Financing Forest Investments in Latin America: The Issue of Incentives

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Abstract

The areas covered by forests in Latin America and the Caribbean have decreased considerably in the last decades. Deforestation rates have reached levels of 0.77 percent per year, and forest investments have been low due to past macroeconomic instability and the high opportunity cost of land caused by, among other things, agricultural subsidies. Improvements in the general economic environment and institutional reforms are crucial to increase private forest investments without the support of subsidies.

Capital market imperfections in Latin America and the long period of maturity for forest investments have resulted in high capital cost and lack of liquidity for forest management projects. The cost of capital may be reduced by curtailing the cost of debt, for example, through co-financing arrangements. Investment risk may be diminished through indirect incentives such as protection against forest fires, and generation of information on technologies and markets. The implementation of appropriate credit programs that take into account the long gestation period would help avoid liquidity limitations.

The use of incentives may be justified as compensation to the forest landowner due to possible positive environmental externalities. Land use for forestry is preferred if the social opportunity cost in alternative land use (usually agriculture) is smaller than or equal to the marginal value of land in forestry production minus the associated costs of conversion.

If incentives are used they should be targeted and cost-effective; producers should be offered just enough money to cover the marginal cost of adopting forested land uses. Rent-seeking behaviour should be minimized, and the maximum number of hectares should be forested within the available budgets. This may be achieved by auctioning at least part of the possible incentives. Incentives should be temporary to prevent any relationship of dependency between the beneficiary and the government.

Incentive policies must take into account cultural and social factors. They should be subject to consultations with relevant groups. Also, incentive policies must be flexible, so they should preferably be established through decrees (not laws), or administrative and budgetary measures that can be adapted to changing situations and directed locally if necessary.

Cost recovery mechanisms for incentive schemes should ideally be indirect, based on taxes and fees. Direct recovery through benefit sharing mechanisms (timber harvest, etc.) may not be feasible due to the long gestation periods of forestation investments. Changing public sector administrations and regulations may pose a risk to private investors and diminish their willingness to establish long-term investment partnerships with the government.

Introduction

Almost all Latin American countries are providing direct or indirect support for private forestry investments. The justification of this practice varies from country to country. The proliferation of the use of direct financial incentives results from the success of experiences such as Chile's where forest plantations helped stimulate vigorous growth in the forest industry. This has raised the value of forest exports to the level of agricultural exports. In other countries, incentives were justified on social or environmental grounds. However, there is a strong counter argument that improving other policies that positively affect investment decisions and the profitability of forestry (due to higher demand for forest products and services) may make some of the incentives unnecessary. The controversy and uncertainty surrounding the application of incentives in forestry led the Inter-American Development Bank (IDB) to organize a seminar in early 1995 on this topic. This report expands on the results of the workshop and its proceedings (IDB 1995).

The need to sustain the world's forests and to manage them for future generations is based on an appreciation of the growing demands for their goods and services. The worldwide projections of the FAO indicate that between now and the year 2010, the total land under crops will increase to 850 million hectares, with most new expansion taking place in Latin America and sub-Saharan Africa. A sizeable amount of this land is currently forested and will be cleared for agriculture (FAO 1993).

Between 1990 and 2010, consumption of wood products is expected to continue growing at annual rates ranging from 1.2 percent for fuelwood and charcoal to 3 percent for paper and 4.3 percent for panel products. Demand for nonwood forest products essential for rural societies (such as medicinal plants) recreation, and environmental benefits will also continue to grow. Forest gene pools will remain of crucial importance especially for agriculture and medicine. These trends indicate that forests will experience increasing pressures for multiple and often conflicting uses. It will be necessary to protect and manage existing forests and create additional forest resources to meet growing demand (UN 1995).

The Forest Situation in Latin America

Latin America and the Caribbean have about one quarter of the world's existing forests. Forests cover about 970 million hectares, of which 115 million are in Central America, Mexico and the Caribbean, and 855 million are in South America. Approximately 52 million hectares of temperate forests are situated in Argentina, Chile and Uruguay and in high elevation areas of the tropical countries of the region (World Resources Institute 1994). The FAO Forest Resource Assessment, estimates a total forest area of 918 million ha. and an annual deforestation rate of 0.75% for Latin America and the Caribbean.

Table 1. Forest Area and Deforestation Rate

Subregion	Natural forested area (1,000 ha.)	Area deforested annually (1,000 ha.)	Annual deforestation as % of total natural forested area
Central America and Mexico	68000	1112	1.63%
Caribbean a/	47000	122	0.26%
South America	854700	6244	0.73%
Total	969900	7478	0.77%

a/ Includes Suriname, Guyana and French Guiana.
Source: World Resources Institute (1994)

The rate of deforestation is high in the region: about 7.5 million hectares (0.77 percent) of forest disappear yearly (see Table 1). The highest deforestation rate, 1.6 percent is observed in Central America and Mexico. This rate is higher than that of continental Southeast Asia (1.5 percent) which has the world's second highest regional deforestation rate (World Resources Institute 1994). Annual biomass losses due to deforestation amount to approximately 40 percent of all developing country biomass damages (FAO, 1995a).

Estimates of the area in plantation forests in the region vary from 8 to 11.1 million hectares.[1] Thus, the total planted area corresponds to approximately only 1% of the natural forest area, or the deforestation rate of a single year in the region. While most of the fuelwood, nonwood products and environmental benefits come from natural forests, an ever growing portion of industrial timber is produced in plantations (FAO 1995b).

