# Forest Management for Timber Production: a Sustainable use of the Brazilian Amazon.

**JOSÉ NATALINO MACEDO SILVA and CHRISTOPHER UHL**

EMBRAPA/CPATU, Caixa Postal 48, 66017-970 - Belém, Pará - Brazil

## ABSTRACT

Logging in Amazonia is a source of wealth but also a cause of concern because of destructive harvest practices. Logging is practiced in both the upland and floodplain forests of Amazonia. The number of species cut varies from very few in the selective logging of floodplain forests to more than a hundred in the intensive logging of upland forests. Intensive logging in both upland and floodplain forests can cause severe damage, modifying, sometimes drastically, forest structure and composition.

Roundwood production in Amazonia rose from 6.7 to 24.6 million cubic meters in the period from 1976-1988, and presently represents more than half of Brazil's total. Logging is lucrative: a typical sawmill, engaged in both logging and wood processing, realizes a net profit of more than $200,000 per year. Forestry and wood processing activities could create about one job per 200 hectares of forest -- more than twice the employment generated by cattle ranching on an aerial basis.

World concern with the future of tropical forests has grown recently and has motivated environmental groups to contemplate campaigns to boycott tropical wood from non-sustainable sources. Meanwhile, there has been almost no effort to manage the Amazon forest sustainably, nor has there been much progress in the establishment of mixed-species plantations of native species on degraded Amazonian lands. However, there are no serious technological barriers to the practice of sustainable forestry. The scientific knowledge exists for the management of natural forests as well as the establishment of mixed-species plantations of native species. What is lacking is the political will to apply this knowledge.

Agro-ecological zoning of Brazilian Amazonia is the necessary starting point for the implementation of a wise forestry policy. It is imperative to create forest reserves of sufficient size to guarantee the preservation of the principle forest ecosystems of Amazonia, as well as to demarcate areas for production forestry. Alternatives are presented for the sustainable use of Amazonia's forest, together with suggestions for how ranchers, farmers, and forest dwellers can integrate forest management and tree planting in their production systems.

**Keywords**: natural regeneration; silvicultural systems; sustainable management; Brazil; Amazonia

## 1. INTRODUCTION

### Socio-Economic Importance of Forest Use in Amazonia

Brazil has the largest continuous expanse of tropical forest in the world. Logging in Amazonia is a source of wealth but also a cause of concern because of destructive harvest practices.

With the volume of wood estimated at about 45 billion cubic meters, of which approximately 13 billion have commercial value (Nascimento and Homma, 1984), the Brazilian Amazon is in a unrivaled position to become the principle sup-

plier of tropical woods for the world, as the African and Asian reserves become depleted. Even today, the socio-economic importance of forestry to Amazonia is obvious: the income from forest wood extraction and processing is surpassed only by that derived from mining (Yared, 1990). Even so, this advantageous situation could worsen with increasing pressure from environmentalist groups directed against the use of tropical woods originating from non-sustainable sources, presently the case in Brazilian Amazonia.

There are four main logging patterns in Amazonia. These patterns are defined by the type of forest (upland or floodplain), and the intensity of logging (highly selective or intensive). The most traditional logging pattern is highly selective logging in floodplain forests (Fig. 1). In this model, few species are extracted and the volume harvested per hectare is very low. This type of logging does not harm the forest, but it also does not bring social benefits to local populations because of low production and because wood processing is done far from the logging areas. Recently, on the floodplains, a much more intensive type of logging has started in which large, as well as small, trees (down to 15 cm in diameter) of some 50 species are harvested. This intensive floodplain logging is practiced mostly by local populations and significantly alters the structural characteristics of the forest, frequently leading to a forest dominated by palms and vines (Fig.1).

