity. Biodiversity requires the protection of selective “islands” of specialized habitat. In terms of our three figures, these islands are often in the neighborhood of point D or beyond it, and the foregone future development opportunities associated with them are often smaller than even the current opportunities foregone when protecting marginally commercial forest lands for carbon sequestration at points B', B'', and D.⁶ This means that many critical habitats remain unthreatened today simply because they are beyond the limits of access for either agricultural land conversion or extractive forest activities. Their inaccessibility protects them—for now.

In other cases, some habitats can be protected in the normal course of management for other forest products and forest-based environmental services. Hyde (1991) showed that this is the case, for example, for many red-cockaded woodpecker habitats in the southern pine region of the US.

This leaves two fundamental problems for policy resolution, protecting that currently threatened habitat that is in competition with other, consumptive uses of the forest (or monitoring to ensure that its management and use is not competitive with the endangered habitat), and identifying additional specialized habitat that is inaccessible now and protecting it before it becomes threatened in the future.

The currently endangered habitat will mostly often appear in the neighborhood of point D in our figures. Protecting it requires the establishment of boundaries around the endangered

⁶ The few empirical studies from temperate regions suggest that the foregone development opportunities associated with endangered species protection are small—at least partly because higher-valued development opportunities have already been exhausted (*e.g.*, Hyde 1991).

habitat and the permanent exclusion of incompatible land uses. Excluding land conversion and agricultural use of the forest is a problem only for habitats at new frontiers in regions described by figure 1. Therefore, reducing the incentives for agricultural expansion will only be important for the preservation of habitat in newly settled regions like some parts of the Amazon or the interior of Papua New Guinea.

Otherwise, for regions characterized by the more developed forestry described by figures 2 and 3, the threats to diverse forest habitats originate from either the development of new infrastructure or from extractive activities in the remaining natural forest. Changes in the infrastructure can affect all non-market forest values—and we will discuss them in their own section of the paper following our discussion of the five non-market values. Extractive activities in these natural forests are typically undertaken in a transitory manner by loggers or other operators who are here today and gone tomorrow. They have all the private economic incentives to harvest resources, often timber, and controlling their activities is a difficult task. It requires continuous monitoring of the boundaries of the protected habitats as long as the habitat is to be protected. Therein lies another problem. The resource management agencies of most developing countries do not have either the human or the financial resources to adequately ensure the protection of many critical habitats. Furthermore, most donor assisted projects and most debt-for-nature swaps fail to include long-term continuing maintenance costs. In fact, long-term commitment to any single project is unusual in the practice of donor agencies. Therefore, the long-term protection of currently threatened habitat remains a largely unsolved policy problem and, in the presence of very limited resources, we have the additional problem of deciding which of many threatened habitats are most critical and most worthy of the long-term demands on these limited resources.

The second fundamental policy problem has to do with those critical habitats that are currently inaccessible and unthreatened. If the broad regions within which they are contained do develop, then some of these habitats may not be threatened in the future either. We can explain this conclusion in the context of our prior discussion of environmental Kuznets curves. That is, local forests tend to recover after regions develop beyond some level. However, many critical habitats could be lost forever before the regions around them attain this level of development. Can we identify those threatened habitats and preserve them before they become commercially accessible and are lost forever?

Identification is a task for field research and it is one reason for the current interest in developing ‘indicators’ of forest quality. As current opportunities for biotechnology expand, the values of some endangered habitats may become clearer to private investors and those private interests may undertake the effort to save some of them. Otherwise, this too is a public problem and one that the donors and public research institutions of the developed countries may be particularly well-suited to address. Once the public researchers do identify critical habitat, however, policymakers are still left with the previously discussed and largely unsolved task of finding a publicly-funded means for excluding extractive users of the forest from the critical habitat.

Finally, *ex situ* preservation can be a partial solution for long-term preservation. *Ex situ* preservation is the off-site storage of the endangered biological material. Once the threatened

flora or fauna is identified, its germplasm can be catalogued and stored, preferably in a public institution that will maintain the biological material for the benefit of all of the world's people in this generation and future generations as well. Zoological parks are one example. In addition, some institutions in the CGIAR system of international agricultural research stations maintain cold storage banks of germplasm. Gene banks, however, are static institutions. They fail to capture and preserve dynamic genetic evolution. They can be important contributors to the preservation of existing biodiversity while we search for ways to identify and permanently protect critical forest habitat.

Box 4: Biodiversity and critical habitat

In conclusion, the preservation of critical forest habitats for endangered biodiversity is a difficult and largely unsolved problem. It requires identifying the critical habitats and excluding all competitive uses from them. Reducing the incentives for forest land conversion to agriculture will help protect some critical habitats in select regions of new development. However, in these regions and all others, the more fundamental problem is finding the human and financial resources to permanently exclude consumptive activities from these habitats. This is a tall order. The governments of the tropical countries that host the largest numbers of threatened species have very limited resources for monitoring and enforcement and the developed country donors that could assist are not in the habit of making the long-term commitments necessary to protect these habitats. Moreover, the problem will only compound in any region where local development is associated with further clearing of the forest.

Erosion Control and General Watershed Protection

Erosion control and watershed protection include all the wind, water, and soil movement services of trees and watersheds; for example, water supply, storm protection—especially in coastal areas, and control of the upstream loss of soil nutrients and downstream effects of sediment deposition. Like carbon sequestration, watershed protection can be divided into two broad classes of activities; those requiring new conservation investments such as tree planting in shelterbelts to deter wind erosion and along streams and gulleys to deter water erosion, and those maintaining the services of existing forested watersheds and controlling their deterioration.

The difference in economic effect is that watershed values are local, while carbon sequestration is a global public value. Depending on the watershed management activity, it can benefit an individual land owner who makes the conservation investment and improves his or her own land's productivity, or it can benefit a range of downstream or other off-site land managers in the same watershed. In the latter case, when watershed management is a public good, it involves a smaller and more local public than the global society affected by carbon sequestration, the benefits of the activity are clearer and more immediate for the local community, and obtaining support and compliance with local public management is somewhat easier than for carbon sequestration.