The largest plantations are in Brazil with some 7 million hectares, 4.1 million of which are industrial man-made forests. Chile has 1.6 million hectares of reforested areas, practically all for industrial purposes; Argentina has 0.7 million hectares; Venezuela, 0.5 million hectares; Cuba, 0.4 million hectares; Peru, 0.3 million hectares; and Colombia, Mexico and Uruguay have about 0.2 million hectares each. In each of the other countries of Latin America and the Caribbean the reforested area is less than 100,000 hectares. The estimates of the current yearly forestation rate vary

[1] According to the FAO (1995 a) plantations cover some 8 million hectares in tropical Latin America and the Caribbean, while the World Resources Institute (WRI 1994) estimates there are 8.6 million hectares of forest plantations in the region. The temperate zone of the region has some 2.5 million hectares of plantations (FAO 1995a).

from 386,000 to 520,000 hectares (FAO 1995a; Haltia 1995; WRI 1994).

Practically all the plantations have been established on abandoned agricultural lands where erosion is prevalent. The overwhelming majority has been established with fast growing exotic species in the *Eucalyptus* and *Pinus* genera, although research is also yielding fast growing native species that are increasingly used in plantations. Only in exceptional cases has prime agricultural soil or land with existing natural forest been used for tree plantations. This has been the case lately in Chile where industrial plantations are highly profitable and encouraged by government incentives.

Although the majority of existing plantations are industrial in nature, agroforestry and social forestry (in which communities grow trees for their own nonproduction needs, e.g., firewood) are widely practiced in the region. These plantations have yielded important benefits to local communities and improved environmental conditions. For example, about half of the targeted 774,600 hectares of plantations financed in the past 15 years by the IDB have been financed for community forestry (see Keipi 1995). The IDB support for industrial plantations was channeled primarily through three large programs.

The Rationale of Government Incentives for Forestry

A Brief History of Forest Development Theories

Substantial change has occurred over time in the way the forest sector and forest investments are viewed in an economy. To provide a perspective on this changing framework and a background for the discussion of forest incentives, the following section briefly reviews the development economics of forestry.

From the viewpoint of development economics, the rationale for forest investments (and incentives) can be traced to Keynesian ideas. While Keynesians stressed the task of expansionary fiscal policy in combating unemployment, early development economists argued for some form of public investment planning. Investments would mobilize the underemployed for the purpose of industrialization, and should be allocated in accordance with a pattern of balanced growth, i.e., several sectors should be stimulated by investments simultaneously to retain the balance between supply and demand and to reach the highest rate of economic growth (Scitovsky 1954).

Hirschman (1958) agreed that investments were the right way to stimulate the economy, but he questioned how they should be allocated. What was needed were "pacing devices" and "pressure mechanisms." Hirschman argued for unbalanced growth, i.e., concentrating investments in only one or a few sectors. This would guarantee the use of economies of scale (Streeten 1959), while intermediate linkages between sectors would ensure that investments would spread throughout the economy.

The theory of unbalanced growth as introduced by Hirschman (1958) rests on the concept of a "key sector." Concentrating investments in a key sector with high backward and forward linkages would result in the highest possible stimulus to the economy through a multiplier effect. It was initially Westoby (1962) who suggested that the forest sector would be an especially appealing vehicle for industrialization and development. The forward linkages of forestry may be considerable if the sector integrates vertically to processing industries such as pulp and paper and other high-value products.[2]

Westoby (1978) also made a speech at the Eighth World Forestry Congress in Jakarta, where he expressed frustration about the poor impact that foreign aid was having on the forest sector and economic development. His original optimism, which was based on linkages and other positive effects of the forest sector, had now turned to a pessimism fed by unsuccessful forest projects in the developing world during the previous two decades.

"[F]orestry projects had little or nothing to do with…a significant and many-sided contribution to overall economic and social development. It had everything to do with the fact that many of the rich, industrialized countries needed, and needed badly, new wood material resources; and their forest industries, their equipment manufacturers, together with miscellaneous agents and operators, scented golden opportunities for profit in those underdeveloped countries with forest resources. This was the dominant consideration which determined the location, shape and direction of forestry and forest industry development projects" (Westoby 1978).

Instead of large export oriented pulp and paper mill projects, Westoby was now suggesting the development of a smaller scale agriculture-supportive

[2] From the beginning, Westoby´s linkage approach was closely related to staple theory. This theory emphasizes the export role of products based on natural resources in the economic growth of countries that are abundant in resources but lack capital.

forestry which would not exclude forest industries. The main target of forest-based development would be to respond to the needs of the local population and to support the rural economy. Small rural industries would be an integral part of agriculture-supportive forestry. Examples of these industries are: fuelwood, charcoal, poles, stakes, fencing, building materials and simple furniture; that is, forest products that would satisfy most basic, domestic demand (see for example, Arnold 1992).

Douglas (1983) challenges Westoby's claim that rich countries are better off than developing countries because forest product exports flow from the latter to former. According to Douglas (1983):

"Better control of natural resources in wood-rich lesser developed countries (LDCs) would undoubtedly be to their economic advantage, and there are good theoretical and practical reasons for LDCs to trade in forest products with other countries to mutual advantage. Our argument is merely that this should be kept in some perspective. Wood-short LDC's, in particular, should pay most attention to their own specific needs when determining resources policy."

Thus, Douglas does not share Westoby's doubts about the mutual benefits of the use of forest resources, and takes the conventional development economics position relying on the results of international trade theory (cf. Riihinen 1981).

Nevertheless, since the publication of Westoby's paper in 1978, rural development issues have played a central role when considering strategies for forest-based development. For example, the principle of participation has been applied in the Tropical Forestry Action Plan concept by the FAO. While Westoby's (1962) approach in practice often implied top-down planning, today it is suggested that top-down should be merged with a bottom-up approach emphasizing the goals of rural communities while also taking into account national targets (Simula 1991).

