10 Precious Woods, Brazil

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10.1 General aspects of forest management in the Brazilian Amazon

Timber harvesting in the Brazilian Amazon is regarded by many as predatory (Silva et al. 2006) even after many governmental and private attempts to improve the situation with research, publications and demonstration projects.

The focus of nature conservationists all over the world is on deforestation rather than on the less damaging selective (and often only light) logging. Until recently it was difficult indeed to detect selective logging from satellite observations.

Logging usually opens the area up for further incursions ultimately leading to final clearing for rangeland or agricultural cultivation, so it is an important precursor of deforestation. With a new technique of remote-sensing analysis, an estimate was made of the area selectively logged in the top five timber-producing states of the Brazilian Amazon (Asner et al. 2005). Areas logged per year, in the period between 1999 and 2002, ranged from 1.2 million to about 2 million ha, equivalent to 60 to 123 % of the previously reported annual deforestation area. Also in conservation areas annually areas up to 120 000 ha were selectively logged, a demonstration of the difficulties to guard and preserve these conservation areas. Forest conservation areas need a master but this is difficult to finance, unlike the forest under active production management discussed in this book.

Historically, logging companies in the Brazilian Amazon region only exploited forest areas that afterwards were left and usually became agricultural land leading to agricultural expansion into the forest area. In the beginning of the 1990s, when the Brazilian government determined that forest products may only be obtained and transported if they originated from deforestation authorizations or forest management projects, the Brazilian logging companies started to create forest management projects in order to

obtain the necessary credits for transporting their round wood production. Most of these forest management projects were based on manipulated forest inventories and were not even implemented. They were only elaborated on paper as a tool to obtain the necessary credits for the transportation of still conventionally and illegally exploited round woods.

In the late nineties, IBAMA revised and re-analyzed all existing forest management plans in the Brazilian Amazon region. The results were very clear. From a total of 2 800 forest management plans that were registered at IBAMA 1 128 were suspended and 633 were cancelled. During 2001, IBAMA analyzed again 822 forest management plans, of which only 49 % were considered in accordance with the existing law, rules and regulations (Lentini et al. 2003).

Logging in the Brazilian Amazon largely is done by small enterprises, with little mechanization, and if so, often with worn-out heavy skidding machines, some trucks and few, formally untrained but usually experienced personnel. A story apart is the logging of varzea-forest, where the annual inundation facilitates log transport by hand and motor launch. Chainsaws are used widely. They constitute a relatively small investment, though maintenance of these little machines is quite expensive. Until recently logs were sold to mills at low prices, and the deal with the landowner (or colonist without official land titles) often was that roads would be made as payment for the right to take the logs out. This whole procedure breathes a spirit of salvage logging, as the obvious future use of the land continues to be agriculture or rangeland.

Such logging is difficult to control by government, especially taken into consideration the dimensions of the Brazilian Amazon region and the scale of activities that are conducted inside the region. The Brazilian Amazon region comprises a total surface of more than 5 million square kilometres. About 2 500 wood companies are operational inside this region, exploring a total amount of about 28 million m^3 of round wood. The transportation of this volume involves 5 000 to 7 000 vehicles of various types (trucks or barges) dispersed over the roads and rivers inside the region (Lentini et al. 2003).

Government control would be much easier when logging were done by larger and better organized timber companies. Unfortunately, large timber companies only exist in small numbers, but they gained some more terrain in the first few years of this century, helped by governmental studies and regulations, as well as by the stimulus of markets asking for certified timber.

Silviculture in the Amazon so far was largely tree planting, e.g. the extensive Eucalypt plantations of Jari Cellulose SA. Since forest management is a relatively new concept in the Amazon, the main focus is still on regulation and reduced impact logging, two basic requirements for implementing sustained forest management including eventual silvicultural interferences. Experiences with natural forest management are largely experimental, done by EMBRAPA-CPATU, the IFT (Instituto Floresta Tropical), IMAZON and some FSC-certified timber companies.

Most information on the conducted silvicultural experiments is unpublished but in general the early experiences on tree liberation showed that applied interferences, moderately reducing the basal area of the remaining forest stand, were not effective, as competition of the remaining trees forcefully surged up again. The far heavier interferences in experiments in Suriname were regarded as being too strong to be acceptable for the often ecologically-schooled, conservation-minded foresters operating in the Brazilian Amazon region. On the other hand regular thinning in plantation forestry, often removes half of the standing volume in well-growing and young plantations. This is a well accepted procedure in Brazil.

