CASE STUDIES

Sustainable forest management - technical and production aspects

SUSTAINABLE FOREST MANAGEMENT: IS IT POSSIBLE?

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Sustainability of forest management usually implies the maintenance of three main services of the forest:
- The ecological services (e.g. hydrology, nutrients, biodiversity);
- The timber production services (annual allowable cut); and
- The social services (employment).

It has been shown and it will be shown at this seminar (van der Hout and van Leersum, 1997; Yasman, 1997) that, in all three major tropical rain forest blocks, considerable progress has been made in terms of the technical aspects of sustainable forest management, or more precisely, the harvesting aspect of it. Arguably, suitable harvesting systems have been developed for most tropical rain forest regions.

As tree falls are not uncommon in the rain forest, felling at moderate intensities appears not to be a too unnatural event in the forest. There are two problems:
- Felling increases the natural dynamics of the forest; and
- Felling gaps are usually larger than natural gaps, because prime trees, in the full bloom of their life, are preferred for felling.

Furthermore, mechanical assistance is necessary to extract the logs from the forest, and usually skidders or small bulldozers are being used for this purpose. There is no natural equivalent for this sort of impact (except possibly elephants in Africa and Asia). Particularly in unplanned operations, these machines account for the major part of the damage to the remaining stand, including the small regeneration (Hendrison, 1990; ter Steege *et al*., 1996).

Damage can be reduced considerably by using directional felling (Hendrison, 1990; van der Hout, 1996; van der Hout and van Leersum, 1997; Blate, 1997). Directional felling can be used to avoid damage to the future crop trees and small regeneration, to facilitate skidding, or a combination of both.

If systems that use low-impact logging have been developed in several areas and their technical feasibility has been shown, a question we have to ask ourselves is: why are they not used more often? One logical answer could be that there is no guarantee that subsequent harvests will be as good as predicted, nor that land tenure will be secured. Nevertheless, if it can be shown that low-impact logging is already profitable at the first harvest (Hendrison, 1990; Blate, 1997), then the question is not satisfactorily answered by the above, but rather by a lack of convincing demonstration and/or extension in those areas where it is needed most.

When these problems can be overcome, half of the race may be won. What is not yet known is what will happen with the forest after the extraction of timber - the uncertainty of the second and later harvests.

It has been shown that felling results in increased gap sizes (Hammond and Brown, 1991) and that, in large gaps, small-seeded, fast-growing pioneers are at an advantage, compared with small gaps, where large- seeded climax species may regenerate more prolifically (Boot, 1994; 1996; see also ter Steege *et al*., 1996; ter Steege and Hammond, 1996). Furthermore, logging can be viewed as increased dynamics, to which dense slow-growing species are less adapted. Consequently, medium and light wood species will prevail in the future in forests with a history of logging (ter Steege *et al*., 1996; ter Steege and Hammond, 1996).

As an example, the secondary tree species *Cecropia* and *Pourouma* are very common in several CELOS experimental plots in Suriname, and their input into the soil-seed bank should be enormous. Thus, if heavy liberation or second harvest will occur before their life cycle has ended and before their seeds have disappeared from the seed bank (several years after the pioneers have died out; Dalling *et al*., 1997), their abundance will be enhanced.