Vincent and Binkley (1992) find economic and sector-specific policy failures a main reason for the problems experienced in forest sector management: "…if the right policies are followed, forest-based industrialization can provide an important source of employment and income and can promote conservation by enabling forests to outcompete alternative land uses." Correct policies can only be formulated based on well-defined principles of efficiency that should serve as principal guidance in organizing the forest sector. The emphasis in Vincent and Binkley (1992) is no longer on the question of whether the forest sector can promote development, but how the forest sector should be organized so that potential inefficiencies are eliminated. On the other hand, according to the authors, macroeconomic stability is of crucial importance for forest-based development due to the relatively long time period required for investments to reach maturity. Therefore, the most important role of government is to create stable conditions where market driven forest-based development can take place.

The market system should determine prices for forest products. Competitive pricing would eliminate inefficiencies in processing industries, signal the optimal size of forest stocks and result in the appropriate allocation of raw materials and products to exports and domestic industries. The development of downstream industries should be guided by the principle of comparative advantage, and therefore government tasks would include promoting free trade. A successful forest policy formulation should also take into consideration the environmental externalities that markets may not incorporate.

Prevailing Reasons for the Use of Incentives

On the basis of the above historical review it is interesting to notice changes in investment practices and the application of incentives. The prevailing systems of incentives have their rationale in the economic philosophies reviewed above. Some of the Latin American incentive systems were designed in the 1960s and 1970s, while others are more recent. Due to changes in rationale and different histories of incentive systems in different countries, the motiva-

tion for afforestation subsidies is fairly heterogenous. The following is a list of reasons given for the establishment of subsidies (Beattie 1995, McGaughey and Gregersen 1988, Southgate 1995):

i. modifying the social bias against forestry investments among farmers who have traditionally considered forests enemies of agricultural development;

ii. increasing the rates of return on investments that may have relatively low private profitability but offer externality benefits for society as a whole;

iii. reducing the risk and uncertainty that arise particularly from the long return time of afforestation investments;

iv. reducing the cash flow problems that arise during the often long periods required to recover planting and operational costs through harvest income;

v. establishment of a critical mass of plantations needed for the initial building of competitive forest industries; or

vi. acceleration ("jump starting") of the initial development of plantations for industrial or social forestry purposes.

Traditional development arguments for subsidies have included import substitution or promoting exportable production. However, the validity of this rationale depends on the competitive advantage of the forest sector with respect to forest production in other countries, or relative to activities in other sectors in the same country. On the other hand, a social justification for plantation subsidies can be made on the basis of employment generation and the reduction of rural poverty. But this raises obvious questions about the labor intensity of plantations versus alternative investments in rural areas. Therefore, an analysis of the effectiveness of forest investments compared to other sectors has to be carried out.

Forest investments may generate important environmental externalities. Government incentives for conversion of land to forest uses may be considered as a payment for the production of public environmental benefits. They compensate the investor for revenue forgone by not engaging in a more lucrative alternate private land use. However, guidance may be needed to make ecologically appropriate forest investments. For example, mixed plantations may be preferred to monocultures in some areas, while in others it may not matter.

It is possible to consider forest incentives as a self-financing investment in the sense that the income generated over time may greatly exceed the subsidy, and if that income is taxed, a government may, at least partly, recover its outlays. In Chile the subsidies have reportedly been profitable to the State (Beattie 1995).

The issue of incentives and government subsidies is highly controversial. Vaughan (1995) quotes two different views. The "old" conventional wisdom is reflected in the study of McGaughey and Gregersen (1988):

"Debate over the various arguments about subsidies for forestry investments is not as critical as the recognition that subsidization is already widely accepted and practiced by Latin American governments. Subsidies have become a politically legitimate and accepted tool for promoting investment in forestry and forest industries."

The "new" conventional wisdom does not advocate subsidies as corrective measures to offset distortions existing elsewhere in the economy; rather it proposes the direct elimination of those distortions. Stewart and Gibson (1995) make a strong case, recommending: (i) the removal of export bans on forest products, and tariff and nontariff barriers to international trade in all products; (ii) the elimination of export subsidies; and (iii) the removal of all forest product consumption taxes other than the general sales tax. Stewart and Gibson argue that once these reforms are in place, direct incentives for forestry are not necessary; therefore, subsidy programs for

afforestation and forest management should be eliminated. In its study on the use of environmental funds, the OECD (1995) concludes that financing through subsidies cannot act as a substitute for proper policies and institutional framework.

Promotion of Forest Plantations

The roles of the public and private sector have undergone major changes in Latin America during recent years. Many countries, such as Brazil and Uruguay, have eliminated or reduced the use of forestry subsidies. This transition has been part of a general economic policy, rather than being specific to forestry. The key is to identify conditions in which forest management or tree plantation investments may prosper. Constantino (1995) cites studies that mention the following elements for success in plantations that have been key to forest land development in Chile:

i. political and macroeconomic stability;

ii. trade liberalization and open foreign investment;

iii. stable property rights for land with and without trees;

iv. credible government with adequate institutional capacity to enforce laws and administer possible incentive schemes; and

v. good natural growing conditions, availability of proper technologies and basic infrastructure (roads, electricity, ports, etc.) to support investment decisions.

In the cases of Brazil and Chile, the availability of adequate incentives was a minor factor contributing to forest industry growth once a critical initial mass of plantations was established (Beattie 1995). For example, Wunder (1994) claims that subsidies had only a secondary impact in promoting plantations in Chile. Factors such as low production costs and a favorable general economic environment have been more important. Today, many Chilean forest companies choose not to access incentives in order to avoid major government controls related to long-term tying of the land to forestry and restrictions on the management and harvesting of the plantations. Similarly, Brazil, which has been using incentives longer than Chile, has discontinued much of its forest incentive program.