Many of the first class of watershed management activities, those requiring new conservation investments, are responses to human development. They are a means of improving the productivity of existing (often agricultural) land uses. These investments typically occur on the private lands—to the left of the intersection of the agricultural and forestry value functions with the rising property rights cost function in our three figures (points B or B’). Therefore, the increases in the manager’s private long-run productivity are generally sufficient to induce the private conservation investment. In fact, this observation conforms with the established analytical economic evidence for developed countries where the land use rights are generally more secure (e.g., Crosson 1985, Crosson and Stout 1984). More recently, Yin (2000) and Alemu (1999), demonstrated its reliability in China and Ethiopia, respectively, once farmers in those countries received new longer-term land use rights. That is, economic reforms in the 1970s and 1980s in both countries gave farmers more secure and longer-term land use rights. The farmers responded by increasing various inputs, including trees to protect against wind and water erosion. Farmers in both countries obtained statistically significant increases in the levels of their private agricultural productivity due to the newly planted trees and related conservation investments.

The second class of watershed management activities protects the upland watershed or the coastal wetlands for the benefit of off-site residents of the same local area. Grazing livestock are a common source of upland erosion and downstream sedimentation [e.g., the Lake Victoria watershed in central Africa (pers. comm. with ICRAF) and the Philippines (Cruz *et al.* 1988)]. Upland collection of fuelwood and fodder [e.g., Nepal’s hills (Dangi and Hyde 2001)] is a second source in some severely degraded forest areas. Even less intrusive activities like picnicking can also affect local water supplies to a sufficient extent that the city of Portland, Oregon, for example, restricts all human activity on one critical section of its adjacent Mt. Hood watershed. Finally, logging and land conversion in many coastal areas have damaged local fisheries and decreased local protection against the effects of tropical storms.

These examples are all characteristic of either the open access degraded forest or the boundary of the mature natural forest in our figures 2 and 3 (between points C and D). The costs of protecting these watersheds exceed the open access private (grazing, fuelwood collection, recreation, timber harvesting or land conversion) values on these lands. That is, in terms of the figures, the function C_r explaining the costs of property rights is above the agricultural and commercial value functions. Therefore, private management will be unsuccessful and only public monitoring and enforcement can insure the common watershed benefits for the local community.⁷

Where most or all members of the local community share in common watershed benefits, then the local residents also share a common incentive to protect the watershed, and monitoring and enforcement may be a relatively simple matter. In other cases, where the local incentives are dissimilar, M&E will consume more resources and protecting the public benefits will be a more difficult task.

For example, some poorer households in the village of Basantapur in Nepal rely on the watershed for fuelwood, but their fuelwood collection degrades the watershed and increases the

⁷ Nevertheless, Landell-Mills and Portas (2002) identify over 180 cases of markets for watershed services.

off-site flow of soil to the detriment of the agricultural productivity of the better-off households at the base of the watershed. This community's two interests in the watershed are in conflict and the community's forest guards have been unable to fully restrict access. The degradation of the watershed continues (Dangi and Hyde 2001).

Box 5: Erosion control and general watershed protection

In sum, local land managers with long-term rights to the land internalize many watershed values. Other watershed values obtained from lands with less secure private claims or from public lands are more difficult to protect. They require M&E provided by a public institution representing those who benefit from the watershed's protection, and their M&E will be least expensive and most successful where the affected local inhabitants share in similar benefits from the watershed.

Tourism

A broad range of people obtain the benefits of tourism and a broad range of forested sites provide for it. Those who benefit range from wealthier global tourists to local picnickers and others just looking for a pleasant moment in a natural setting. Site characteristics range from unique global resources like Yellowstone, the Serengeti, or Sagarmantha to pleasant local forested groves and even village parks. The unique sites can provide a focus for substantial demands for tourist support services like restaurants, motels, guide services, and outdoor equipment shops; and these can be important sources of hard currency for the local economy.

Once more, the economic problem is either one of protecting "islands" of specialized forested sites within lands that are valuable for other, commercial uses (out to point D in our figures), or identifying commercially inaccessible forestlands (beyond D) that are uniquely attractive for nature tourism and protecting them before they become accessible for those commercial uses.

For the most unusual sites, fees can be charged at points of limited access and the revenues from them can be used to establish boundaries and to monitor and enforce the exclusion of undesirable uses of the park and the provision of tourist services. For example, Kenya charges an increased visa fee for national entry for global tourists, Nepal charges for trekking permits which can be obtained at the offices of guide services, and many national parks with natural boundaries charge a gate fee.

There are two problems, however, even in the case of these unique resources. First, the fee is general. It makes no distinction for particular resources or specialized services within the region covered by the fee. For example, fees collected at national borders do not distinguish between different parks within a country or between particular resources within a park. Therefore, there is no market signal that assists managers in the allocation of revenues among numerous resources and services. Sometimes this problem can be addressed by placing the

general management of all resources under one integrated operation; a national park service, for example; and competitively allocating concessions for specialized services like hotels and guides with the each park boundary.

The second problem exists even when this first problem can be solved. While tourists from long distances can be excluded unless they pay the costs of park management, the exclusion of local users is more difficult. Therefore, monitoring and enforcing restrictions against competitive local uses of the unique resource is more difficult. Poaching within East Africa's game parks and timber harvesting within the boundaries of Southeast Asian natural reserves are examples.

A partial solution to this problem can often be obtained by establishing an interest in the park's tourist services within the local population. When some of the local population gain, as from employment in park concessions or by providing guide services, then local citizens have their own incentives to assist in the M&E of park boundaries and management, and their own incentives to discourage their neighbors' violations of the park boundaries. Even this solution, however, does not prevent all local trespass.

For those forest resources that are not unique and do not attract global tourists the most common non-consumptive users are members of the local community. Local institutions are generally better-suited to manage these resources and we observe many successfully protected village parks and forest sanctuaries around the world. The employees of local institutions have a better understanding of both the patterns of demand on these resources and the arrangements of their most appealing physical characteristics. Therefore, the management costs of a local institution will be lower than for a comparable level of management by a national authority. Nevertheless, these costs will still be positive and, since the exclusion of local users is difficult, the local community must bear these costs either as part of its community budget or as part of a commonly respected decision not to exploit the extractive resources within the park.

