ECONOMIC INCENTIVES AND FOREST CONCESSIONS IN BRAZIL*

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Abstract

This study is an attempt to draw attention to some economic issues that are in general not explicitly mentioned in the literature and are crucial for the attainment of the objective proposed by the Brazilian government in promoting sustainable logging extraction in concessional terms in National Forest units in the Amazon. Departing from a careful analysis of the failures occurred in other countries' similar experiences and accounting for institutional and

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economic barriers found in the region, we have tried to point out effective economic incentives to counteract deforestation trends and open room for making sustainable logging a viable alternative for the use of forestland in the Amazon.

Introduction

The deforestation process in Brazil, mainly in frontier areas, is a result of economic and social factors, along with institutional failures. In the past, structural problems as a highly concentrated income distribution and land tenure worked in conjunction with policy failures, such as favorable credit and fiscal system to agricultural activities and regional development programmes in frontier areas, to create a deforestation process driven mainly by the synergy between agricultural and logging activities.

The association between these activities play a crucial role in the deforestation trend by financing land clearing for agricultural purposes in exchange for timber extraction. Economic agents move to the frontier, clear the land, sell the timber and start an agriculture or cattle raising activity expecting to get the title for the land. Such exploitation pattern, identified as a typical dynamic behavior in open access areas, is a direct consequence of the lack of perception of scarcity associated with the forest value. Consequently, the privatization of forest and its land through the assignment of private individual rights to it has been very harmful for sustainable purposes in the region.[1]

Some of these factors cannot be easily reverted since it would require long-term structural adjustments to alleviate social inequalities, accomplish a satisfactory land reform, create the proper incentives and enhance human resource's planning capacity in governmental agencies.

Because of these failures, regulation on sustainable logging practices and economic instruments such as funding mechanisms, forestry taxes and fiscal incentives did not succeed in promoting sustainable extraction practices in the Amazon.

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[1] *See Schneider (1995) and Serôa da Motta (1993) for a more detailed analysis of this process.*

A promising alternative policy that is being discussed and implemented in Brazil is a system of public concessions in National Forests (FLONA), where long-term leasing contracts of large tracts of forests are made with private corporations, by international auction, with clauses specifying accepted conditions on the sustainable use of land and natural resources. Non-compliance with sustainable practices defined in concession licensing would be subject to sanctions and concession termination. Additionally, supervision and monitoring costs could be decreased if monitoring could be shared with NGOS and communities. Such scheme is particularly feasible, for example, in the Amazon where there is still a large availability of unclaimed areas.

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Nevertheless, the need for sustainable logging practices in these concessions, together with the prevailing pattern of timber extraction in the Amazon, raise some issues in terms of the financial viability of these concessions schemes. Sustainable logging will represent higher average costs if compared to the actual pattern of production. These additional costs are mainly associated with:

a) Selective extraction has to reckon on rotation practices. Considering the variety of species in the Amazon and its density, the area used for sustainable logging would have to be larger if compared to the actual pattern of exploitation;

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b) Sustainable logging is going to be more intensive in capital and advanced technology. This could create productivity gains, but will also create additional costs and will increase the need for skilled labor.

c) The necessity of post logging care in order to decrease waste.

d) Efficient infrastructure for transportation and costs associated with auditing, certification and administration needed in order to attend rules and norms imposed on the concession.

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Consequently, for the logging concession system to work, given the market structure, some compensation is going to be needed for this additional higher unit average cost. The price charged for this sustainable log will therefore have to be higher. Nonetheless, this will only be financially sustainable if either the sustainable product could be differentiated from the open access extraction or the supply of illegal logging is decreased.

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Additional to the feasibility problem, the use of a concession system implies on the replication of a pattern of logging that is known to have not worked properly in many other countries.

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Therefore, bearing in mind the current deforestation and logging patterns taking place in the Amazon, this article is going to address some of the determinants that are needed to be taken into account to foster an efficient system of concessional forests in the region. These determinants are going to be analyzed using the following classification:

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a) Auction procedures for concession allocation;

b) Payment instruments;

c) Regulation and monitoring aspects;

d) Industrial structure and competition on timber markets.