Yet, in other countries new subsidies are being proposed. For example, in Colombia, Ecuador and Paraguay, the Chilean case has been taken as a model, although the justification for the use of incentives may be different. In Colombia the rationale has been largely environmental. In Ecuador the traditional subsidy arguments prevail, as far as getting the wood products sector off the ground, generating jobs and increasing forest products exports. In Paraguay the incentives are a response to a high deforestation rate and the interest in industrial development. However, a lack of comparative advantage may limit the effectiveness of the government incentive programs in these countries (see Southgate 1995). On the other hand, subsidies may not be necessary if the activity is already financially attractive or if policy measures other than financial incentives are more effective in promoting afforestation.

Private and Public Benefits

Opportunity Cost of Land

This section reviews the factors that critically affect forest investment decisions from the private and public decisionmakers' point of view. The owner of forest lands can expect financial returns from future sales of timber, fruits, latex and other marketable products. The projected profitability, the risks involved, the opportunity costs of land in other uses and the availability of financing are the most important factors affecting the investment decision. In Latin America, the predominant alternative land use to forestry is cattle ranching. Lack of liquidity during the long gestation period for forest plantations is a major disadvantage compared to cattle ranching.

When considering forest investments, an answer has to be found to the question of optimal land use. Suppose a country faces the problem of whether to convert agricultural land to forestry use or to continue with agriculture. The welfare of the country is now assumed to be a function of market and non-market benefits from agricultural and forestry land uses. The country aims at maximizing welfare taking into consideration that agricultural and forestry land uses are inversely related; that is, increases in afforestation imply smaller areas for agricultural production. However, adjustments in world market prices could change the relative private profitability of agriculture and forestry.

Solving the welfare maximization problem yields a useful cost-benefit rule for land conversion; namely, that it makes sense to convert agricultural land to forestry use if the social opportunity cost of agricultural land is smaller than or equal to the marginal value of land in forestry production minus the associated costs of conversion. *Forestation is justified if the discounted net benefits exceed the discounted net benefits of the next best use of land.*

Cost of Capital and Risk

Capital market imperfections and high rates of inflation in Latin America have depressed investments in forestry in the past. Inflation rates reached 1000 percent in the 1980s in Argentina and Brazil, 100 percent in Mexico and 25 percent in Chile and Colombia. High inflation has increased the borrow-lend interest differential (Fernández 1995) as expected inflation has been embodied in the expected value of monetary assets. Structural adjustments in the region slowed down inflation to the following rates in 1995: Argentina, 3.4 percent; Brazil, 84.4 percent; Mexico, 35 perecent; Chile, 8.2 percent; and Colombia, 21 percent. Nevertheless real interest rates have remained relatively high in many countries (IDB 1996).

Capital market imperfections in Latin America have been partly due to government intervention and the regulation of capital markets. As a result, capital market liberalization has been an important policy in recent Latin American economic reforms. For example, in Chile, several restrictions have been removed from capital flows, including reserve requirements imposed on external borrowing and regulations on the overseas issues of stocks and bonds made by Chilean companies. Access to the foreign exchange market was improved by allowing investors to obtain and pay back foreign debt, to make investments abroad, and to purchase hard currency for portfolio management (Eyzaguirre 1992). In Colombia, restrictions on foreign investments and profit remittance have been largely eliminated and the private sector has been allowed to borrow from abroad (Martinez 1992). Argentina and Mexico have also adopted fairly liberal policies especially for

attracting foreign capital. Brazil, however, has not yet moved toward a comprehensive approach in deregulating its capital account (Fernandez 1995). In general, these developments also suggest that future forest investments in Latin America are likely to be less hampered by lack of capital (Scott & Litchfield 1994). Although the struggle against inflation is likely to continue, there is no doubt that financial reforms have already decreased inflation and improved the availability of capital (see Bulmer-Thomas 1991, 1992).

Forestry investments with a long gestation period are especially vulnerable to high real interest rates. The smaller the cost of capital, the greater would be the private profitability of an investment. The cost of capital of a forest investment can be reduced by lowering the cost of debt or risks. Cost of debt can be decreased by eliminating part of the debt (for example, through co-financing without getting into debt). Other strategies may include, for example, implementing suitable tax regimes that decrease the cost of debt through tax breaks or credits. The cost of capital can also be reduced by minimizing systemic risk. The systemic risk, or nondiversifiable risk, is measured by the so-called "beta value" and is affected by macroeconomic factors such as the rate of national economic growth and the volatility of exchange rates. The beta value is also increased by such forestry factors as the probability of forest fires. The beta value of forest investments can be reduced by creating stable political and macroeconomic conditions to which forest investments, in particular, are sensitive due to their long-term nature. For example, establishing and securing property rights reduces systemic risk (the current existence of property rights in Chile has been mentioned as a major driving force for forest investments while lack of property rights has been blamed for stagnation in the forest sector of Costa Rica). Finally, the availability of extension services and technical assistance can also improve information and reduce risk.

Liquidity

The long gestation period of forest investments also affects liquidity. In principle, a forest owner with a current need for cash might sell the property outright, liquidate the timber at its current commercial value, or borrow from capital markets using the forest property as collateral.

Each of the alternatives are optimal only under special conditions. The first option is optimal if the value of the asset is set equal to discounted future net cash flow. The second option is only optimal if the rate of growth of the value of the forest stock is equal to the market rate of interest, i.e., trees have reached financial maturity. Additionally, borrowing capital (option 3) is difficult in most Latin American countries, especially if the stand of trees is of marginally marketable size. Thus, for a young forest, practically the only feasible liquidation option is to sell the land.