10.2 Precious Woods Amazon

During the early 1990s, a Swiss company investing in tree planting in Costa Rica under the name Precious Woods took the bold step to start a forest management project in the Amazon basin, in Brazil. The country was chosen because at that time it still was possible to purchase forest lands (something that nowadays is much more restricted by law), and what is more important, the forest obtained was largely untouched or only creamed long ago, and available in sufficiently large areas of several hundreds of thousands hectares. The forest was relatively cheap at that time, because one did not see much value in it, even when exploitable. Cost of developing such areas was indeed large, and permits for clearing, the usual way of adding value, already were difficult to obtain. The first studies by Precious Woods of this project in Amazonia indicated good prospects.

In the region of Manaus, it is generally known that the ubiquitous yellow loamy soils (Latosolo amarelo) with very high clay percentages (above 90 % sometimes) but very low absorption capacity are not suitable for permanent agricultural use (after clearing). Alumina saturation also is very high in these soils and structural degradation, such as compaction, is a high risk with and after clearing. Because of the tourist industry the idea of logging is not popular in Manaus, and so far the interest of traditional loggers has not been strong in the region, quite different from the situation e.g. in deforestation zones in the state of Pará. There is also no population pressure on the land, so the risk of illegal settlers along the forest roads is low. There is some traditional settling, with subsistence farming and fishing/ hunting along major rivers, a practice already existing before the Conquista. It appeared that these conditions were fit to introduce the CMS as a form of sustained exploitation (De Graaf et al. 2003). Starting the CMS in actual colonization frontiers as found in e.g. Paragominas (state of Pará) would not have been a valid option, as the social conflicts are too large in that situation to work on land use of such an extensive type.

Selected was an area of some 80 000 ha located at 40 km from the small riverside town of Itacoatiara, which lies some 200 km downstream of Manaus, the capital of the state of Amazonas. The already existing but deficient wood processing installations were located inside the forest area, shortening the round wood transport distances. A public (dirt) road ran through the area, making infrastructure investments for the first years lower. No settlers were found along the road and they also did not arrive later. The forest had no abundance of already popular wood species, but the idea was to introduce lesser used species in due time and to aim for export production.

The general forest inventory estimated a total standing tree volume of 290 $m^3.ha^{-1}$ above 5 cm DBH and a commercial standing tree volume of 80 $m^3.ha^{-1}$ above 50 cm DBH, considering 65 different tree species. Initial programmed harvest volume was set between 30 and 35 $m^3.ha^{-1}$.

A few deforested areas were located close to or in the area occupied by local communities and Precious Woods recognized their traditional land use rights from the very start of the project. Two areas were converted into agricultural land and into rangeland by the former owner. The community areas and converted areas covered 5845 hectares and were left outside the scope of the forest management project. Precious Woods set aside an Absolute Nature Conservation Area of 5 478 hectares. Several thousands of hectares had been heavily logged in the decennium before the purchase, but were included in the forest management area that totalled 69 400 hectares. Inside this forest management area some 8 % were covered with "*Campinarana*" forest, a non-productive forest vegetation type. Furthermore, some 20 % were allocated as stream buffer zones around the many existing water courses inside the forest management area.

The total forest production area resulted in 50 000 hectares that was divided according to the previewed harvest cycle into 25 yearly compartments of around 2 000 hectares each. The capacity of the saw mill was dimensioned according to the annual allowable cut estimated at around 60 000 m^3 of round wood delivery. The production of sawn timber was mainly directed to the export market (Europe) for public water works, bridges and construction purposes such as houses and buildings.

10.3 Development of the project

The Forest Management Plan was approved in 1994. The plan was based on the CELOS Management System (CMS) and adapted to the local conditions based on researches done by EMBRAPA-CPATU and INPA (the National Research Institute of the Amazon). A preliminary manual for applying the CMS was translated in Portuguese to aid the knowledge transfer (Van Bodegom & De Graaf 1994). The first years were not easy, and sometimes big mistakes were made. Especially the sawmill, of a quite common and traditional type, gave a lot of trouble. The large capital losses before it really worked were nearly disastrous. It should not have been so, with all experiences, in Brazil as well as in other developing countries, with such low-tech installations. The forest management, however, soon worked well, also because Brazilian field workers are quite good in understanding and adapting to new procedures.