Box 6: Tourism and other forest-based recreation

In sum, the protection of those forest resources that are attractive for environmental tourism is a property rights problem, just as protecting the forest for each of the previous non-market valued uses was also a property rights problem. The two steps to addressing this problem are i) identifying the resource to be protected and ii) establishing the appropriate public institution for its management. For resources that attract global tourists, a national authority will generally be the most successful manager, but it will have to provide some local incentive for park management—or the park will suffer the trespass of local users with competing market-based values. For forest resources that only attract regional or local tourists, then regional or local institutions will be more successful at excluding competitive market-valued uses.

Specialized Local Products: Fuelwood, Forage and Fodder, Fruits and Nuts, Latex, etc.

These are non-timber forest products (NTFPs) that local residents extract from the forest, sometimes for domestic use and sometimes for sale in local markets. As extractive uses of the forest these NTFPs are often in competition with timber production and they are almost always in competition with other non-market forest values in locations where those values are important.

Production behavior with respect to NTFPs follows the market pattern of our figures 1-3, and these products are generally market-valued themselves—despite some assertions to the contrary. Local markets exist for most of these products and in most regions where they are consumed. The markets may be thin, and most households may collect for their own domestic consumption in preference to purchasing in the market. However, local markets generally do exist and whether local collectors choose to buy or sell instead of collecting for their own consumption is an economic decision. In fact, a few local residents do buy and a few do sell, and the number who participate in the market changes as the local prices for these products change.

Furthermore, the household decisions regarding these NTFPs are market-related even for households that neither buy them nor sell them. These households use their own labor to collect these resources and that labor is exchangeable for market-valued goods—sometimes as hired labor that earns a wage which can be used to purchase goods, sometimes as labor used in the domestic production of marketable agricultural products. Therefore, all households have incentives to apply their labor for collecting NTFPs until the marginal value products of that labor approximates the marginal value product of their labor in those other, marketable activities.

In sum, NTFPs do reflect market activity even when the local markets are thin, and a growing body of literature demonstrates this point; for example, for fuelwood, forage, and fodder in Nepal and India; for fuelwood in Ethiopia; and for general forest collection in Madagascar. [See Singh *et al.* (1986) for a review of the concepts, and Hyde and Kohlin (2000) for a survey of the empirical literature.]

The collection of NTFPs proceeds farther and farther into the open access natural forest and the act of collection degrades the open access lands closest to the village more and more—until some households find it less costly in terms of their labor opportunities to substitute other products (*e.g.*, kerosene for fuelwood) or other sources for the same product (*e.g.*, wood grown on their own agricultural lands). An increasing number of observations from poor rural areas around the world confirms this point too. Farm households plant and grow trees for their domestic use once the natural forest resources become sufficiently scarce. This pattern too is entirely consistent with the pattern of, first, extraction and, then, management illustrated with our three figures and observed for market forest activities like agricultural land and commercial timber.

In fact, the extractive collection of NTFPs is a major source of forest degradation and deforestation in some regions. We previously discussed the incentive for the poorest households (those with the lowest opportunity costs for their own labor) to venture farthest and remove the smallest and lowest quality material. These poor household collectors of NTFPs are often the primary source of forest degradation and deforestation. Many of the rural poor also live at the frontiers of development, where the institutions protecting property rights are least effective in restricting these activities.

Clearly, if the pursuit of NTFPs is a source of forest degradation and deforestation in general, then it is also a source of trespass into those forested areas that are set aside for carbon sequestration, for critical biological habitat, for watershed services, and for tourism. What can be done about it?

Foster *et al.* (1997), Bluffstone (1995), Amacher *et al.* (1999) have shown that providing alternative, higher wage, opportunities attracts workers away from those extractive NTFP activities and decreases the pressure on the forest. The first two papers suggested new agricultural and urban wage opportunities, but another possibility presents itself as well. Vesting local interest in the areas protected for non-market values like tourism and erosion control is a means of increasing the returns the local population obtains from these areas, and increasing their returns is comparable to increasing their labor opportunities for activities different from forest extraction, degradation, and deforestation.

Box 7: Specialized local products: fuelwood, forage and fodder, fruits and nuts, latex, etc.

In sum, the collection of NTFPs follows the pattern of market-based extractive forest activities—until the NTFPs in question become sufficiently scarce for local farmers to begin growing and managing their own NTFPs. Until this occurs, the collection of NTFPs is a competitive product within many areas that are protected for important non-market values. Improving the opportunities for the collectors of NTFPs, either through improved wages in agricultural or urban employment or from participation in the rewards from the protected area can attract labor away from NTFP collection, reduce competition between these joint products with protected areas, and help protect the non-market values of the forest.

Institutions and Infrastructure

We have referred to the importance of infrastructure and institutions several times over the course of this paper. Both can affect the competition between the market and non-market values of the forest and we will review both in this section.

The term infrastructure includes public utilities and public services like education, hospitals, and communication networks. The full collection of items identified with infrastructure has a significant and positive effect on rural economic development in general (*e.g.*, Antle 1983). Improved roads in particular have important effects on the general condition of natural forests and, therefore, on non-market forest products. They have an *indirect* effect through their general impact on overall regional development. That is, improved access to external markets for local agricultural products and local labor improves local employment opportunities and attracts some labor away from forest-based activities—including local timber extraction and the collection of NTFPs. If new roads only improve external access to the local community itself and not to the forest, then the new roads save mature natural forest, decrease the use of the degraded open access forest and, thereby, decrease conflict with all non-market forest products.

In terms of figures 1-3, the returns to agriculture increase, and so do the returns to agricultural inputs. The agricultural value gradient V_a becomes steeper, although its intercept with the horizontal axis remains unchanged. As some labor is attracted away from the forest, the forest value gradient's intersection with the horizontal axis shifts inward (left) and point D, the boundary of remaining natural forest, shifts left as well. The use of the natural forest declines for the second and third stages of forest development.⁸

However, many roads also improve forest access. These roads have a *direct* effect on forest development itself, extending commercial access farther into the forest, shifting the agricultural and forest value gradients further to the right, as in figure 4, and shifting points B (or B" in stage III), C, and D to the right. The degraded open access lands are extended and a larger area is deforested as the remaining natural forest becomes more accessible for agricultural conversion, timber extraction, and the removal of NTFPs. Carbon sequestration always suffers and the other non-market values; biodiversity, watershed services, and tourism; suffer wherever the locations of their special value become more accessible to the competitive extractive activities.