In terms of liquidity, forest investments only become comparable to other investment opportunities if an instrument is introduced that allows timber revenue to be cashed out before the end of the rotation period. For example, Rinehart (1992) has suggested a forest loan program based on an expectation of the future value of the forest (unlike a conventional loan which is based on an estimate of current value). Such a loan would probably be considered nonconventional and a guarantor may be required to ensure a secondary market for the loan. For administration of such a credit line, availability of a service for forest valuations and forest management would be crucial.

Empirical Analysis of Financial Feasibility

This section includes simple empirical case studies that compare the profitability of forest investments to agriculture (i.e., cattle ranching). Profitability is measured by net present value over various discount rates. Results are presented in Table 2 for Brazil, Chile and Costa Rica.

Assumptions and Data

i. Cattle ranching is considered the best alternative land use. (Unused, deforested or degraded agricultural lands are available in Brazil and Chile, but in Costa Rica land may be considered a scarcer commodity. It has been estimated, for example, that in the state of Paraná in southern Brazil, at least 20% of the land is not being used.)

ii. In Brazil and Chile the investor buys treeless land and must decide whether to allocate the land for forestry use or cattle ranching.

iii. The length of the rotation (period of one generation of planted forest) as well as the timing of intermediate harvests, protection and management activities depend on the species.

iv. At the end of the rotation period the land has to be replanted.

v. In the case of Costa Rica, all commercial species of the natural forest are harvested (see Kishor and Constantino 1993). The area will be reforested and managed with native species.

vi. Cattle are assumed to yield revenues from meat four years after birth in Brazil and Chile, and after two years in Costa Rica due to productivity and market conditions.

The site specific features of the applied forest and cattle ranching models are as follows. The data for Brazil were collected from southern and southeastern areas of the country during 1995 (Scatolin 1995). In Chile the models describe conditions on Regions VIII and X. Eucalyptus and pine are the most common species used in plantations in these countries. In Costa Rica, the results are specific for *Cordia alliadora* which is a native species; the data were derived from Kishor and Constantino (1993). Prevailing prices for wood products and meat were used. This simplified analysis does not include agroforestry systems or other agricultural or forest products.

Results

Table 2 suggest that in Brazil forestry yields greater benefits than cattle ranching, especially in the case of *Eucalyptus grandis*. The plantations of *Pinus taeda* compared with cattle ranching would generate positive private benefits only at interest rates below 12 percent. Forestry in Chile would yield positive returns under all discount rates scenarios. In Costa Rica, plantation forestry is profitable at discount rates below than 12 percent, while cattle ranching would yield higher private benefits than managed natural forests over all discount rates examined.

Hence, a rational decisionmaker would prefer forest investments to cattle, with a discount rate of eight percent or less, in all cases examined, apart from managed natural forest in Costa Rica. However, investor decisions may be distorted by imperfect capital markets. If the availability of credit is restricted the relative position of forestry is likely to weaken.

Restrictions on the availability of capital may affect the forest investor more than the extensive cattle rancher due to the larger investments needed to initiate the forest operation. The limits to capital have the same effect as a higher interest rate (cf. Kuuluvainen 1989). Table 2 suggests that if the (credit rationed) discount rate is 12 percent compared to a market discount rate of eight percent, private benefits from cattle ranching in Brazil become greater than benefits from *Pinus taeda* plantations. Correspondingly, if credit rationing implies a discount rate of over 12 percent, net benefits from planting *Cordia alliadora* in Costa Rica become negative. In the first example of pine plantations in Brazil, rationing would decrease the positive difference in net benefits of forestry over ranching by US$398 per hectare. In the second reforestation example using *Cordia alliadora* in Costa Rica, rationing would decrease the positive difference in net the benefits of forestry over ranching by a strik-

Table 2
Net Private Benefits from Forestry Investments
Compared to Cattle Ranching (F^{PRI})
US dollars/ha.[a.]

	Brazil [b.]		Chile [b.]		Costa Rica [c.]	
Disc. Rate	*Eucalyptus grandis*	*Pinus taeda*	*Eucalyptus globulus*	*Pinus radiata*	*Cordia alliadora*	*Managed natural forestry*
20%	20	-272	322	173	-763	-378
15%	151	-217	512	246	-454	-415
12%	274	-101	705	405	61	-438
8%	522	297	1133	1065	1904	-465
4%	928	1380	1932	3364	8942	-456
2%	1223	2484	2582	6186		

[a.] The formula is $F^{PRI} = \Sigma_t a^t(B_{F,t} - C_{F,t}) - \Sigma_t a^t(B_{R,t} - C_{R,t})$, *where* F^{PRI} is the difference between private net benefits in forestry and cattle ranching; a^t is discounting factor; $B_{F,t}$ $B_{R,t}$ denote benefits from forestry (F) and cattle ranching (R), respectively at time *t*; $C_{F,t}$ $C_{R,t}$ denotes costs for forestry (F) and cattle ranching (R) at time t.
[b.] Own calculations
[c.] Derived from Kishor and Constantino (1993)

ing US$1,843 per hectare.

Externalities

Without intervention, banks will look at market benefits but will not necessarily allocate funds to those projects for which the social returns are highest (Stiglitz 1993). For forest investments the social returns differ from private returns because of externalities. The externalities can be classified as ecological values, recreation use value, and option and bequest values.