FSC-certification was obtained in 1997. This was at that time the only project for sustained timber production in natural forest in Brazil, but luckily more have followed in later years. The strong link of forest and processing industry under the CMS was logical and necessary to obtain certification, but it made supplementing the processing part with raw material from other, non-certified forest sources impossible. That proved a handicap for milling many species with low standing volumes. The export market (to Europe for example) became increasingly more receptive for lumber from certified sources, which presented a real advantage. Still, the sheer existence of large supplies of

tropical hardwood of competitive qualities, but from uncertified or even illegal sources, exerted a real downward pressure on the price level.

A memorable event was the presentation of the 1998 Corporate Award to Precious Woods, by the Ecological Society of America (ESA) in August 1998. ESA believes Precious Woods Ltd. provides an excellent example of how ecological principles can be used to sustainably manage forest resources. The CELOS Management System was mentioned and special conservation measures (in the Management Plan) for the mostly tree-dependent fauna were appreciated.

During the first years of operation, Precious Woods faced several facts that required adjustments in their forest management plan. It turned out that the forest area yielded less than half of the expected harvest volume. This was mainly due to the occurrence of many hollow and otherwise defect trees in the forest and the fact that the forest area contained relatively low quantities of the commercial species and Lesser Known Species that were wanted by the export market at that time. The sawmill yield also turned out to be below expectations due to inferior log qualities and smaller log dimensions, mix of a large number of different species including many Lesser Known Species, and a lack of production options due to the encountered marketing limitations.

Soon the original forest area of 80 000 hectares was found too small in order to reach sustainability. The sawmill capacity needed to be doubled in order to come to reasonable supply volumes for a successful introduction of the many Lesser Known Species. In total 312 000 hectares of additional forest lands were purchased by the company to expand their forest management base. Luckily these forest lands were still available adjacent to the original forest management area. These areas are being gradually integrated in the existing forest management plan.

It was possible to use the abundant sawmill rejects for generating electricity since a power plant was installed near the mill (Photo10.1). The power plant now supplies as a stable source also much of the electric energy used in the nearby small town of Itacoatiara, which was formerly dependant on costly imported diesel fuel.

Photo 10.1. A wood-fuelled power station was built at the sawmill site in Itacoatiara. (Photo N.R. De Graaf)

Sustained forest management is thought by the authors to be an alternative to just preservation. It needs proof by demonstration, also as an economic option, and this is what the Precious Woods example did (De Graaf et al. 2003) and will continue to show, with constant evaluation, in a situation of learning by doing.

Of course there was a lot of criticism and even contempt, especially with the traditional loggers, that saw the CMS methodology as downright impractical and too costly. Nature

conservation adepts saw it as another form of organized degradation of native forest. Questions remain until ecological studies have shown the change in the forest functioning to be really acceptable in the long run. It is relatively easier, and at least needs less time, to pass the exam of financial viability than to prove ecological sustainability. But without financial success there will be no follow-up; the enterprise simply breaks down.

10.4 Forest production regulation in the Brazilian Amazon

According to article 15 of the Brazilian Forest Code, law 4.771 of 1965, forest exploitation is only allowed within the context of sustainable forest management projects. The process to apply for a deforestation authorization is still relatively easy as the law allows the conversion of up to a maximum of 20 % of the total property area of rural properties that are located in forested areas. However, the process to apply for a forest management plan approval is known to be very bureaucratic.

Forest management plans are required to be elaborated by accredited professionals and, since April 2003, these professionals are also formally held responsible for the correct implementation and execution of the elaborated sustainable forest management plans. An approved forest management plan has to submit a yearly harvest plan to IBAMA for obtaining the necessary harvest permit.

According to the latest regulations, the minimum harvest diameter of all species is set at 50 cm DBH. Maximum allowed harvest intensity is 30 $m^3.ha^{-1}$ and the harvest cycle is calculated based on a mean annual increment of the commercial stock of 0.86 $m^3.ha^{-1}.year^{-1}$. In practice however, harvest intensities of 30 $m^3.ha^{-1}$ are rarely realized by logging companies and the average is believed to lay somewhere between 18 and 22 $m^3.ha^{-1}$.