This analysis, instead of proposing normative recommendations, will try to draw attention to some issues that are in general not explicitly mentioned in the literature and are fundamental for the attainment of the objective proposed by the Brazilian government in promoting sustainable logging extraction in concessional forests.

Section two presents some characterization of the deforestation process in Brazil. The next section analyses the international experience on concessional forests. Section four identifies the main conditions for sustainable logging under

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concession in Brazil. The last section presents conclusion and recommendations.

2 Forest Conversion and Deforestation in Brazil

To understand the context in which the creation of national forests and its utilization for private logging took place, it is fundamental to comprehend the process of forest extraction and deforestation in Brazil. There is a wide array of work done on the causes of deforestation in Brazil.[2] Nevertheless, the geography of deforestation and its causes have changed substantially during the years. Nowadays, the main causes of deforestation are less associated with cheap credit from the government and road building, and more related to the link between agriculture conversion and timber extraction.[3]

2.1 The Deforestation Process

The expansion of the agricultural frontier took place in the last twenty years, following the same development model adopted in the southern regions. The movement occurred from south to north into the Central and North regions of the country where the Cerrados and Amazonian Forests are respectively located. Moreover, the occupation of these regions was determined by ambitious regional development programs and this expansion resulted in large areas of forest conversion.

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Furthermore, regional development programs were accompanied by an important migration process, which was accentuated by the income and land inequality in Brazil along with the need of incorporating higher productive areas for the development of agriculture activities. EMBRAPA (1991) classified areas in Brazil according to their appropriate use,

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[2] *See for example Mahar (1986), Serôa da Motta (1993), Ozório de Almeida and Campari (1995) and Young (1996).*

[3] *This process was accentuated with the entrance of Southeast Asian companies in Brazil.*

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namely: crops, livestock and extractivism/preservation[4]. According to its results, less than 10% of the total area in the Amazon is suitable for crops/agriculture and livestock while this proportion is over 90% in Southern regions. Secondly, it can be seen that livestock activities in the country as a whole exceed the area suitable for them in about 800,000 km². Furthermore, more than 90% of this excess takes place in the North and Central Regions where most recent deforestation is occurring. Consequently, low productivity cattle raising is occupying non-appropriate areas in the Amazon region. This activity expansion takes place after the soil is exhausted for agricultural activity causing the conversion of fragile ecosystems and pushing crops towards inadequate areas.

On the other hand, land areas suitable for crops are still available with the impressive figure of about 1.6 million km² for the country as a whole. Thus the expansion of agricultural activities towards the Amazon, taking into account agroecological features, cannot be recommended.

So why does it occur? Timber exploitation in the Amazon takes advantage of legal land clearing for agriculture which gives right to deforestation. Timber sale based on this license creates an opportunity for making up-front capital for full clearing afterwards and to bear later costs of securing property rights. Timber exploitation, in fact, acts in some areas as inducing factors for land conversion.

Apart from the general weak capacity of public agencies in a country where public deficit cuts are erratic and, sometimes, drastic, institutional performance in such large and remote area is likely to be fragile and creates more room for illegal logging at the top of the clearing license loophole.

As said before, a very minor fraction of forestland in the Amazonian region is suitable for cropping and cleared soil ends up eventually in extensive cattle raising in order to

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[4] *In fact, the classification is broader but it was aggregated here to allow for calculations.*

secure property rights. Once the soil is degraded the movement for new areas of forestland continues. In a simple way, that has been the land conversion pattern elsewhere but in the case of the Amazonian there is still time and opportunities to make a better use of forestland.

Deforestation in the Amazon should not be measured on remaining area basis because it is a recent frontier region covering almost 50% of the country area. In 1978-79 when recent occupation was at the peak, annual deforestation was of 0.54% or an equivalent area of 21,000 ha. The forest would be totally deforested in 130 years if this rate was kept. During the eighties, economic recession and the consequent lack of public and private resources to maintain the costly and ambitious development programmes, associated with increasing monitoring forced by external pressure, can explain the decreasing deforestation rates estimated for the following years. In 1991, the deforestation rate fell to 0.30% or less than 11,000 ha. [5]

After the 1994 stabilization plan, the deforestation rate increased substantially. The 1994/1995 rate was the highest ever reaching 0.81% which represented an average gross deforestation of 29,059 km^2/year. This rate decreased in 1995/1996 to 0.51% representing 18,161 km^2/year.[6]

Although total deforested area is still no more than 10% of total original area, the recent increasing of deforestation rates in inner regions may indicate that new frontier advance fronts are being opened.