Because private enterprises do not receive all the forest's benefits, land use tends to be distorted. More than the socially optimal amount of land is often allocated to agricultural and livestock activities. Furthermore, when competition for land suitable for forest exists, there may be excessive transformation of native forests into plantations using exotic fast growing species with higher private returns. This may not be socially optimal because native forests usually produce higher social benefits than plantations especially in the form of biodiversity, and option and bequest values (Kanowski et al. 1992, Sargent & Bass 1992). The distortion becomes even greater if governments allow plantation incentives to be used for areas currently with tree cover.

The ecological benefits of tree plantations include positive hydrological and soil quality impacts. In cases where a variety of species is used, biodiversity benefits may also exist. Plantations are most likely to have recreational use value as green space within or near urban areas. Carbon sequestration is another important benefit (although it accrues globally, while hydrological, soil and recreational benefits are local or regional by nature). Countries tend to be more willing to co-finance forestry investments that generate positive externalities at the national and local levels. They are less willing to finance programs with mainly global benefits (Laarman 1995,

Table 3
Net Private and External Environmental Benefits
from Forestry Investments (F^{SOC}) Compared to Cattle Ranching
US dollars/ha [a.]

	Brazil [b.]		Chile [b.]		Costa Rica [c.]	
Disc. Rate	*Eucalyptus grandis*	*Pinus taeda*	*Eucalyptus globulus*	*Pinus radiata*	*Cordia alliadora*	*Managed natural forest*
20%	405	202	773	683	-213	372
15%	536	257	963	756	-96	335
12%	659	373	1156	915	611	312
8%	907	771	1584	1575	2454	294
4%	1313	1854	2383	3874	9492	285
2%	1608	2958	3033	6696		

[a.] The formula is $F^{SOC} = \Sigma_t(a_P^t(B_{F,t} - C_{F,t}) + a_S^t B_{EF,t}) - \Sigma_t a_P^t(B_{R,t} - C_{R,t})$; where F^{SOC} is the difference between the sum of private and social net benefits in forests and private net benefits in cattle ranching; a_P^t is a private discounting factor (cf. Lawrence 1991); a_S^t is a social discounting factor (cf. Kishor and Constantino 1993); $B_{F,t}$ $B_{R,t}$ denote market benefits from forestry and cattle ranching, respectively at time t; $B_{EF,t}$ denotes nonmarket benefits from forestry; $C_{F,t}$ $C_{Rt,}$ denote costs for forestry (F) and cattle ranching (R), at time t.
[b.] Own calculations.
[c.] Own calculations, partly derived from Kishor and Constantino (1993).

Constantino 1995).

On the basis of these observations, Niklitschek (1995) proposes that if subsidies are used, they should be directed primarily to the protection and management of native forests where the benefits are most significant. Incentives may be used to convert deforested lands to plantations. However, in this case regions should be selected where positive externalities are most significant. When incentives are used they can be considered as payments for environmental services (positive externalities) pro duced by forest land owners or plantation investors.

Empirical Analysis of the Impact of Environmental Externalities

Method and Data

The environmental values of forests are generally nonmarket benefits; therefore market prices do not usually exist. The analysis that follows examines the role of carbon sequestration and hydrological benefits in social returns from forest investments.

Trees take carbon dioxide from the atmosphere and convert it into organic matter. Depending on the use of wood, the fixed carbon is eventually released in the form of CO_2 in varying degrees. For example, burning wood would result in a sudden emission of

carbon, whereas wood used in construction would "lock up" carbon for a relatively long period since natural degradation occurs slowly.

Environmental externalities were incorporated into the analysis by obtaining rough estimates for environmental output volumes, both for carbon sequestration and hydrological impacts. Corresponding prices were based on the literature and a model of carbon sequestration (Pearce 1994). The environmental values accruing to society were discounted using a social discount rate of eight percent (Kishor & Constantino 1993, Niskanen et al. 1993).[3]

Based on the estimated total carbon sequestration and hydrological benefits, the net present values for each species used in the analysis was:

Eucalyptus grandis:	US$385/ha.
Pinus taeda:	US$474/ha.
Eucalyptus globulus:	US$451/ha.
Pinus radiata:	US$510/ha.
Cordia alliadora:	US$550/ha.
Managed natural forest:	US$50/ha.

Results

Table 3 shows that environmental externalities may be a significant reason for the use of incentives. First, *Pinus taeda* planting in Brazil is preferable to cattle ranching not only at low discount rates, but also at rates of 12 percent or higher. Here, incentives equal to the value of the environmental externality (US$474/ha) would result in correct social ranking between forestry and cattle ranching over all examined rates.

Second, it should be noted that if soil type and other factors allow a free choice of tree species, *Eucalyptus grandis* should be preferred to *Pinus taeda* in Brazil at a discount rate of eight percent or higher, as was the case in the analysis of private profitability. The fact that eucalyptus may have negative externalities in terms of soil quality and fertility has not been taken into account due to lack of data (see Sargent & Bass 1992).

Third, in Costa Rica taking environmental externalities into account (US$750/ha) would make managed natural forests the preferred option over cattle ranching and plantation forestry with *Cordia alliadora* at a discount rate of 15 percent or higher (see also Kishor & Constantino 1993).

Finally, the calculations suggest that incentives would not be justified in Chile based on environmental externalities. Positive environmental externalities increase the attractiveness of plantation forestry, which in this case was found preferable to extensive cattle ranching based on purely private benefits (see Table 2).

[3] Lawrence (1991) has demonstrated that rates of time preference vary widely among economic agents (i.e., different types of decisionmakers). These variations affecting the discount rate are independent of the assumed social discount rate of 8%. The social discount rate is held constant in the comparisons below, while the private discount rate applied to marketed inputs and outputs is allowed to vary (See Stiglitz 1994). Note that the applied approach is formulated to answer the question, "Would incentives based on externalities affect the behavior of private land users?"