In newly opened frontiers in regions of upland forest (e.g., forest bordering Para highway 150), logging is highly selective with only about a dozen species of high value being extracted (e.g., *Tabebuia serratifolia* (ipê), *Caryocar villosum* (piquiá), *Manilkara huberi* (maçaranduba), among others). This selective logging does not harm the forest, but, in general, the entrance of loggers catalyzes subsequent forest clearing by ranchers and small farmers. In old frontier areas (e.g., forest along the Belem-Brasilia highway), logging is much more intensive, involving more than 100 species. The forest is severely damaged during this intensive logging (Fig. 1).

Logging is expanding rapidly throughout Amazonia. For example, from 1976 to 1988 roundwood production in the Brazilian Amazon increased from 6.7 to 24.6 million cubic meters, representing 54% of Brazil's total in 1988. This indicates that, at last, the forest is being valued for the wood it contains.

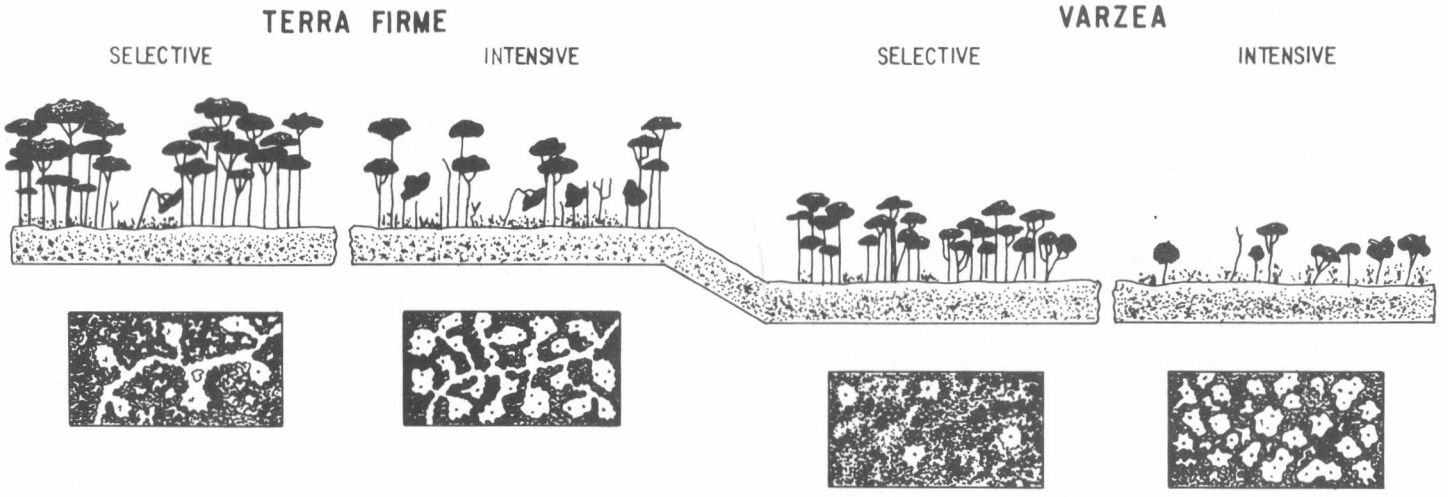
Logging can be quite lucrative. For example, a typical sawmill in the eastern Amazon, involved in forest extraction and wood processing realizes a net profit of approximately $200,000 per year (Verissimo and co-authors, in press). By taking steps to carefully harvest and manage the forest, logging industries could guarantee future wood harvests. However, up to now, most mills engage in careless logging practices which could contribute to the slow degradation of Amazonia's forest.

Studies conducted around Paragominas in eastern Amazonia show that forest management and wood processing activities could employ about one person per 200 hectares of forest. To arrive at this figure, an area of 10,000 hectares was considered as the area necessary to supply a typical sawmill sustainably, given a cutting cycle of 35 years and wood production of 30 $m^3$ $ha^{-1}$ per cutting cycle. Such a sawmill would employ 30 people, as well as 12 forest loggers and 8 workers involved in the application of silvicultural treatments, giving a total of 50/10,000 ha or 1/200 ha. This is more than twice the number of jobs generated per unit land area in cattle ranching, even considering the employment associated with cattle slaughtering.