2.2 Timber Activity Expansion

The fraction of the Brazilian timber production that has its origin in the Amazon (Northern region) increased from 9.2% in 1980 to 23.1% in 1991. This substantial increment

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[5] *See Serôa da Motta (1996).*

[6] *Deforestation data are based on official figures from INPE (1998).*

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represents the increasing importance of Amazonian timber species in the national timber activity.

The timber production coming from the Amazon region has increased dramatically in the last decades, if measured as effective production, as shown in the table below. It also presents, for several periods of time, estimates of the potential commercial volume of timber which could be extracted from cleared areas due to agriculture expansion. Comparing these figures with the timber output values which were effectively produced in the region, one can estimate the fraction corresponding to the relative amount that is utilized for commercial purposes from the timber that is cut for agriculture purposes.

Volume of Timber Available from Deforested Areas and the Effective Production of Logs in the Northern Region: 1975-1990

Period	Average area deforested per year (ha.)	(A) Commercial volume available from deforestation (1000 m^3)	(B) Effective production of logs(1000 m^3)	Fraction (B)/(A)
1975/78	1,619,300	32,386	4,064	0.13
1978/80	2,323,550	46,471	11,476	0.25
1980/88	5,940,987	118,820	19,539	0.16
1989/91	2,064,600	41,292	39,087	0.95

Source: Prado (1995)

From the previous table, one can observe from the total amount of potential timber available in the opening of the frontier process that in 1975/78 only 13% was sold as commercial timber. This result contrasts enormously with the

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result in 1989/91 where 95% of the timber stock cleared in the advancement of the frontier was used for commercial purposes. This pattern change through time confirms that the product from the timber extraction activity is increasingly financing the deforestation since legal licenses for the agriculture expansion in the frontier legalize the timber extraction activity. This synergy generates a much higher private economic value from the deforested land areas than the one that could be obtained with a sustainable logging activity.

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Serôa da Motta, Young and Ferraz (1998) present some estimates of the rates of return for the sustainable logging activities developed in the traditional areas of the Amazon. They estimated financial rates of return lower than 1%. This implies that sawmills in the Amazon can count on an illegal supply of timber (sometimes legalized trough deforestation licenses for agriculture purposes) at very low cost. This allows high rates of return with which the sustainable timber production can hardly compete.

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Summing up, the agricultural expansion in Brazil has to be reoriented in terms of its spatial dimension regarding soil suitability. Moreover, logging activities have to take place based on a distinct land property right system if ecosystems are to be preserved.

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3 International Experience with Concession Systems

A forest concession system is a contractual arrangement where the rights of exploitation of the natural resources from a government owned area are given to a private user. This mechanism was created as an alternative to the sale of public land for private exploitation. Concession schemes are common, as an alternative to privatization, in many types of markets characterized by natural monopolies with high sunk costs. Nevertheless, the use of concessions in forestry are not associated with the monopoly characteristic, but are

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related to two other factors: the capture of rent and the sustainability issue. On one hand, there is a need for the government, as the resource owner, to capture part of the rent generated from the logging process. On the other hand, there is also a need to regulate the extraction process in order to preserve other socially valuable services associated with the forest existence.

In the past, the establishment of concession systems was mainly motivated by revenue-raising aims from user charges, royalties and fees for forestry exploitation. The basic concession scheme had, on one hand, logging companies trying to maximize profits, and on the other hand, the government trying to maximize rent capture.. Both economic agents, the companies and the government, were mainly interested in the type and quantity of timber extracted without paying any attention to the sustainability of the harvesting process.[7]

This logging behavior has motivated depletion of vast areas of Southeastern Asia tropical forests. Furthermore, as the timber stock diminished considerably, Southeast Asian companies looked for forest areas in other geographical locations, and Latin America was a natural destiny due to its forest richness.