Box 8: Roads

The contrast between the indirect and direct effects of roads highlights the importance of road location, and also the importance of early identification for those sites that are high-valued for their biodiversity, watershed, and tourism services. New roads that are designed to avoid forest access as they approach rural communities can improve the conditions for overall regional development and, thereby, reduce pressure on the remaining natural forest (indirect effect). New roads that also improve forest access (direct effect) but avoid critical natural areas will extend extractive forest activities without damaging biodiversity, watershed services, or areas of great tourist appeal. Finally, new roads into the forest that are designed without consideration of the location of high-valued non-market forest resources can be responsible for declines in all important local forest resources, market and non-market.¹

Like roads, the institutional arrangements for local property rights also affect the competition between market and non-market values in many forested locations. Citizens of developed countries tend to think of property rights in terms of secure formal titles to land and other resources. However, Feder *et al.* (1988) used an example from Thailand to demonstrate that formal titles are insufficient protection unless the titles can be transferred easily as higher valued uses of the resource present themselves. On the other hand, Migot-Adholla *et al.* (1991) used examples from sub-Saharan Africa to show that formal titles are unnecessary where customary rights are sufficiently enforced by the local community.

Both points are important in forestry today, as many countries are finding that formal rights to forests, which tend to be the official responsibility of the forest ministry, are not easily

⁸ In the first stage of forest development, figure 1, all roads affecting agricultural development also affect the forest because agriculture extends out to the remaining natural forest in this early stage of frontier development.

enforced. Yet some local communities protect their forests even when those communities have few formal rights to these resources. In fact, these considerations provide the justification for most transfers of public forest to some form of local private (*e.g.*, China and Viet-Nam—Yin and Hyde 2001, Linde-Rahr 2002) or local community-based forest management (*e.g.*, Nepal, India, Philippines, Indonesia, Colombia, Zambia, Mexico—Dangi and Hyde 2001, Kant 1996, Hyde *et al.* 1997, Hyde *et al.* 2000, Hyde and Ferriera 2002, Mulenga and Hyde 1999, Asbjornsen pers. comm. 1999; respectively). The argument is that local users of the land and forest resources know those resources and the demands on them better than the officials of the forest ministry. Therefore, local users can manage the resources more efficiently, and they will manage more of the local resource sustainably. In terms of our figures, the property rights cost function C_r is lower, as in figure 5, more land is managed sustainably (points B or B' shift to the right), and the area of degraded forest declines (between B or B' and D).

These arguments and the shift to local management work well where the forest values at stake are local and they are shared by most of the community. Therefore, local management can improve long-term land management for agriculture, timber and NTFPs, and also for local non-market values like erosion control and local recreational forest use. However, local property rights and local management have their limits.

They are less successful where important groups of local citizens have competing demands for the forest—as in our previous example of the conflict between poor fuelwood collectors and better-off agricultural households affected by the eroding hillsides around Basantapur in Nepal [Dangi and Hyde 2001. Also see Kant's (1996) discussion of joint forest management in India.]

In addition, local management may be no more successful than management by the forest ministry where either the local property rights are incomplete or the general policy environment is unstable. Incomplete property rights are common in forest transfers as the ministries desire to maintain some restrictions over local decisions—but often succeed only in removing the incentives for local management (*e.g.*, the Philippines and Nepal—Hyde *et al.* 1997, Dangi and Hyde 2001). The general policy environment is more difficult to define, but any general civil action that causes rural inhabitants to be reluctant to make long-term decisions will have an unsustainable affect on forest management. Frequent and unpredictable government policy changes in China (Yin and Newman 1998), continual domestic military activity in Cambodia, and frequent bouts of inflation and unstable monetary policy in some Latin American countries are examples.

Finally, local management is never a successful substitute for regional or national management, or even international assistance when the values at stake are public values that are shared by the broader regional, national, or global community. Carbon sequestration, biodiversity, and tourism are all in the global interest. In these cases, broader institutional management is necessary to assure the broader interest, but local involvement is also necessary in order to insure local cooperation—instead of local trespass in search of local extractive products.

Numerous national parks in both developed and developing countries have successfully included local participation in the benefits of the park (*e.g.*, providing various tourist services and also employment in park management itself). Even in these cases some amount of trespass is inevitable. We can anticipate that creating a local interest in sequestering carbon or protecting biodiversity will be even more difficult.

Box 9: Property rights

The widespread modern discussion of some form of forest transfers from state agencies to local communities ('community forestry', 'joint forest management', 'public participation') has property rights at its core. What should be clear (but often is not) is that a) the institution that can manage best is the institution that is most affected by the values at risk. For global treasures, like unique habitats or high profile national parks, national or even global institutions will be appropriate. For local values, like erosion control on a small watershed, then local institutions will be more effective managers.

Conclusion

There are no market activities that compete with all non-market forest activities and there are no general policy instruments for the successful protection of all non-market uses of the forest. The conflicts between competing values vary depending on the stage of forest development—with agricultural land conversion, for example, more competitive with general sustainability of the natural forest in the earliest stage of development but market timber extraction and extractive non-timber forest products like fuelwood, forage, and fodder more competitive in later stages.

Moreover, the non-market forest values at risk also vary because most of them occur at selective and specialized sites. All non-market values may be under greater stress in developing countries than in developed countries simply because smaller forest ministry budgets for forest protection and relatively lower opportunity costs for rural labor make entry into the remaining natural forest easier and more likely in the poorest rural regions of developing countries. Under these conditions, the extraction of marketed forest products and also forest products consumed for domestic use are more likely and the concurrent destruction of non-market values is also more likely.

Partial solutions are all we can offer for the problem of protecting non-market forest values. Most non-market values are associated with specific sites of greater risk and greater value. If we can identify these, then we can design roads to control destructive access to them. For those non-market values that are local (many values obtained from watershed management and some classes of tourism), local management of the specialized sites can often be more successful than management by regional or central government authority. For some non-market values which are global (other classes of tourism) broader national institutions and even global assistance may be necessary but local participation in the economic gains from the resource will be necessary in order to limit trespass and conflict with local extractive resource users. In a fourth case, there are those global values which provide little associated immediate reward for

the poor rural inhabitants of many developing countries (carbon sequestration and biodiversity). In these cases, identification and uncompensated monitoring and enforcement of the boundaries of protected sites may be the only solution. Since most developing countries cannot afford the permanently high costs of this task, the developed countries which also benefit from the protection of these resources and which can afford to place greater value on them must make long-term commitments of assistance.