## 2. SILVICULTURAL ALTERNATIVES FOR SUSTAINABLE PRODUCTION OF WOOD IN THE BRAZILIAN AMAZON

### 2.1 Natural Silviculture

Many people feel that there is insufficient knowledge to manage tropical forests for timber production. However, there are examples of successfully managed forests in several tropical countries (Dawkins, 1988). The criteria used to evaluate the success of management is the capacity of the forest to produce high value timber after silvicultural treatments compared to the




| LOCATION | SPARSELY SETTLED AREAS/New frontiers | WELL SETTLED AREAS/Old frontiers | SPARSELY SETTLED AREAS | WELL SETTLED AREAS |
|---|---|---|---|---|
| LOGGING CHARACTERISTICS: | | | | |
| -Nº species extracted | 5 - 15 | 100 | 1 - 5 | 40 - 60 |
| - Volume extracted ($m^3$/ ha) | 10 - 20 | 30 - 60 | 3 - 10 | 50 - 100 |
| -Canopy damage (% opening) | 5 - 10 | 40 - 60 | 5 - 10 | 40 - 60 |

Fig. 1 — Characteristics of logging in the terra firme and varzea forest eastern Amazonia. (Amazonia Institute of Men and the environment – IMAZON).

production of high value timber in the absence of management. On the Malaysian peninsula Dipterocarp forests, logged 50 years ago and treated silviculturally, are being re-logged (S. Korsgaard, personal communication, 1991), suggesting that sustainable timber production might be possible as long as there is responsible extraction and efforts by loggers to encourage the regeneration and growth of desirable species.

A proposed silvicultural system for sustainable management of Amazonian forests (Silva, 1989) recommends timber extraction at intervals of 30 years, extracting $40m^3$ $ha^{-1}$ of high value wood in each cycle.

A planned extraction is the critical starting point in the forest management system recommended by Silva (1989). Prior to harvest the stand should be inventoried and the location of desirable trees should be mapped. Trees should then be cut to avoid the creation of large canopy gaps and to minimize the damages to the remaining trees (stock for the next cut). Therefore, oriented felling should be tried whenever possible. In addition, the area devoted to skid trails and log landings should be kept as small as possible and these access paths should be reutilized whenever possible. Species that grow rapidly in the open could be planted in log landings.

Also important are silvicultural treatments to promote better growing conditions for future crops. Openings in the canopy created by the first cut improve growing conditions, but this lasts only a couple years (3-4 years in the case of EMBRAPA research in the Tapajos national forest; see also de Graaf, 1986). Hence, periodic thinning and vine cutting are recommended to free desirable trees from competition for light and nutrients. Open conditions are known to be correlated with improved growth rates of tropical trees (Bryan, 1981; Korsgaard, 1986; Silva, 1989). The estimated interval for the application of these thinning treatments is ten years.

A third and very important part of Silva's (1989) forest management system is the monitoring of tree growth during the interharvest period to determine the timing of silvicultural treatments.

Research to date shows that management leads to increased production and healthier forests. For example, carefully planning forest extraction operations reduces the damages caused by logging by half (Marn and Jonkers 1981; Appanah and Putz, 1984; Hendrison, 1990), and simple thinning treatments at ten year intervals, such as we recommend here, increases the accumulation of commercially valuable wood volume 4 to 10 times over that recorded in unmanaged forest (de Graaf, 1986). Thus, the volume of wood accumulated over 30 years in managed forest is easily 5 times greater than that accumulated in unmanaged forests. Although there is only a 3-6% return on this management investment, these measures should guarantee long-term sustainable forest production (Verissimo and co-authors, in press).