Criteria and Selection of Incentives

General Economic Justification for Incentives

Based on the financial analysis of forestation investment to the land owner, three basic cases can be identified with regard to justification of incentives. First, incentives are not justified if forestry yields higher private profitability than alternative land uses ($F^{pri} > 0$). If the investment opportunity provided by tree planting under these conditions is not realized, the reasons may lie in macroeconomic factors, capital market imperfections or misguided sectoral policies or institutional arrangements. The negative impact of these factors may be eliminated by reforms rather than by incentives (Steward and Gibson, 1995).

Second, incentives are not justified if the net present values of forest investments, including externalities, are lower than returns obtained from alternative land uses ($F^{soc} < 0$). This may be due to the fact that externalities of forestry are positive but small (compared to private losses) or that they are negative. A combination of the first and the second case, i.e., $F^{pri} > 0$ and $F^{soc} < 0$ would call for taxation or a negative incentive for afforestation.

Finally, the case for incentives arises when the private net returns are lower, but the returns including externalities are greater than the returns from alternative land uses, i.e., $F^{pri} < 0$ and $F^{soc} > 0$. Here incentives should be designed so as to be *effective* in the sense that they may alter the land use pattern in a direction considered socially more desirable. They should also be cost-effective. The formulation and scale of possible incentives should be guided by such principles as *efficiency* (Hueth, 1995).

With limited funds available for incentives the government should maximize the area under plantations. A convenient solution could be an *auction* arranged such that landowners and investors submit bids for the number of hectares they wish to forest, and the compensation they solicit to do so. The ranking of the bids, according to per-hectare payment, would provide a cost minimizing subsidy allocation.

Types of Incentives

Given that under specific circumstances incentives may be justified in economic terms, there still remains a question of the types of incentives and their definition. Gregersen (1984) defines incentives in the following narrow manner: "Incentive mechanisms can be defined as public subsidies given in various forms to the private sector to encourage socially desirable actions by private entities."

Direct monetary subsidizing is not the only way to encourage forest investments. McGaughey and Gregersen (1988) classify market information, extension and education, research, etc. as indirect incentives. Structural adjustments such as securing property rights and eliminating capital market imperfections also encourage forest investments; these objectives should be approached by eliminating the distortions rather than through monetary incentives.

The objective of achieving a socially desirable allocation of forest investments can be a vague concept. It normally incorporates some income-generating goals for low-income groups and environmental benefits. The argument is, as discussed earlier, that society often benefits more from forest investments than the private entity undertaking the investment (McGaughey and Gregersen 1988). In general the issue is not the existence of externalities but their

measurement and magnitude.

Hueth (1995) reports on research by David Kaimowitz in 1992, according to which direct subsidies for forestry investments in 18 watershed management projects in Central America included input financing, food for work, wage payments, directed credit and special prizes for competition. However, Kaimowitz did not find any evidence detailing the effectiveness of the alternative forms of incentives.

Table 4
The Case for Incentives

Case [a]	Action
1. Private forest investment is more profitable than the next best use of land. $F^{pri}>0$	No Incentives If the calculated investment opportunity is not realized, macroeconomic factors, capital market imperfections, misguided sectoral policies or institutional arrangements should be rectified.
2. Forest investment is not profitable in socioeconomic terms. $F^{soc}<0$	No incentives
3. Forest investment is profitable only in socioeconomic terms. $F^{pri}<0$ $F^{soc}>0$	Incentives possibly justified: "The Classical Case" the incentives should be formulated taking into consideration: -*effectiveness*: incentives are just enough to offset the marginal net benefit of alternate land use in order to induce forestation; -*efficiency*: as the marginal productivity of forest investments differs among landholders, apply auctions to allocate subsidy funds; -*cost-effectiveness*: there may be alternatives to forestation to internalize the externality; the most inexpensive method should be used.

Fiscal subsidies have been criticized widely because they may ignore the fundamental purpose of the incentive, which should be afforestation and the generation of production and environmental benefits. Fiscal subsidies are often established with inadequate technical considerations (poor species and site selection, etc.). The recipient of a tax incentive is often more interested in short-term tax relief than future benefits from the trees once they mature. Therefore, these subsidies are often ineffective for stimulating tree planting. Moreover, tax-based incentives may not be equitable. They are often used by large industrial landowners who may not need the incentive. Small land holders may not benefit from them because they are not informed or because they do not pay income or property taxes (e.g. Levingston 1983, Ugalde and Gregersen 1987).

Subsidized credit is not a proper incentive mechanism because it leads to de-capitalization of the financial institution giving the loan. Directed credit also has its problems, as it may be difficult to administer. Whereas loan guarantees and government supported insurance for plantations have been suggested in the literature, they have been hard to establish in practice. Finally, Hueth (1995) criticizes using food for work as a subsidy, because it can cause distortions in local markets as well as perverse incentives that discourage food production.

Due to the failure of other mechanisms, the most common direct incentive has been government cofinancing of inputs such as seedlings, and the provision of extension services. The indirect incentives of research and access to market information may also provide good ways for governments to support private forest investment efforts (see McGaughey and Gregersen 1988; Southgate 1995).

Argentina is currently using auction procedures to lower the costs of forestation incentives. Nicaragua government's and other countries are contemplating following suit. This mechanism may work well with big- and medium-sized landowners, but may be more difficult to implement with small farmers with fewer skills to prepare forestation bids. However, their incorporation would improve transparency and competition, thus creating a base for efficiency. Hueth (1995) proposes a similar procedure for its use in watershed management programs.