Finally, we must recognize that a reduction in rural poverty would improve conditions for all non-market forest values. However, this is the most difficult task. It is the general objective of all development activities. Reductions in poverty would mean improving the labor opportunities of the rural poor, and improved labor opportunities would attract them away from extractive activities in the forest.⁹ Furthermore, the most general global observations suggest that improving local economic welfare is eventually associated with expansions in local forest cover and increased protection of environmental values. Therefore, we anticipate that any broader policy or program that assists rural economic development will eventually have positive secondary effects on the forest and on many non-market forest values.

⁹ As a corollary, the opposite is also true. Policies that make poor people poorer cause some of them to migrate to the forested uplands and others who already live near the forest to increase their dependence on it. Trade policies and agricultural policies that favor the introduction of manufactured capital and, therefore, implicitly favor capital over labor, could be examples—but we are unaware of any examinations of these effects.

Appendix 1: Analytical Approaches and Tools

Three distinctions are fundamental for useful market and policy analyses involving forests. The first (A) is the requirement to identify the targeted class of trees or forests. The second and third have to do with whether (B) the question at hand has to do with national or regional markets or policies and a broad class or classes of forest, or whether (C) the question has to do with a single resource or activity like management of a single identifiable timberstand or forest park.

A. It is an important lesson of this paper that any analysis of policy affecting either the market or the non-market values we discussed must be clear about the link between the particular policy and the trees or forests or classes of trees or forests being affected. If the policy objective is to halt deforestation, then the policy is likely to affect at least two distinct classes of forests, managed forests and natural forests. If the policy objective is to sequester carbon, then we are interested in impacts on all trees, those in managed and natural forests and also those around homes, in fields, and along roadsides—none of which are included in most forest inventories but all of which occur in significant numbers and all of which sequester carbon. If the policy objective is protection of selective environments, then any analysis must focus on the selective forest areas that contain these environments. If all the selective areas are not known, as all critical habitats for example are not known, then analysis can still be selective to the category of forest that is most likely to contain the selected areas, particular classes of the remaining natural forest (not all forests) in the case of critical habitats.

B. When the policy interests are broadest, as for deforestation in general or for carbon sequestration, then it is also important to separate impacts on at least two classes of forests, managed and natural, because the various policy instruments have opposite effects on these forests. Our discussion of the three stages of forest development and figures 1-3 showed that policies like taxes and subsidies that have price effects that encourage managed forests are likely to discourage the retention of natural forests. Regulatory controls that rely on monitoring and enforcement by a government agency will be more successful on the more accessible managed forest where M&E will be less expensive. It may be difficult to obtain any favorable impact whatsoever on those natural forests where extractive activities can be undertaken by a very dispersed lot of the poorest local inhabitants.

Unfortunately, most economic analyses fail to make the distinction between impacts on managed and natural forest. However, we do have a good model in one very interesting paper describing the sources of change in forest cover for China's island province of Hainan (Zhang *et al.* 2000). The authors of this paper observed opposing price effects on the two classes of forests, and their observations were statistically significant. They also observed that a) general uncertainty caused local inhabitants to expand their harvests of both managed and natural forests but b) managed forests expanded and natural forest cover stabilized as economic growth occurred. That is, general economic growth had a positive spillover effect on forest cover—just as the environmental Kuznets curve would predict.

Another paper illustrates the critical impact of differences in access for any assessment of the broadest policy impacts. Krutilla *et al.* (2000) examined the pattern of deforestation up to

300 miles around 31 cities in eight developing countries. They found that differences in road density and natural terrain accounted for forty percent of the variation in forest stock, while unspecified differences in policies and local institutions accounted for only twenty percent of the variation.

The clear lesson is that the distinction between managed and natural forests and distinctions in access are as important empirically as we suggested in our conceptual discussion in the body of the paper. They must be incorporated into successful assessments of broad policy impacts on forests, and at least two papers have shown us how to do that.

C. When the policy interests are narrower, or when the values in question originate from a more selective segment of forest, then meaningful analyses themselves must be more geographically focused on that selective segment of forest.

C1. Standard benefit-cost analysis is designed for precisely such analyses—in straightforward cases of one output or competing outputs with no joint products.

C2. The applied analysis of cases with multiple products was developed for the examination of multiple purpose river projects (Krutilla 1957. Also see Hyde 1980 for a forestry application.). The procedure features the separation of project costs that affect only one input from those that are common to multiple inputs. Then

$$\begin{aligned} MB_i &\geq MC_i \quad \forall i \quad \text{and} \\ \Sigma_i (B_i - C_i) &\geq C_c \end{aligned}$$

where MB and MC are marginal benefits and marginal costs, the i are each of the multiple outputs, B and C are total benefits and total separable costs identified with each individual output, and C_c are the common costs.

In words, joint production or multiple use is an efficient activity for any product whose marginal benefit exceeds its marginal costs, but only if the excess of its total benefits over its total costs plus the excess of total benefits over total costs for all other jointly produced goods exceeds the costs that are common to their joint management. For example, when timber and recreation are produced together on the same site, the marginal revenues from timber must cover the marginal costs of silvicultural treatments and the marginal recreation benefits must cover the marginal costs of picnic shelters and tables and other recreation services. Any excess of timber revenues over cost and recreation benefits over costs must together be sufficient to cover the costs of roads and forest manager salaries that are common inputs to both products.

C3. Finally, when the policy interest focuses on the regional impacts of an activity like a park and tourists, or the combined impacts of a park and also extractive forest products, then “Harberger” general equilibrium models are appropriate. These models specify the capital, labor, and natural resources inputs used in, say, park and timber production sectors, as well as in the “all other” sector that sums activity for the rest of the local economy. These models also specify the degree of substitution that occurs between inputs used in each of these three sectors as well as between the sectors, and also the flows of inputs and outputs to and from the external

world. Specifying these flows and their changes with time and prices is critical for projects as long-lasting as those involving trees and forests (Harberger 19 . See Daniels *et al.* 1991 for a forestry application.).