Without management, the forest will be degraded over time, creating a new ecosystem full of vines, poor in commercial wood species, and more susceptible to fires. Indeed, consecutive extractions at short intervals increases damage to growing trees and interferes with the natural regeneration which establishes itself after logging. Therefore, logging should be done in a single episode with no heavy machinery permitted in the managed forest between logging episodes. Moreover, in the period between harvests, aside from silvicultural treatments, only regulated hunting and extractive activities that don't harm regeneration should be permitted.

### 2.2 Plantation Silviculture

Familiarity with the silvicultural behavior of native and exotic species in single or multi-species plantations is relevant especially for species subjected to heavy logging pressure (e.g., *Swietenia macrophylla* (mahogany), *Virola surinamensis* (virola), and *Torresia cearensis* (cerejeira), among others ). The silvicultural behavior of more than a hundred native species and a couple dozen exotic species has been observed in experimental plantations in Amazonia under varying conditions (e.g., in open areas, second-growth stands and in agro-forestry systems).

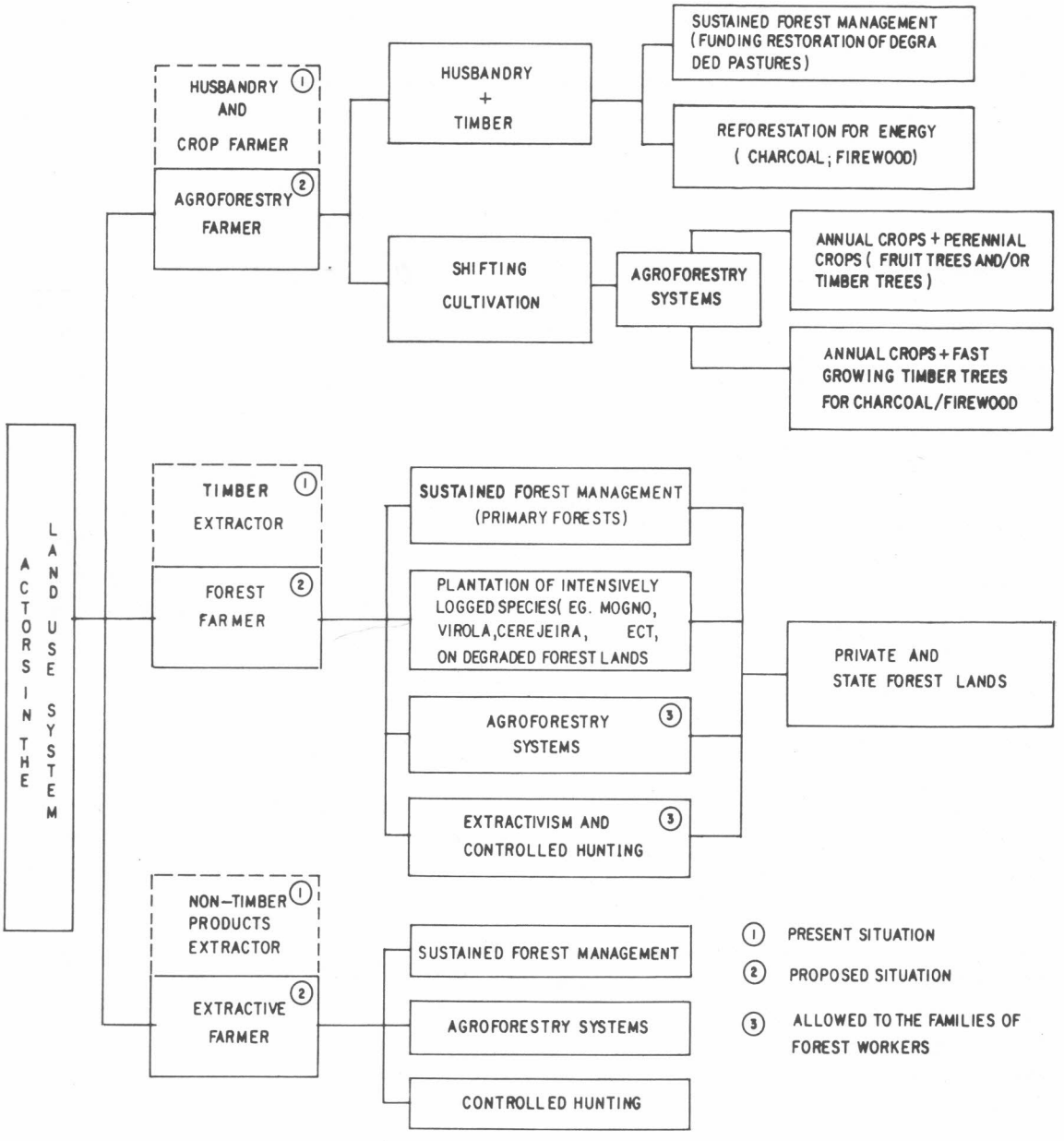



Fig. 2 — Proposal of alternatives for different systems of suistanable forest land uses in the Brazilian Amazon.

We do not advise the substitution of native forests by plantations, even though such plantations may be more productive. However, plantations might be appropriate on degraded lands in areas with a high demand for pulpwood, charcoal or firewood, or when the intention is to increase the land value by introducing forest species of high commercial value into altered landscapes of low value. But, we stress that plantations are recommended only in areas of already disturbed forest or in abandoned pastures.

According to Yared and Brienza Junior, (1989) if just 10% of the area that is fallowed each year in shifting cultivation were used in reforestation programs in Amazonia, approximately 40,000 hectares/year could be incorporated into forestry production, with possible economic returns to the producer. For agro-forestry systems, species such

as *Bertholethia excelsa* (Brazilnut), *Carapa guianensis* (andiroba), and *Dipteryx odorata* (cumarú) are desirable because they produce high-value products and because their seeds are readily available.