Nevertheless, if the pattern of harvesting used in Southeast Asian countries is simply repeated in the Amazon, appended with the institutional and structural failures in the region, the deforestation process can be encouraged faster than it has been occurring. Consequently, it is mandatory for the government to implement sustainable logging practices through stringent regulatory practices. In this perspective, the initiative of using national forest areas for implementing concession schemes for sustainable logging has to take

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[7] *Sustainability in the extraction process consists, on one hand, in allowing for the natural growth of new trees in the harvested areas and, on the other hand, in maintaining the environmental services of the forest such as soil preservation, regulate the water cycle and recycling nutrients. For a detailed analysis of the environmental services of the forest see Myers (1997).*

place in a planned and gradual way, accounting for all the cares needed, particularly on the monitoring and regulatory aspects.

International experiences have shown that concessions were not fully successful in attaining its objectives. In most cases, logging followed an unsustainable pattern with overexploitation. Furthermore, governments were not able to capture the rents associated with the natural resource being exploited.[8] The problems associated with concession systems worldwide can be divided in two types of failures: design failures and implementation failures.

3.1 Design Failures

Design failures are related to the formulation of the concession system. They occur when the government create concession systems that are not compatible with sustainable logging practices. Concession periods that are too short and logging areas that are too large are known to create negative incentives for sustainable logging practices.[9] Short periods do not allow the concessionaire to obtain benefits with second growth forest creating an incentive to harvest as much as possible in the present concession period.[10] The size of concessions are also important. Large areas decrease considerably the perception of scarcity creating a perverse incentive for overexploitation.

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Additionally, the method used to allocate concessions and the mechanism used to collect rents are an important source of design failure. Concessions that are awarded in an *ad hoc*

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[8] *In the Philippines and Indonesia, for example, the government collected only 16.5% and 38% respectively, of the rents associated with timber harvesting (Repetto, 1988).*

[9] *See Gillis (1992) and Gray (1997) for details on size and length of concession in different countries.*

[10] *This will also depend on the possibility of renewable contracts. Nevertheless, great uncertainty in many developing countries creates myopic behavior in terms of extraction.*

way[11] create negative incentives for sustainable management since the concessionaire does not necessarily have the highest willingness to pay for that forest area. Consequently, the company will harvest as much as possible since the forest area was obtained at free cost.

Likewise, the government has to establish in the concession contract the type of fee that is going to be charged. If the fee is not well designed, it could increase the incentive for over harvesting. A fee that is established too low will create an incentive to harvest above the optimal level. [12] On the other hand, a fee that is established too high, could increase the incentive for illegal logging.

Although it is important to take into account all the previous design problems, it is also important to mention that the institutional aspect is fundamental for the incentive of sustainable logging behavior. Uncertainty about the validity of the contract in the future creates an incentive for the logging company to extract as much as possible in the present. Thus, smaller areas and longer concession periods can be necessary conditions for a sustainable pattern of harvesting, but these are not sufficient conditions to guarantee sustainable logging behavior.

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3.2 Implementation Failures

Although the contract establishing the concession system is sometimes wrongly designed for sustainable purposes, the main source of inefficiency in the timber harvesting activity is also associated with implementation failures. Most countries that utilize concession systems have problems in monitoring and regulating concessions, as well as charging the fees associated with the harvesting.

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[11] *Many concessions in the past were awarded on political power base and bargaining creating high incentives for corruption and rent seeking behavior.*

[12] *See Repetto and Gillis (1988) and Gillis (1992) for examples of countries that established royalties that were too low.*

Along with monitoring problems, governments in developing countries suffer, in general, from lack of enforcement power. Due to local political power and strong economic interests, logging companies are able to impose their will through strong power bargaining and rent seeking behavior. Moreover, the government faces strong difficulties in collecting adequate fees from logging activities, mainly because of poor structured collection systems, but also because of corruption. Adequate monitoring is costly and along with political will, it requires a strong organizational structure. Problems with corruption are commonly due to geographical isolation and low wages paid to monitoring workers. Furthermore, sometimes governments lack adequate technology for monitoring vast areas.[13]

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All the previous failures are attenuated by the lack of credibility on government sanctions. Consequently, even when non-compliance is detected , this does not guarantee that a sanction is imposed due to the possibility of bribery and political arrangements between companies and fiscal authorities.