Appendix 2: Terms of Reference

Monday, 19 November 2001

Policy Instruments and Institutional Arrangements for Non-commodity Outputs: Current Status and Effort

1. Context

The influences of other sectoral policies on the development of the forestry sector have been recognized for many years. One of the basic principles of the Tropical Forests Action Programme in 1985, and later on, National Forest Programmes, was a holistic and intersectoral approach. The Forest Principles agreed upon at UNCED in 1992, called for intersectoral means of dealing with pressures and demands imposed on forest ecosystems and resources from influencing policies and factors outside the forest sector. Discussions on the causes of deforestation and forest degradation in the context of the works of the Intergovernmental Forum on Forests (IFF) and currently the United Nations Forum on Forests (UNFF), have also referred to external influences.

Considering the increasing interest and awareness of the influences of external policies on the development of the forestry sector at the global, national or local levels, and the lack of formal and systematic information on these policies or their impacts, and the need for increased intersectoral coordination, the FAO Forestry Department decided to include in its Medium Term Plan (2002-2007) the Major Output “Strengthened cross-sectoral linkages¹⁰ between forestry policies and other national policies”, with a view to:

- improving understanding among government institutions/staff and public of the relationships and impacts of different sectoral policies,
- improving formulation/implementation of forestry policies and plans,
- improving institutional linkages/partnerships among related sectors,
- developing mechanisms to evaluate externalities/internalities of sectoral policies.

Major expected outputs of this effort are:

¹⁰ Cross-sectoral linkages are defined as impacts of external policies on forestry and vice-versa. Sustainable forestry could be defined in terms of 1. the conservation of biological diversity, 2. maintenance of ecosystem condition and productivity, 3. conservation of soil and water, 4. maintenance of global ecological cycles, 5. provision of multiple benefits, 6. responsibility to forest users and dwellers (long term socio-economic benefits), 7. legal, institutional and economic framework for conservation and sustainable management.

- production of preliminary background and conceptual papers in 2001-2002,
- preparation of country case studies in 2001-2002,
- organization in mid 2002 of an expert meeting to discuss main findings and conclusions of background paper and country case studies,
- production of a FAO Forestry Paper on the subject in 2003.

The FAO Forestry Policy and Institutions Branch (FONP) has commissioned in 2000-01 the preparation of a background paper on Cross-sectoral Linkages in Forestry to review available information and identify research needs. An intermediate output is the production of a catalogue of examples of cross-sectoral policy impacts from within and outside FAO. It is proposed to prepare in 2001-2002, a limited number of country case studies. The purpose of these case studies will be to focus on specific regional or local ecological and socioeconomic context. Concept/review papers will also be prepared to further define the analytical framework, explore the potential use for policy analysis of the Integrated System of Environmental and Economic Accounting (SEEA) and to review the state of the art knowledge on policy and institutions measures to promote non-commodity outputs.

The present consultancy is concerned with the review of available information and experience on policy instruments and institutional mechanisms in relation to non-commodity outputs in forestry.

2. Mandate

Under the overall guidance of the Director of FAO Forestry Policy and Planning Division, the supervision of the Chief of FAO Forestry Policy and Institutions Branch and the direct supervision of the responsible technical monitoring team, the partner institution or consultant will:

- review the state of the art knowledge on policy instruments and institutional arrangements for the promotion of positive non-commodity outputs and the mitigation of negative externalities, in general and in forestry in particular; the review could draw inter alia from the work of the OECD on multifunctionality in particular for example the papers presented at the OECD Workshop on Multifunctionality, Paris, 2-3 July 2001, on institutional options¹¹ or non-government approaches¹² to internalize externalities (see <http://www1.oecd.org/agr/mf/index.htm>);
- discuss the advantages or disadvantages of these policy instruments and institutional arrangements as (potentially) applied in forestry;

¹¹ Paper titled "Synthesis and Evaluation of the Evidence from Country Case Studies Concerning Different Arrangements and Institutional Options for Providing Non-commodity Outputs" by A.D. Meister, Prof. Resource and Environmental Economics, Dept. of Applied and International Economics, Massey University, Palmerston North, New Zealand.

¹² Paper titled "Non-government Approaches to the Provision of Non-Commodity Agricultural Outputs: A Transaction-Cost Perspective" by Ray Challen, Agriculture and Resource Economics, Univ. of Western Australia, Nedlands, Western Australia.

- identify information and analytical gaps and make recommendations for future action;
- submit a preliminary draft report with summary findings, conclusions and recommendations on future actions;
- prepare a final draft report on the basis of comments received.

The consultant is also requested:

- to submit a detailed outline of the report at the beginning of the consultancy (during the first month) for comments by the technical monitoring team;
- to submit from time to time draft chapters of the report as they are becoming available with a view to facilitating an on-going technical monitoring dialogue;
- to submit a final draft report and subsequently a final report.

3. Profile of Author

Economist or Policy analyst with more than ten years of experience in policy analysis and planning at national and sectoral levels, as well as in policy instruments and institutional arrangements for non-commodity outputs in particular with reference to forestry

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Figure 1: A New Forest Frontier, Stage I