According to the conclusions of a workshop organized by the Inter-American Development Bank, financial incentives should be targeted and temporary. "Targeted" means that producers should only be offered enough money to cover their marginal cost adoption. This may be implemented through an auction system. "Temporary" means that subsidies should be paid during a well-defined period to prevent any relationship of ongoing dependency between the beneficiary and the government. (IDB 1995).

Public Participation

Gray and Jenkins (1982, as cited by Keipi and Laarman, 1995) proposed a set of requirements for policy evaluation that may be applied to the analysis of incentive policies. *Political preconditions* require that the incentive mechanisms must have the support of high government officials; this is obtained especially when forestation produces important national benefits. *Organizational preconditions* indicate that a policy should be administered efficiently both at national and local levels, and must be incorporated in the decision-making cycles and budgeting processes.

Cultural and social factors need to be taken into account when considering the appropriateness of a grant financing approach (McGaughey and Gregersen 1988). As an example, in some countries food security may have more public support and higher priority than forest incentives. The policies on incentive mechanisms should be subject to *consultations* with the relevant groups. This is gradually becoming a standard principle in Latin America after democracies became prevalent in the 1980s. Among the international donor agencies, for example, the Inter-American Development Bank subjected its forest policy to consultation (IDB 1992). It also has an information disclosure policy that requires that environmental impact study results and other documents of IDB-financed investment projects be made available for public scrutiny in the target countries.

The general objective for forestry is to manage existing resources and establish new forests so that the different local, national and global requirements for forest uses may be met now and in the future. The task is to establish favorable conditions for private investments (Mayers 1995). This is not easy. It calls for strategies on different levels and requires flexible incentive mechanisms. Therefore, it may not be advisable to incorporate incentive mechanisms in forest laws, but through decrees or administrative and budgetary measures that can be designed as temporary, adapted to changing situations and directed locally if necessary.

Latin American and Caribbean countries are providing incentives to forest investments that yield important benefits on local and national levels. They are not necessarily ready to create them for investments with primarily global benefits. Incentives for projects with global benefits should probably be a task for the international community which can provide appropriate financing through mechanisms such as the Global Environmental Facility (see also López 1997).

Conclusions

The roles played by the public and private sectors have experienced major changes in Latin America and the Caribbean during recent years. In addition to the progress in establishing democracy, the countries have re-evaluated the responsibilities of the public sector, moving it toward an increasingly normative role. Private investments are preferred, and government subsidies are not considered to be the primary tool for achieving economic development. However, if incentives are part of a country's policy, they should not be relegated to lip service as has often been the case in Latin American legislation. Instead, they should be real and effective, directed to the indicated purpose (McGaughey and Gregersen 1988).

The most effective vehicles for obtaining significant levels of forest investment are probably the macroeconomic, political and institutional reforms whose principal goal is to create a thriving private sector without the support of subsidies. At the same time there is an increasing environmental awareness in the region. Forestry investments bring potential social benefits in rural areas with high poverty rates and environmental degradation. Forestation programs may provide important positive ecological and social externalities.

The justification for incentives has to be made through applied economic analysis based on beneficial externalities (IDB 1995). In addition to improving the general economic environment for private investments, the indirect incentives (research support, training, extension and possibly providing market information) may be areas where governments can make cost-effective contributions to promote private forestation programs.

If direct financial incentives are used, they should be cost-effective and targeted, i.e., producers should be offered enough money to cover the marginal cost of adoption that compensates for the opportunity cost. This may be achieved by auctioning at least part of the incentives available. Rent-seeking behavior should be minimized, and the maximum number of hectares should be forested within available budgets (Hueth 1995). Targeting may or may not include low-income groups. The cost-effectiveness of forestation programs in reducing rural poverty should be evaluated relative to other sustainable development programs (Vaughan 1995).[4]

Some countries with comparative advantages in forestation may use incentives as a policy tool to accelerate the rate at which plantations are established. However, it is not clear whether governments can control the pressures to extend subsidies to other sectors without such advantages. For example, Chile, with the most successful incentive scheme in Latin America, is having difficulties making a transition away from subsidies even though the subsidies served their purpose by providing an initial stimulus for plantation investment (Beattie 1995, Constantino 1995).

Possible government participation in financing forest investments on private lands should be based on assessed market and nonmarket benefits (IDB 1995).

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[4] This paper has not considered income distribution patterns as a justification for forestry incentives. However, skewed income distribution, poor food security and low forest coverage are often closely related to subsistence farming. Therefore, income distribution is likely to affect forest investment level.

Cost recovery mechanisms must be contemplated if such participation is established. These mechanisms would ideally be indirect, based on taxes and fees. Direct recovery through benefit-sharing mechanisms (timber harvest, etc.) may not be feasible due to the often long gestation periods of forestry investments. Changing public sector administrations and regulations may pose a risk to private investors and diminish their willingness to establish long-term investment partnerships with the government.

To summarize, the use of incentives for forestry may be justified as compensation for positive externalities or payment for environmental services that need to be identified and, if possible, quantified. Incentives will only be effective if the externalities are significant enough to warrant a change in the land use pattern driven by the private sector. Incentives only need to be as big as the difference between the private net benefit from the owner's best land use and the net benefit from forestry use.

The scale for intervention and formulation of possible incentives must be carried out only after alternative mechanisms have been studied, e.g., evaluating the cost-effectiveness of reducing atmospheric carbon through industrial emission controls. Finally, forestry intervention may take forms other than those of direct financial incentives. As indicated earlier, low levels of forest investment, especially by small farmers, may be caused by imperfect information about forestation possibilities and technology. Preferably, this distortion should be tackled through technology transfer programs justified by their social profitability.

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