Based on the pioneer experiences of Precious Woods in the early 1990s, and other FSC-certified companies later on, the Brazilian forestry authorities adopted various management practices in their regulations. Prospection, or better known in Brazil as the 100 % forest inventory of the commercial tree species, for each annual harvest area prior to harvesting has been obligatory by law since 1998, including micro-zoning of the existing water courses, stream buffer zones and the existence of steep slopes over 45°. Since then harvest permits were based on the presentation of a selected tree population out of the 100 % forest inventory instead of being based on merely simple extrapolations based on 0.1 % forest sampling inventories that had proven to be very vulnerable to data manipulation.

Since the latest regulations, established in December 2006, several advanced criteria for guaranteeing the maintenance of the rare tree species and preserving reasonable populations of seed trees, as applied by the FSC-certified companies, were incorporated. This further restricted the selected tree population for which harvest permits could be applied. The obligation to have controls in place for the traceability of the felled logs and the presentation of a formal harvest report were regulated as well. Another interesting improvement was the elaboration of a formal manual for field inspections, turning them less vulnerable to the so far commonly practised corrupt transactions between logging companies and government agency representatives.

Regarding to forest monitoring and silvicultural interferences, the existing forest regulations are still very general in kind. The need for forest monitoring is mentioned in the regulations. However, there are no criteria defined on how this monitoring should be conducted. A logging company could implement the traditional method of permanent sample plots for their forest monitoring purposes, or simply present a new 100 % forest inventory of an annual compartment at the time it has completed the first harvest cycle.

In Brazil, the most commonly accepted silvicultural interferences are vine cutting and enrichment planting in large felling gaps. Liberation of Potential Crop Trees (PCTs) is not yet being considered as a feasible measure to stimulate growth of the commercial stocks during the harvest cycle. Since regulated forest management in the Brazilian Amazon is only recent and existing forest management plans are still operating in their first harvest cycle, it is expected that it will take several more years before important forest management aspects, like monitoring and silviculture, become more structured and better regulated by the Brazilian forest authorities.

10.5 Current practice

Precious Woods has been implementing the CMS on a commercial scale for over 15 years and during this period various interesting adjustments to the forest management system have been developed by the company.

Forest Inventory with GPS technology
100 % forest inventory of the commercial stock is the key for planning reduced impact logging. At Precious Woods Amazon, a 100 % forest inventory is executed at least one year prior to the harvest operation. During this operation, the yearly compartment is subdivided into small working units of 400×250 meters also referred to as being the 10-hectare plots. Within each 10-hectare plot all individuals above 40 cm DBH of more than 70 different tree species are numbered, identified, measured and located on a map. All existing water courses and slope conditions are also located and indicated on the inventory map.

With the introduction of the new generation of GPS equipment based on the *Sirf III* chipset, it became possible to obtain acceptable GPS coordinates under tropical tree canopy cover within an estimated error between 5 and 10 meters. In 2008, Precious Woods adapted the use of GPS technology in their 100 % forest inventories, following the example of the Digital Model of Forest Exploitation developed by EMBRAPA Acre in partnership with the Environment Institute of Acre (IMAC).

GPS was successfully implemented in the opening of the baselines (400×250 meters) and the 50 meter lines inside the 10-hectare plots. The implemented GPS technology improved the accuracy of the field surveys preventing accumulated distance errors, which occurred frequently in hilly terrain conditions. By using the barometric altimeter of the GPS equipment, it is possible to assess altitude at each 50 meter point inside the compartment. This additional information enabled the elaboration of very accurate and detailed Digital Elevation Models (DEM) and Slope Maps.

At present, the forest inventory crews, consisting of 24 operational forest workers and 7 staff and supporting crew members, are able to inventory 1 600 hectares per month.

Harvest Planning and Control

Originally, the CMS used simple spreadsheets and hand drawn maps for the harvest planning. Considering the scale of operation and helped by the introduction of computer science, it soon became interesting to automate the harvest planning and control. In 1996, Precious Woods started investing in the development of a Database application and a Geographic Information System (GIS). Later on, the further development of this software package was taken over by a forest consultancy firm and 50 %-sister company of Precious Woods named Ecoflorestal.

A specific Database application allows processing and manipulation of large amounts of data. Precious Woods Amazon operates in annual harvest areas of around 10 000 hectares including the stream buffer zones around the existing water courses. This produces an annual harvest volume of around 140 000 m^3 of round wood. The 100 % forest inventory collects information on more than 200 000 individual trees. Especially the manipulation of this quantity of data in order to select the trees to be felled and the trees to be preserved for guaranteeing the maintenance of the species and for seed trees, would be very labour intensive if done by a normal spreadsheet application.