Increasing land value

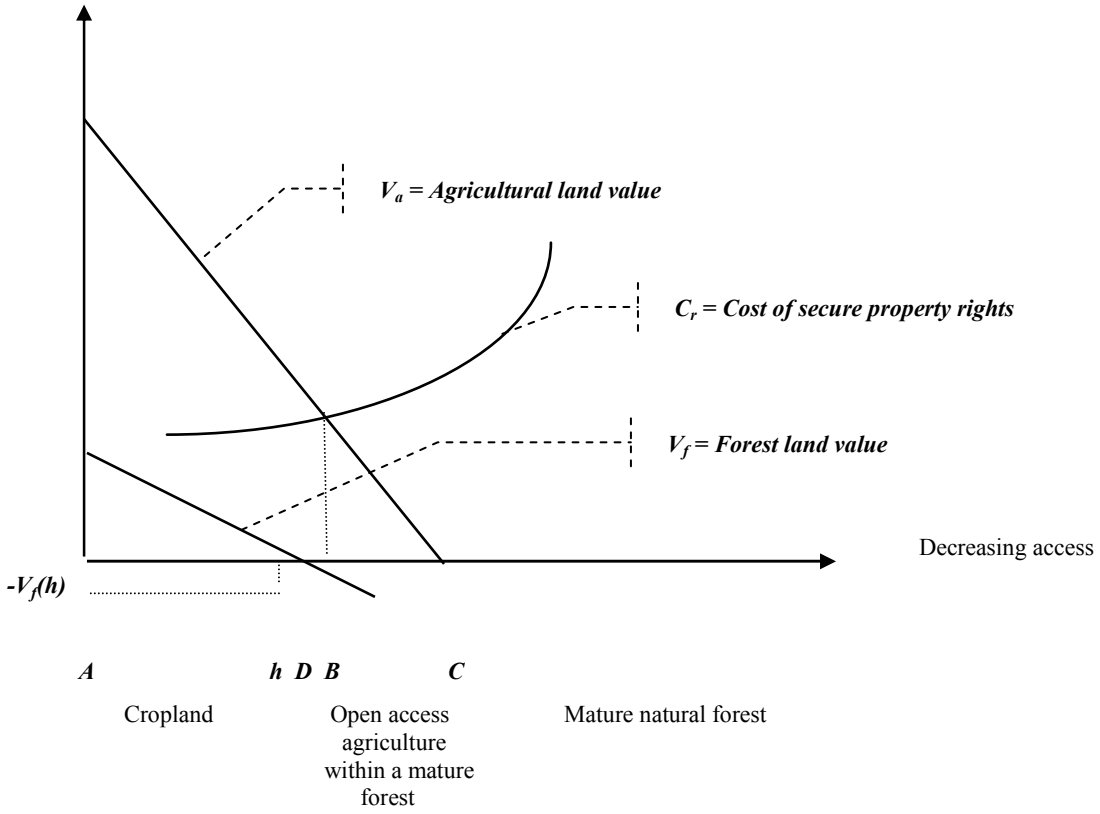
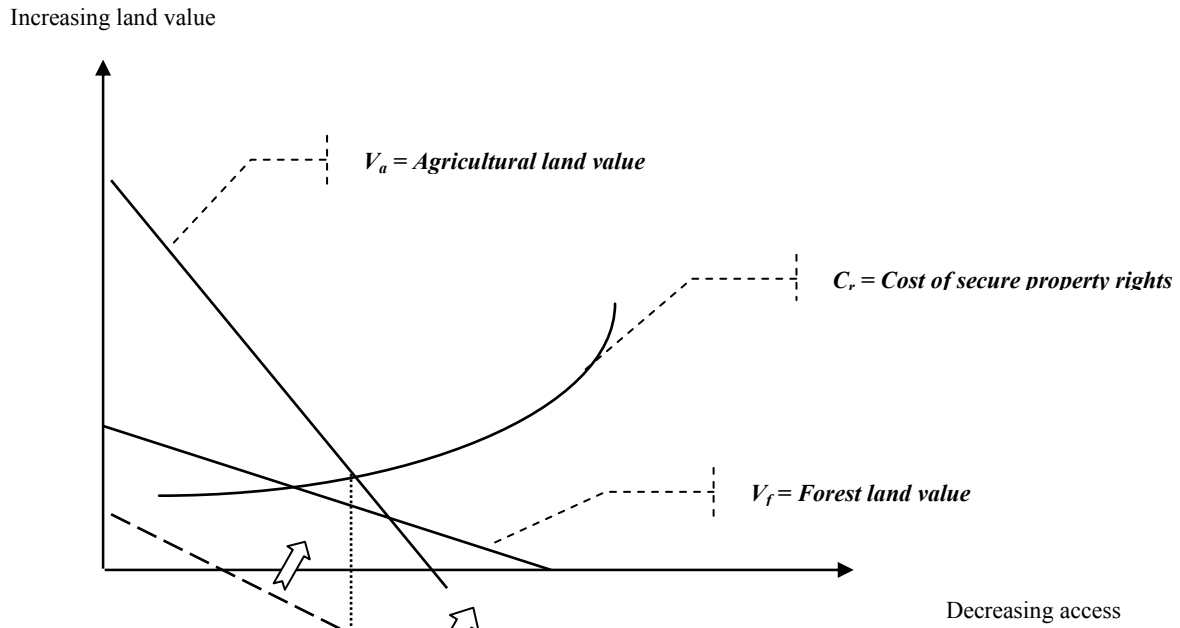