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4 Conditionings for the Brazilian Concession System

Although the analysis of international experiences with concession systems is crucial for Brazil to avoid repeating mistakes that occurred elsewhere, specific characteristics exist for the Brazilian case that need to be understood in order to implement a successful concession system in national forest areas. Furthermore, the use of concessions in the Amazon has to be planned in a gradual path in order to observe outcomes and problems to revise and enhance the system before fully applying it for the whole region.

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[13] *In some African countries, for example, the lack of capacity of governments to measure and classify logs led them to permit companies to present their own data (Gray, 1997).*

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The elements that are important to be analyzed, prior to the ful implementation of the concession allocation, can be classified in four broad categories. Although some of these aspects are relevant not only for Brazil, some of them are not widely discussed in the related literature in other countries. The categories specified are related to each step of the concession progress, namely, allocation of the concession, fees collection by the government, regulation and monitoring and evolution of the market structure.

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4.1 Allocation of Concessions

The establishment of auctions for the allocation of concessions has great advantages. Transaction costs are lowered since there is no need to previously select the company that is going to take the concession. The company with the highest willingness to pay (reflecting its productivity and expected profit) would make the highest bid and take the concession. Moreover, the auction generates additional revenue for the government.[14]

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Nevertheless, some important elements have to be accounted in order to allocate the concession in an efficient way. Firstly, there is an element that relates to participation in the auction. Given the need for sustainable forest logging, the participation in the auction should be restricted to companies that are likely to explore forest area in a sustainable basin. The government could use a series of characteristics to approve the participation of a specific company in an auction. Gray (1997) proposes this approval to take place based mainly on the company's financial situation, environmental performance records and previous experiences with forest management and its plans for utilization of the concession area.

[14] *Although the auction system is the most efficient way to allocate concessions, it has rarely been utilized in the past. This was specially true in Asian and African countries where the allocation of concessions has a direct relationship with rent seeking behavior. For details on the allocation mechanism in a diverse number of countries see Gray (1997).*

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Nevertheless, it can be difficult for the government to obtain some of this information and, if the companies are directly asked, they are not likely to tell the truth. This is a typical case of adverse selection[15] where the companies have private information that is not known by the government. There are possible solutions to this problem. The government could propose a kind of contract that would separate the companies between environmentally and non-environmentally correct. This could be done using a random auditing of the company's history and forcing the company to pay a penalty for falsified information.

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Secondly, beyond the participation problem, there are two additional aspects that are fundamental for an efficient auction design: (i) the revenue generated for the government should be maximum to capture part of the rents associated with the concession area and (ii) it is necessary that the concession should be attributed to the company with the highest valuation for the forest area.

The maximum revenue for the auctioneer (the government) would not depend, in theory, on the type of auction used.[16] Nevertheless, in practice, due to the possibilities of failures in the basic assumptions, different types of auction could yield different results.

The two main failures that are likely to occur are the low number of participants and the low bid values offered by participants. The first problem generates a lower revenue for the auctioneer since the larger the number of participants in the auction, the highest, on average, will be the revenue for

[15] *The term 'adverse selection' is used to designate a relationship between two or more economic agents where the characteristics of the agent (the company) can not be perfectly observed by the principal (the government).*

[16] *In theory, based on basic assumptions, different types of auctions would yield, on average, the same expected payoff for the auctioneer. This result is known as the revenue equivalence theorem and it was first proved by Vickrey (1961).*

the seller.[17] The low bid problem could be solved with the imposition of a minimum price which would, on average, increase the price paid for the concession.[18]

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4.2 Payment Instruments on Concession Allocation

Theoretically, the most efficient way to make sure that the concession is given to the highest valuation bidder is the government trying to extract the maximum amount of information from the bidder. Given the nature of asymmetric information, one way of doing this is to condition the payment for the concession on information that affects the bidders valuation for the good. This could be done if the government could observe *ex-post* the amount of timber extracted. It could charge a multiple part tariff, a combination of an initial fee plus a royalty on the timber extracted.[19]

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In practice, it would be very difficult for the government to control the exact amount of log harvested. The companies, on the other hand, will not have any incentives to tell the truth since they would end up paying higher royalties. Consequently this type of two part tariff would be, in practice, hardly feasible.