Photo 10.2. Most logs are winched out, over often considerable distances, only lightly disturbing the vegetation, instead of being skidded out behind a tractor from the stump. Here the log has reached the tracked skidder that remains on the skid road. From there a wheeled skidder will take over the load and skid it to the log landing. (Photo N.R. De Graaf)

The current version of the Database application together with the Arcview GIS application covers the data processing of the 100 % forest inventory data, the selection of the trees to fell and to preserve, automated production of harvest maps and field forms for each 10-hectare plot, harvest production registration per crew and activity, log measurement of the produced round wood, transportation of the round wood to the industry, and the chain-of-custody controls (traceability of logs) required for FSC-certification. Recently, the obtained output of the applied GPS technology in the 100 % forest inventory permitted considerable improvements in the planning of roads and the layout of the skid trails and log landings. The harvest planning, when done well in advance, does also provide interesting information for the Sales Department to plan future deals for particular timber species.

Harvest Methods

Precious Woods implements reduced impact logging techniques, such as directional felling, careful planning of the access roads, the layout of skid trails and log landings. However, the main difference in the harvest method practised by Precious Woods in Brazil with forest exploitations elsewhere in Latin America is the application of cable winching prior to skidding (Photos 10.2 & 10.3).

Photo 10.3. The tracked skidder shown here is a D4, so it is relatively light and damages the soil under the skid road but little. It is however strong enough as a mobile winching station, which is its main use. (Photo N.R. De Graaf)

For the winching operation tracked skidders are used, equipped with special high-lead winches, and quality steel cables light enough to be drawn from the drum up to 70 meters into the forest by hand. Special techniques to reposition the logs during the winching around obstacles were adopted. The application of cable winching proved to function 100 % on relatively flat terrain conditions. On more steep terrain still 90 % of the logs could be winched normally without the tracked skidder needing to leave the planned skid trails. The winching operation is quite labour intensive and requires 8 forest workers per winching crew. However, productivity reaches between 90 and 100 logs, or about 300 m^3 per crew per day.

The application of the winching technique permits a systematic planning of the skid trails at equivalent distances of 100 meters rather than planning the skid trails according to the projected trees to be harvested. The systematic planning of the layout of the skid trails and log landings permits repeated use over subsequent harvest cycles. This way the heavy machines only degrade the soil under a permanent layout of the skid trails and log landings. In general, the application of this technique considerably reduces the movement of heavy machinery inside the managed forest area. The experience at Precious Woods Amazon is that on average only 2.7 % of the managed forest area is used for the layout of the skid trails. An additional 1.1 % of the managed forest area is used for access roads and log landings. (see also photo 10.4).

Forest Monitoring

Precious Woods initially adopted the permanent sample methodology developed by EMBRAPA-CPATU. In 2003, this methodology was adapted by Ecoflorestal to a forest monitoring system that focused on generating reliable information on growth and yield of the remaining forest stands in order to support the decision making process of the forest manager as regards silvicultural interferences.

The adapted system reduced the sampling intensity to one permanent sample plot of half a hectare for each 200 hectares of production forest area. Furthermore, improved technologies were applied to increase the reliability on diameter and height measurements for obtaining more accurate growth and yield data. Data collection on natural regeneration, saplings, and trees below 15 cm DBH were excluded because of

difficulties with botanical identification. Observations on the sampled trees focussed on crown form and crown position, crown diameter, status and intensity of vine infections, and the damage on the stems and crowns of trees.

Since there is still a serious lack on autecological information on most Amazon tree species, the new system was designed to gather basic data for an ecological grouping of tree species mainly based on their light requirements and their natural diameter growth range, as well as on their diameter distribution pattern and their potential commercial use. Species grouping based on these variables proved to result in satisfactory species categories for a forest manager taking decisions on how to interfere in order to stimulate tree growth of the Potential Crop Trees (PCTs) in the remaining forest stand.