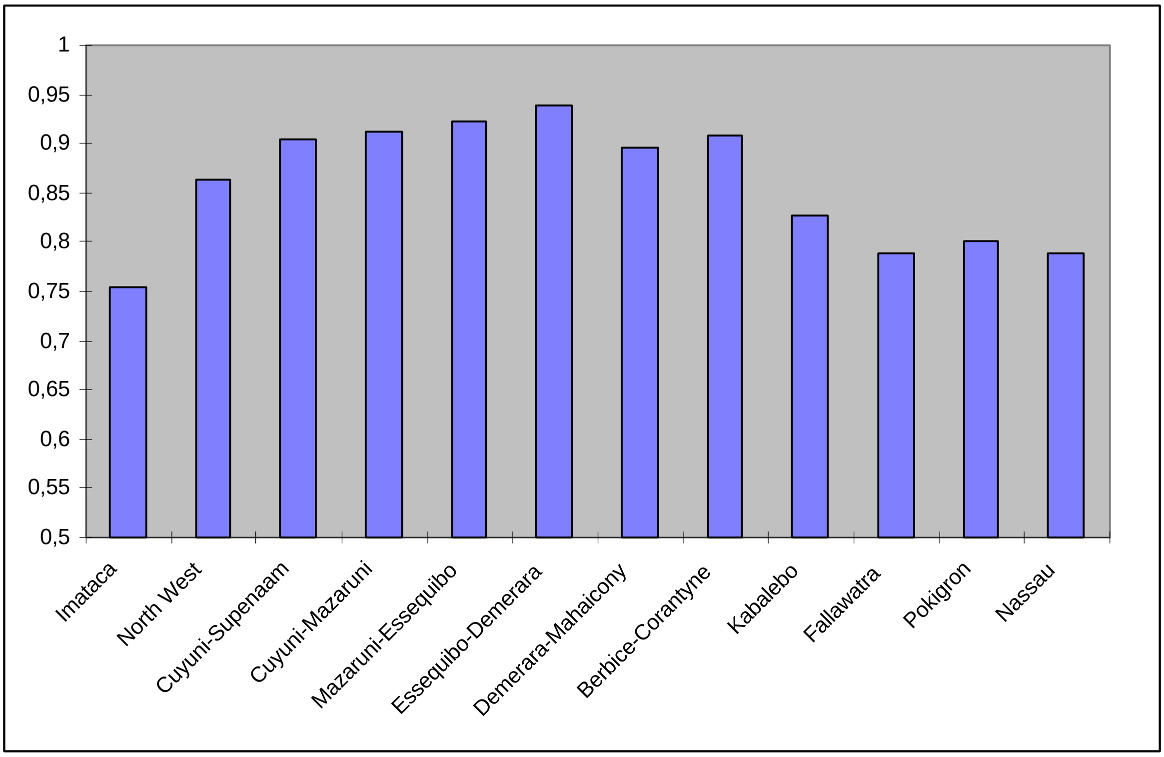

Figure 1 Average wood density meausred in large forest areas in a geographical transect running east Venezuela to east Suriname. The high average wood density of Guyana=s forest is thought to be the product of long term stability in this area (ter Steege and Hammond, *unpublished data*).

If seed-size characteristics and wood density of a forest are a product of the past disturbance regime of the forest (ter Steege and Hammond, *unpublished data*), logging should have an effect on forests that differs in these characteristics. Because forests may differ substantially in terms of median seed size (Figure 1) and wood density (Figure 2), even over relatively small areas, the forest management will have to be fine-tuned to each situation.

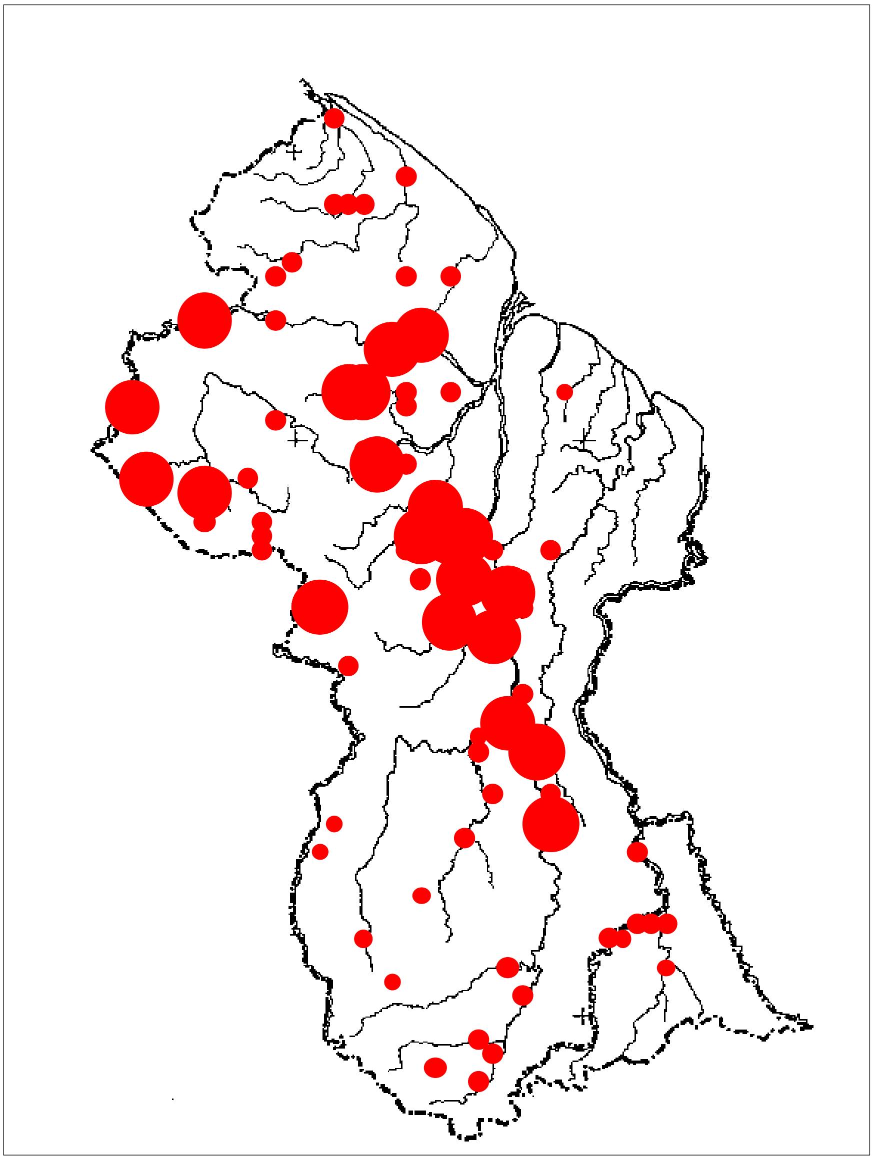

Figure 2 Median seed mass of trees expressed as median per forest community in Guyana. The seed mass in south Guyana differs by two orders of magnitude from central Guyana, probably as a result of higher disturbance in the south.