Other types of charges could be used by the government to collect the rent. Firstly, it is possible to charge concession fees in the beginning of the concession period in order to generate revenue for control and monitoring and, at the same time, decrease speculation behavior in the auction process. Some alternative measures for charging the logging company

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[17] *See McAfee and McMillan (1987) for a review of auction theory. See Brannman* et al. *(1987) for an econometric test of this result for forest services' auctions in the United States.*

[18] *See McAfee and McMillan (1987) for a proof for this proposition. Note, however, that, although this minimum price would include the value associated with the timber in the forest, it would put aside other kind of environmental values associated with indirect and non-use values.*

[19] *See Ramsey (1980) for an example of this mechanism for an oil concession.*

are annual charges based on areas and minimal stumpage prices based on the concession area.[20]

4.3 Regulation and Monitoring Issues

Once concessions are allocated, the government needs to function as a regulator if it wishes to create incentives for logging companies to harvest in a sustainable pattern. Nevertheless, this regulatory process is characterized by incomplete information and limited observation. If on the one hand, the government does not have perfect information on the amount of timber harvested in the concession, on the other, monitoring is limited due to high costs. Thus, one may define two regulatory tasks for the government: one consisting on the design of a regulatory mechanism compatible with the sustainable forestry objective and the second consisting of monitoring mechanisms for this objective to be met.

As previously said, the government regulation over the logging company suffers from the classical problem of asymmetric information. The government does not know what is going to be the quantity of timber harvested after the contract is signed, a situation known in the literature as moral hazard.[21] Without any regulation from the government, the logging company will have an incentive to over extract. Since it is very costly for the government to set up a complete monitoring system, it will have to use some alternative instruments in order to create the right incentive for the firm to approach the desirable logging outcome.

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[20] *For more details on charging mechanisms see Gray (1997).*

[21] *A situation of moral hazard occurs when there is a relationship between two (or more) economic agents, usually known as principal and agent, and (i) the agent makes a decision that affects his utility and the principal's utility; (ii) the principal can only observe the final result of the action and this final result is an imperfect signal of the action taken; (iii) the action that the agent would chose spontaneously would not be optimal. For additional examples of principal agent relationships see Salanié (1997) and Macho-Stadler and Pérez-Castrillo (1997). For an example of moral hazard and environmental regulation see Laffont (1995).*

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There are basically two types of mechanisms that the government could use to create incentives for sustainable management. It could impose command and control methods or, alternatively, economic instruments can be used for creating incentives for sustainable management.[22]

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Under the command and control approach, the regulatory agency would fix the maximum amount of timber that could be extracted from the concession area per period of time. The company exceeding this limit would pay a fixed monetary penalty. This penalty has to be sufficiently high to create the appropriate incentive for the company and, at the same time, the government enforcement power has to be sufficiently strong in order for the penalty to be credible.

Market-based instruments to control the amount of timber extracted from the concession can be applied as taxes and royalties as previously identified for the capture the rent associated with the resource extraction. Furthermore, taxes and royalties on the quantity extracted also impose an additional variable cost to logging companies creating an incentive for lower logging levels. Nevertheless, as it was already mentioned, levies on the quantity extracted suffer from the problem of monitoring and observation of the quantity extracted.