Silvicultural Methods

In most of the silvicultural systems used in Tropical Moist Forests much attention is given to successful regeneration of the valuable species, and often special treatments are applied to secure such regeneration. In Suriname already Schulz (1960) found that regeneration was nearly always present, or coming in after light disturbance, in sufficient numbers, and this was seen also in the forests of Precious Woods near Manaus. Both regions, Suriname as well as Manaus, appear to have comparable forest types and dynamics, although the species composition is different. The problem in silviculture lies more in the low increment of valuable species after logging. Silviculture in the Precious Woods forests is mainly focussed on growth stimulation of Potential Crop Trees (PCTs) by reducing competition for light. Unwanted neighbouring trees that are competing for light with PTCs are eliminated, mostly by applying girdling techniques. Precious Woods Amazon adopted this view from the very beginning.

Precious Woods started its first silvicultural treatments in 1997. Indeed the local management regarded the CELOS Silvicultural Management refinement option as being too strong to be acceptable. Overall refinement was replaced by intensive liberation of marked Potential Crop Trees (PCTs), which could be found in sufficient numbers. This liberation treatment was a variant of one already studied in Suriname, but had been found slightly less effective and somewhat more expensive than overall refinement (De Graaf 1986).

One serious problem arose in applying the original system. While in Suriname the use of arboricides had been accepted (at least in the experimental period of research and early management by the Forest Service), the Brazilian reality was that such arboricides would transform silviculture into a polluting industry, and thus, according to the law, should be more heavily taxed. A double and deep girdle, some 20 cm separated from each other, in which the bark was completely removed, was used as a substitute for frilling and spraying (Photo 10.5).

Photo 10.4. Overview of a forest stand (Compartment B) after logging. The light opening of the canopy is not easily discerned and shows mainly exposed stems. The log landings already have been emptied and cleaned up. (Photo N.R. De Graaf)

(A frill is a series of overlapping axe cuts around the tree base without removing the bark.) Diesel oil, which was not seen as a serious pollutant in Brazil, could be accepted for additional treatment of difficult-to-kill species, e.g. those with abundant latex,

Photo 10.5. Making a double girdle by power saw is a substitute for chemicals to kill undesirable trees. Such tree killing is done to liberate Potential Crop Trees from competing trees, such as this one, in order to promote their growth. (Photo Van Eldik)

Since silvicultural interferences are in fact long-term investments for the next few harvests, a forest manager needs to carefully evaluate how to invest the best way to achieve his forest management objectives. The data gathered in the 100 % forest inventory were used to differentiate the site conditions of the harvested forest areas in three categories: a) areas that even after harvesting are still sufficiently rich in commercial timber to provide a harvest in the next cycle; b) areas that even with treatment will not be able to produce any reasonable harvest next cycle; c) areas that need a liberation treatment to produce enough volume for a next harvest. The categories were grouped on the management map in areas consisting of several or many half 10-ha plots (the basic units). This way the area to be liberated as a rule amounted to some 70 – 80 % of the harvested areas. This meant a considerable reduction in work load, only made possible by the 100 % forest inventory which, together with the collected information in the Database and Arcview GIS application, also permitted the preparation of the basic field maps for guiding the silvicultural operations.

It soon became clear that in the case of reduced impact logging, one often finds more PCTs than can effectively been liberated in the remaining forest stand. Several PCTs will in fact be competing for light with each other and choices are necessary to be made by the forest manager. Initial experimenting tried to define priorities for liberating species groups according to the occurred harvest intensities per compartment. To make the silvicultural intervention more cost effective it was decided to focus the liberation on PCTs with a straight stem form, with acceptable (circular, half circular or irregular crown forms) and having crown positions receiving only vertical light or crowns that were partly shaded by neighbouring trees. This methodology required investing in an additional inventory on PCTs prior to the liberation treatment. It was not possible to use the available data from the 100 % pre-harvest inventory since data on PCTs between 30 and 40 cm were not recorded, and neither information on crown forms and positions. Also, silvicultural interventions should be based on existing forest stand conditions that are found a few years after the harvest.

This treatment has been applied to over 14 000 hectares of managed forest and the implementation on this large scale permitted a reduction of the costs. As Brazilian foremen and forest workers have the ambition to improve their work, mainly labour costs were considerably reduced, namely to 5 hectares per team day, the team consisting of

one crew leader and three assistants (De Graaf et al. 2003). Special training was given to personnel for this type of silviculture, for selecting and evaluating PCTs, their crown form and position in the canopy, and determining the need for liberation (see Photo 10.6). It was necessary to explain the field crews why the forest needed to be opened up for regeneration and growth. Killing trees for production was generally accepted, but killing trees to reduce competition without harvesting the timber first needed to be made understood as an useful practice.