## 3. CONCLUSIONS AND RECOMMENDATIONS

Scientific knowledge about forest management and tropical forest function makes possible the establishment of a forestry development policy for the Brazilian Amazon. Agro-ecological zoning of Amazonia is the necessary starting point for the development of this forestry policy. Zoning should include the creation of forest reserves of sufficient size to guarantee the preservation of the principle forest ecosystems in the region, as well as the demarkation of areas for production forestry.

The economic, social, and environmental implications of irresponsible forest use justify a more rigorous control from state and federal authorities. In countries in Southeast Asia, such as Malaysia, all forest lands are property of the state (S. Korsgaard, personal communication, 1991). Canada also maintains most (90%) of its forests as state property (J. Yared, personal communication, 1991).

Figure 2 provides suggestions for how forestry might be integrated into present-day land uses in Amazonia. Starting with ranching, we suggest that this land use might interface with lumbering activities in two ways. In the case of ranchers who control large tracts of forest, we recommend measures that stimulate sustainable forest management. Revenues from sustainable forestry could be used by ranchers to periodically restore degraded pastures. For ranches located in regions where there is a demand for charcoal and firewood (e.g., Programa Grande Carajas), we recommend reforestation activities on degraded pastures using fast growing, plantation-type species.

In colonization areas where itinerate agriculture is practiced, we recommend that agro-forestry systems be established on fallowed lands to diminish deforestation and increase family incomes. In this case, the use of combinations of short-lived food crops with perennial crops (fruiting and wood producing trees) or rapidly growing trees suitable for charcoal production are recommended.

In areas of virgin forest, we recommend forest management following the guidelines of Silva (1989) as outlined above. At the same time, intensively logged species (e.g., *Swietenia macrophylla* (mogno), *Cordia goeldiana* (freijó), *Virola surinamensis* (virola), *Torresia cearensis* (cerejeira), among others) might be raised in mixed-species plantations in cut-over areas (Fig. 2).

Finally, considering the extractivist producer (i.e., forest dwellers), we recommend measures to increase income and sustainability of forest extraction activities. These measures may include forest management for timber production, agro-forestry with annual and perennial crops, controlled hunting, and/or the raising of wild animals.

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