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An alternative for this is the utilization of performance bonds. This instrument consists on collecting a penalty bond associated with the non-compliance of the sustainable management contract. This bond would be returned to the company if its exploitation pattern complied with all the pre-established harvesting conditions. Additionally, a relationship that returns part of the bonus could also be employed. This function, relating the bonus to the type of environmental degradation, should be defined *a priori* in order for the

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[22] *For a review on environmental regulation see Cropper and Oates (1992). For a definition of economic instrument and some examples for Latin America see Serôa da Motta; Huber and Ruitenbeek (1999).*

incentives to be as clear as possible and to avoid rent seeking behavior.[23]

No matter what type of incentives are used, command and control or market-based instruments, the participation of a regulatory agency is necessary in order to monitor the logging companies. Consequently, the institutional capacity strength of the regulatory environmental agency in charge of the system is crucial in order to increase its efficiency and decrease the incentives to destructive logging. Besides, it is important to include communities and NGOs in the monitoring and auditing process to reduce transaction costs associated with the monitoring process and give it an international credibility.

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4.4 Industrial Structure and Competition on Timber Markets

It is plausible to expect that the concession of national forest for timber extraction can produce a transformation on the pattern of timber exploitation in the Amazonian region. That change could occur in relation to three basic aspects: change in the technological profile; change in the industrial concentration and change of the deforestation geography.

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There is a current trend of vertical integration between the extraction and processing activities in the Brazilian Amazon.[24] This tendency has direct influence in the technological profile being used in the region. Additionally, this trend could be reinforced if the companies taking the concessions are processing saw mills already operating in the region.

Furthermore, the requirement of sustainable logging would also transform the technological profile of the companies in the region. This type of exploitation requires a more advanced technology, relatively more capital intensive and, moreover, a significant investment in research, inventory planning and

[23] *See Kahn* et al. *(1998).*

[24] *See Stone (1998).*

management plans in order to reduce the negative environmental impacts of extraction.

One possible problem associated with this technological change would be the change in the composition of the labor demand in the region. Due to the potential decrease in the utilization of labor in relation to capital and knowledge could create a change towards the demand of skilled labor. This increase of the average qualification needed could bring negative impacts to income distribution in the region. Moreover, a more advanced technology and the need for a knowledge intensive pattern of exploitation (selective logging, GIS and other techniques) will affect the comparative advantage between national and international companies. This could serve as an entrance barrier for national companies and firms with experience in other countries would dominate the market.

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Secondly, it is important to take into account the possible change in market concentration levels. If firms that win the concession are vertically integrated and are already producing in the Amazon area, there will be a trend towards the concentration of the productive capacity in the region. Furthermore, it is possible that large companies with economies of scale expel small firms from the market, concentrating the timber activity in fewer hands.

Nevertheless, this phenomenon will only occur if the government can deter illegal logging. If the present possibilities for illegal logging along the frontier continue, small companies will always be able to survive since they can harvest the timber from open access areas at very low cost and sell it in local markets. Moreover, with the existence of this dual market and the difficulties with monitoring, there exists the possibility that companies working with concessions will harvest applying sustainable techniques in its concession area, but participate in the illegal market buying logs from near locations at lower prices.

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One way to skip from that is to segment the markets (illegal and legal) by applying certification schemes to the timber extracted from concessions in a sustainable pattern. Nevertheless, as long as the frontier is still open access, it will be very hard for the certified timber to compete with lower price from unsustainable extraction. Moreover, the national market will be very reluctant to pay a higher price for the certified product.[25]

A third consequence of concessions in national forests is the potential change in the geography of deforestation. Once the raw material in the main traditional logging areas is exhausted, logging firms will have to move on the frontier.[26] If the illegal logging process is not curbed , logging agents will have the incentive to move near concession areas, cut the logs and sell them to the concessionaire companies. The lack of monitoring and penalties, and the construction of new roads can create new agglomeration economies for logging and saw mill activities near concession areas.

Conclusions and Recommendations

The creation of concession areas in the national forests (FLONAS) and its private exploitation consist, theoretically, in a solution to the problem of deforestation associated with timber exploitation in the Brazilian Amazon. Nevertheless, if this system is designed and applied without careful analysis of the failures occurred in similar experiences in other countries and accounting for institutional and economic barriers found in the region, the outcome will not be, not even in the short run, the control of the deforestation process in the region. This is because such processes are a consequence of the rational reaction of economic agents to the prevailing institutional context, i.e. weakly defined property rights, lack of credit, concentration of land and income, lack of monitoring

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[25] *It is important to mention that approximately 90% of the timber extracted in Brazil goes to the national market.*

[26] *See Stone (1998) for a description of this process in the Brazilian Amazon.*

and punishment. As we have tried to point out, the national forest system has to offer very effective economic incentives to counteract these deforestation trends and open room for making sustainable logging a viable alternative for the use of forestland in the Amazon.