Although the silvicultural experiences were considered successful in terms of operational procedures and production, Precious Woods Amazon temporary suspended the applied silvicultural treatments in 2006, because it felt the need to fine-tune the planned interferences on basis of the expected information that becomes available by the adapted forest monitoring methodology described above. This is anticipated to happen within the next few years.

10.6 Main issues restricting Sustainable Forest Management at present

It appears from the results of Precious Woods that the CMS may really be an alternative for rampant logging-induced deforestation frontiers, as was suggested by De Graaf & Poels (1990). For nature conservation it is important that the CMS-option makes more land available for strict reserves. It was hoped for that nature conservation organizations would pick it up and promote the idea. Indeed in 1999 Greenpeace recognized the CMS, as practised by Precious Woods, as an acceptable form of forest use. Conservation International in 2001 still kept seeing it as undesirable, preferring a creaming of forest followed by closure (or restricted access, see Rice et al. 2001).

Sustainable Forest Management may be considered a form of forest domestication, and as such it is not acceptable to everyone. Also the need for increment stimulation of the Potential Crop Trees by silvicultural interferences is not generally recognized. Views on forest management are often determined by an antipathy of the traditional ways of logging, as these are very destructive. Foresters are first of all conservators, and then accept also the felling of trees for making a living from the forest. The CMS means a change in attitude from loggers towards foresters. But probably the former loggers are not easy to convert into forest managers, as it is difficult to teach an old dog new tricks. It might be easier to recruit such forest managers from the group of conservationists, who seem now inclined to see the various possibilities of moderate forest uses (Anderson 1990).

In Brazil, the development of the forestry sector has stagnated since 2005, mainly due to more stringent rules and regulations addressing the problematic and chaotic land tenure situation of forest lands in the Brazilian Amazon region. Also rules and regulations regarding forest management have been tightened since 2006. In fact, sharpened up regulations do not directly affect illegal loggers for the simple reason that they do not comply with them anyway. More stringent rules and regulations only distance them more from becoming legal. A contrary effect of sharpening up rules and regulations is

that it directly affects legal operations by an increased bureaucracy, resulting in costly delays of obtaining the necessary environmental licences for normal operations.

Even though government control and law enforcement have been intensified over the last years, the lack of governmental infrastructure, corruption and falsification practises unfortunately still allows a significant continuation of illegal logging practises. Therefore, the continued existence of unfair competition inside the forestry sector turns the actual scenario for responsible forms of forest management not very favourable in the Brazilian Amazon region.

In 2006, the Brazilian government has regulated forest concessions on public forest lands in order to provide legal access to forest lands for logging companies. As a result of the defined procedures, it required some years before large scale forest concessions could become a reality in the Brazilian Amazon region. One of the main reasons for this slow process is believed to be due to governance inconsistencies that exist between the involved Ministries responsible for the development of Brazilian Amazon region. However, at this moment about 22.5 million hectares of public forest lands are legally appropriate for forest concessions. In 2010, one million hectares were under the different procedural phases for forest concessions. For 2011 the Brazilian Forestry Service planned to bring out another 5.1 million hectares of forest concessions.

An important difference in opinion exists between the agricultural lobby and the conservation-minded lobby about the need for forest preservation and land use planning. The logging lobby just perseveres in their approach, also because predatory logging appears to be cheap, and in the mean time prepares the way for further forest clearing and final agricultural use. This has been the traditional approach, and is tried to be continued. But is agriculture and rangeland really sustainable and profitable in the long term on these poor soils?

In a region with seemingly boundless forests, as is Amazonia Legal, priority is not easily given to sustained forest use. Attention is given rather to alleviation of food scarcity and poverty by granting land to small farmers for e.g. agroforestry, a potentially good approach (Anderson 1990), or by allowing the age-old land use of shifting cultivation. People are rightly the first concern of government. However, in our opinion a better approach would be to provide jobs in sustainable forestry, to furnish an income to buy the food so abundantly grown in the south of Brazil. The deficiencies of shifting cultivation in supplying real development for the people should be well known by and by.

For such sustainable forestry development as discussed above one of the sticking points is the need for capital. The Precious Woods venture has shown much of the way with its daring first entry.

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