Relationships between seed dispersers and trees are important for ensuring long-term sustainability (Hammond *et al*., 1996). At present, harvesting does not take this into consideration and may disproportionately target tree species of a specific disperser type (e.g. mammal-dispersed species in Guyana and wind-dispersed species in French Guiana; Hammond *et al*., 1996). There are substantial geographic differences in the dispersal spectrum between forests (Figure 3), and such differences should be taken into consideration for sustainable forest management.

Silvicultural treatments are thought to be important for sustainable forest management. Only with such treatments can the balance of commercial versus non-commercial trees be restored and can sufficient production be attained (de Graaf, 1986). However, there are some doubts about the effect of such treatments (ter Steege *et al*., 1996; ter Steege and Hammond, 1996, see above). Also, as the timber market changes over the years, trees that were eliminated may become commercial. For instance, the *Couratari* individuals poison-girdled in the CELOS experimental plots in Suriname several years ago would fetch a good price now (G. Zondervan, *pers. comm.*). Furthermore, treatments are a long-term investment, only to be made by a concessionaire if long-term tenure without land-use conflicts is guaranteed. So, who will carry them out?

We cannot accurately predict how forest composition will change under heavy or light forest management, but we can predict that it will change, and that the forest will likely be less valuable in terms of marketable timber. It may need careful monitoring over a period of three harvests to obtain a better appreciation of future forest composition.

One has to agree with ITTO (Prebble, 1997) that there should be much emphasis on the establishment of demonstration forests where low- impact logging is practised, and on the extension of these practices. Also important are the monitoring and modelling of forest composition changes and the marketing efforts that take foreseeable changes in log availability into account.

Sustainable forest management may be possible if we accept that changes in forest composition occur. Part of global sustainability of forest diversity should include good land-use planning to ensure that a comprehensive set of forest communities - preserving not only species, but also processes that have led to current forest communities (ter Steege and Hammond, *unpublished data*) - will be achieved.

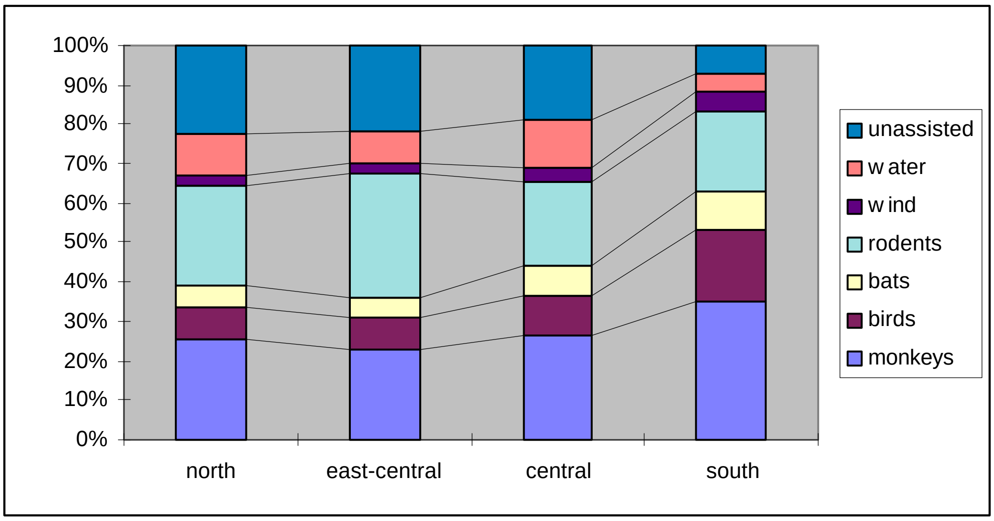

Figure 3 Proportional dispersal mechanisms of forest trees in Guyana. Many species in central Guyana are dispersed by rodents. In the south bird and primate dispersal prevail.

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SUSTAINABLE FOREST MANAGEMENT. IS IT POSSIBLE?

Achievements
- Suitable harvesting systems have been developed for most tropical rain forest regions.

Challenges and Problems; Information Needs
- Even though feasible harvesting systems have been developed, they are not applied.

Points for Future Research
- Efficiency of silvicultural treatments for regenerating timber species.
- Response of forest system and timber resources to second felling cycle and beyond.

Conclusions
- Intervened forests will be dominated by light-wooded species.
- Regional differences in forest composition and dispersers should be taken into consideration for sustainable forest management.
- Sustainable forest management may be possible if we accept that changes in forest composition occur.