In such a manner, we can summarize the main conditions and cares needed for the establishment of forest concessions in the Brazilian Amazon:

- Concessions should be designed taking into consideration the size and the time needed in order to develop a sustainable logging process and, at the same time, making it financially viable and attractive.

- Concessions should be established using a first price sealed bid auction based on minimum price criteria clearly established with the participation of many bidders to assure fair levels of competition, although restricted only to environmentally sound companies.

- An efficient and credible system of monitoring and sanction fees should be established. Fees should be a function of the non-compliance level and a performance bond may be an interesting option to create this kind of incentive.

- There is a need for the participation of civil society through NGOS and local communities, including the monitoring and auditing phases in order to reduce transaction costs and increase credibility.

- Monitoring is crucial to control the existence of a dual logging market where illegal logging supply from agriculture clearing will reduce the market options of timber supply from concession areas.

- It is paramount to act on the demand side in order to create incentives for the purchase of timber with a sustainable management origin. This should be done, not only through marketing and environmental education, but also through direct instruments as certification.

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- The relative intensity of capital in the sustainable management forest industry will increase the need for more qualified labor supply in the region. Consequently, that will require labor and income policies related to job qualification and training with active community participation.

In sum, even taking into account the points presented above, it is mandatory to close the frontier in order to create a scarcity value related to forestland.[27] This structural change will take time to be implemented due to national social pressures associated with the need for an agrarian reform and the opposition of political groups that benefit with the deforestation process.

Consequently, other types of measures are going to be needed in the short run to ensure the survival of companies that would enter into the forest concession exploitation. One possibility would be for that the government to give a subsidy for sustainable logging in national forest concession areas. Alternatively, if the national market does not have the demand for sustainable timber, the solution would be to increase activities on exporting markets, although the international market is limited and a subsidy may still be needed in the initial phase. Note however, that subsidy instruments, although attractive in theory, may also be difficult to implement due to the current fiscal crisis.

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Another option could be the capturing of indirect values of the forest associated with carbon sequestration and biodiversity conservation.[28] Taking advantage of the recent proposals of the Clean Development Mechanism in the Climate Change Convention, Brazil could use its areas of national forest to sequester carbon and sell its credits in the international market. This could serve as a compensation for the sustainable forest management method employed, helping to finance the concession system.

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[27] *See Serôa da Motta and Ferraz (1998) for an example of the low value associated to the scarcity rent of timber in the Amazonian region.*

[28] *See Fearnside (1997) for a proposal similar to this one.*

Whatever the incentives, instruments and mechanisms to be adopted, the social question in the Amazon region has to be accounted for. Due to the large size necessary for the sustainable logging exploitation, land conflicts can arise due to the current need for agrarian reform actions in Brazil. Thus, the participation of local communities in the timber extraction and processing activities is crucial to deal with this equity issue.

It is also important to give priority to the institutional capacity of regulatory and monitoring agencies related to the system. The government has to establish a sound reputation and credibility for the sanctions and penalties imposed on non-compliance. This is a basic condition for the security of property rights and the development of efficient incentives which are needed to accomplish the economic and environmental aims of this promising concessional forest system in the Amazon.

Additionally, it is important the emphasize that concessions should be allocated gradually in order to make possible the revision and improvement of the system according to the existing institutional capacity.

We can conclude, therefore, that the implementation of large concessions in national forests with the adequate contract design is a necessary, however not sufficient, condition to guarantee the sustainable timber exploitation in the region. Political will, the resolution of persistent social problems and the implementation of policies that create the land scarcity perception in the region are fundamental conditions to assure that timber exploitation in the Amazon forest can be compatible with the possibilities of sustainable development in Brazil.

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