Figure 2: A Developing Frontier, Stage II

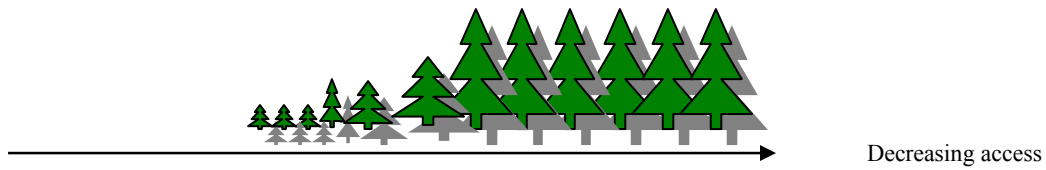


A *B* *C* *D*

Cropland,
sustainable
agricultural
production

Open access,
agriculture and
degraded forest

Mature natural forest



A *B* *C* *D*

Cropland,
Sustainable
agricultural
production

Open access,
agriculture and
degraded forest

Mature natural forest

Figure 3: A Mature Forest Frontier, Stage III

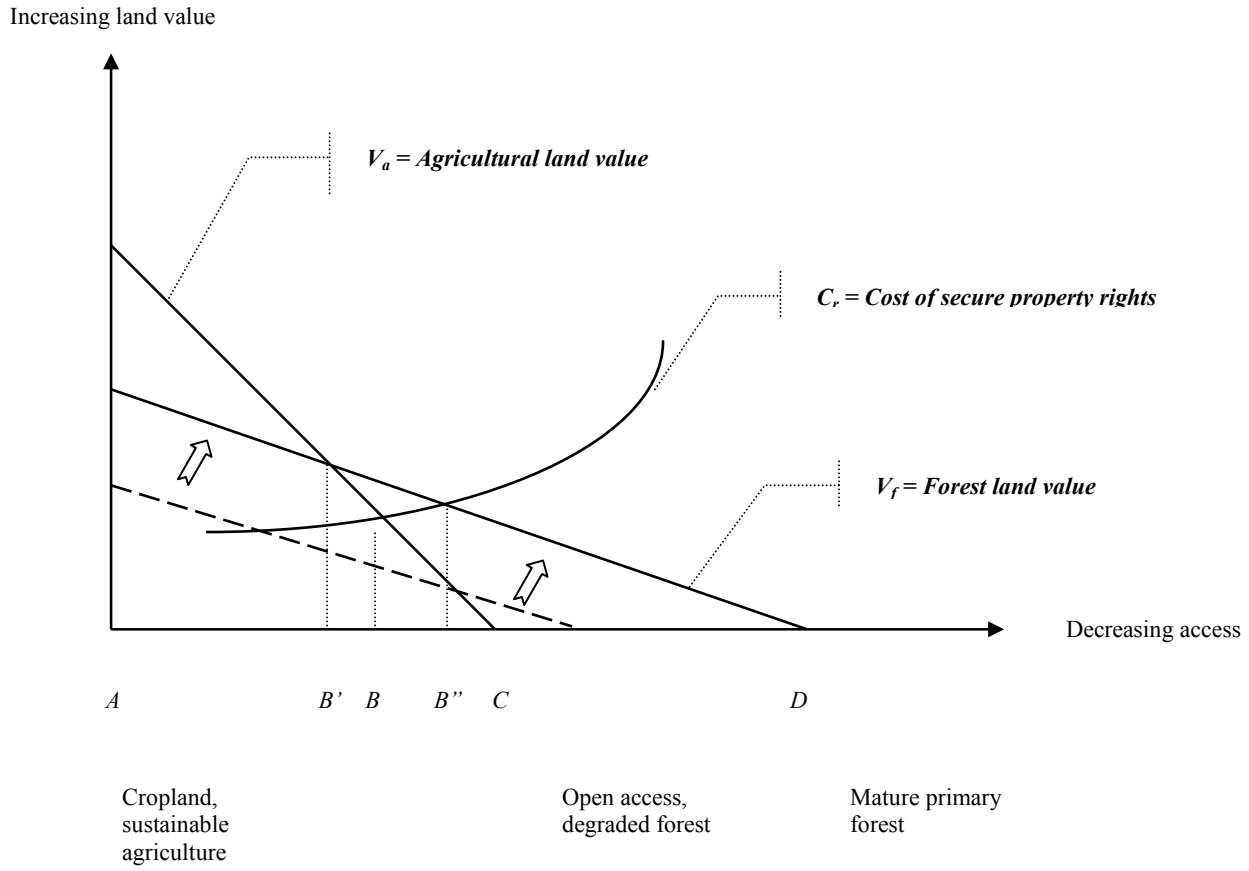


Figure 4: Extending the road system (the example is for a region in the second stage of forest development)

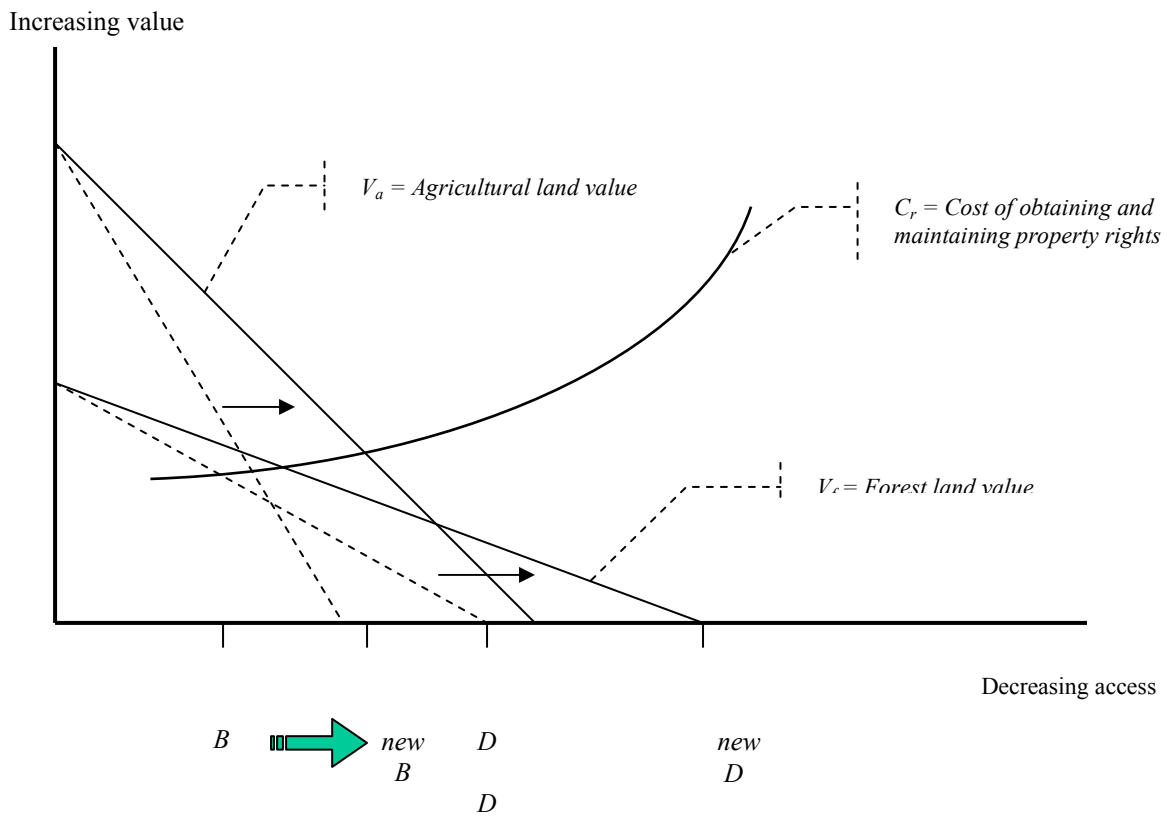


Figure 5: Transferring property rights from a central agency to a local institution (the example is for a region in the third stage of forest development III)

